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EDITORIAL

Interdisciplinary Research: Silos and Walls

Newly appointed heads of institutions, especially old and traditional ones, are usually enthusiastic about changing and influencing their environment. I was no exception, when some years ago circumstances suddenly pitchforked me into the job of the steering a course for the Indian Institute of Science (IISc). This is an old institution, tracing its evolutionary history over the course of a dramatic and turbulent century. Its calm and serene surroundings are in complete contrast to the hustle and bustle outside its boundaries. In 2005, when I began my new task, the new century seemed to be in its infancy, full of promise for the future. The first decade still had a long way to go. A new government was in place and the economy was growing rapidly. Change seemed imminent. Academia, worldwide, was just beginning to learn the use of new tools to assess institutional performance. Grading research performance and producing ranked lists of universities and academic institutions was a new phenomenon. The Shanghai rankings, so widely dissected in subsequent years, emerged in 2003. The *h*-index, first introduced unobtrusively in a paper posted on the physics arXiv appeared in 2005, and was largely unknown in Indian academic circles. Few could have predicted then that this single number index of research performance would spread like a cancer through academia across the world. I was an early follower of the Shanghai ranking system; quickly seduced by the simplicity of quantitative analysis based on easily measurable parameters. The Hirsch index, first introduced to measure individual performance, also seemed irresistible. It was clear that in an intensely competitive global environment, Indian institutions needed to understand the rules of a new game in which peer perceptions of institutions were based on quantitative measures of performance. Increasing institutional productivity in a significant way was, undoubtedly, the way forward. Since academic institutions are invariably judged by the number of publications produced by the faculty and students, it appeared sensible to urge everyone to do more. While a boost in the quantity of output was clearly essential in making a move up the rankings chart, enhancing the quality of publications and their 'impact' was also an imperative. In the current 'era of impact factors', publication quality is judged by the number of citations a paper receives or, somewhat more simply and quickly, by

examining the impact factor of the journal in which it appears. The former is limited to judging papers published years earlier, while the latter is full of infirmities, but is a favourite of those with little time to worry about the niceties of academic evaluation.

'Impact' is a word pregnant with meaning. Presumably, proponents of the impact factor mode of evaluation believe that papers published in the best of journals have a higher probability of advancing the field. It is also generally true that when scientific advances are made, the fall out is felt by the environment in a positive manner. In considering ways of enhancing 'institutional impact', I became aware that for some time the best of institutions, the world over, had been experimenting with strategies to enhance interdisciplinary research. Science in the 21st century was moving rapidly in a direction, where the borders between traditional subjects were turning porous. The revolution in biology in the latter half of the 20th century created a 'new world', welcoming immigrants from every discipline of science. Chemists, physicists, mathematicians, computer scientists and engineers of all persuasions were suddenly interested in problems of biological interest; making inroads into an area that had long been the province of an insular discipline. Materials science, the precursor to the currently glamorous area of nanoscience and technology, exploded in the 1980s and 1990s. Research in biology and materials, almost necessarily, requires an interdisciplinary approach, if the promised breakthroughs in the areas of medicine, agriculture and energy are to be realized in the future. The most visible institutions in the West had been engaged for sometime in creating interdisciplinary centres; often focusing on the creation of new buildings and laboratories designed to foster interactions between researchers specialising in different areas of science. Proximity in an artfully designed ambience was advanced as a catalyst for promoting interdisciplinary research. A new breed of architects seemed to be becoming popular on academic campuses in the West; specialists in designing laboratories that facilitated collaborative interactions.

In my first surge of enthusiasm for stimulating an atmosphere of change, I began to envision the creation of an interdisciplinary research centre at IISc. The naivete of a newly minted institutional head led me to believe that

support, both academic and financial, would be readily forthcoming. The idea of building a physical facility that would house and seamlessly integrate scientists and engineers from various disciplines, nudging them towards the solution of problems that were clearly challenging, appeared attractive. The idea received a mixed response. Traditionalists and serious specialists dismissed the proposal as a short lived flight of fantasy. Dangerous optimists, who surprisingly can still be found in our institutions, were enthusiastic; convinced that it would indeed be possible to raise the resources needed to embark on a major new venture. I quickly realized any such proposal was a magnet for sharp criticism. Some critics argued that an interdisciplinary centre would merely be an expensive façade, behind which academics did whatever they pleased; with little by way of interdisciplinarity. These critics suggested that a specific theme needed to be identified, which would draw researchers with diverse specializations to work for a common goal. 'Focus' is a popular piece of advice when diffuse proposals are to be recast. Too sharp a focus can also attract criticism, especially when an interdisciplinary centre is intended to bring together a broad coalition of interests. To critics of academia, scientists always seem to function in isolation, pursuing esoteric interests. Individualism appears to take precedence over teamwork in academic institutions. A perceptive critic noted that the greatest danger in the projected centre would be the tendency of academics to work in 'silos'.

'Silos' is an uncommon word. I had heard of the term in connection with the granaries in America and the fortified launching pads for missiles, so often talked about at the height of the Cold War. The internet and *Google* quickly revealed that I was not alone in thinking of the term 'silos' as unfamiliar. A site that helps with English language and usage provided a precise meaning: 'A tower or a pit used in a farm to store grain'. A dictionary offered an alternative: 'An underground installation constructed of concrete and steel, designed to house a ballistic missile and the equipment for firing it.' There was also a metaphorical meaning: 'A system or process or department that operates in isolation from others.' The term seemed quite popular in a corporate context, where 'functional silos' emerged by the 'creation of barriers that do not serve any business purpose'. Having spent a lifetime in academia, I had to admit that 'silos' was an accurate descriptor of most departments in most academic institutions. Even as I surveyed the remnants of a still-born project, a thoughtful friend drew my attention to a column entitled 'Mending walls', which reflected on the issues confronting the state of interdisciplinary research in the biomedical sciences.

Greg Petsko, a structural biologist of distinction and a prolific and highly readable columnist borrows his title from a poem by Robert Frost and begins with a quote:

*'Before I built a wall I'd ask to know
What I was walling in or walling out.'*

In talking about the difficulties of interdisciplinary research carried out with 'the aim to bridge the gap between discovery and translation to the clinic'. Petsko notes: 'One often hears the word "silos" used to describe the separateness of cultures. Silos is an evocative word, conjuring images of isolated white cylinders against the flat horizon of a Midwestern farm state.' He prefers 'to talk in terms of walls'. His argument in favour of walls over silos is compelling: 'Silos seem inherently separate. Walls can be knocked down' (Petsko, G., *BMC Biology*, 2012, **10**, 41). Petsko's concerns are primarily about the 'Balkanization of biomedical research funding by disease phenotype and organ system', which make 'connections between diseases ... hard to find'. Genomics and all the other 'omics' that have followed demonstrate the unity of biology. Petsko argues that we need to 'think more about pathways and processes within the cell and organism'. What is true of biology and biomedicine is indeed true of most other disciplines. No major problem of our time in the areas of health, environment or energy is likely to be solved by a narrow, specialist approach. Teams whose members possess complementary skills need to be built and fostered. There is indeed a great need to experiment with new approaches to building structures for scientific research. The importance of interdisciplinary approaches to courses, degrees and training needs to be emphasized. Petsko asks: 'And shouldn't NIH (and its foreign counterparts) also develop specific mechanisms to promote cross-disciplinary training? Not just for basic researchers, where the idea is already fashionable, but especially for physician scientists.' In India, cross-disciplinary training is yet to be recognized as crucial for basic scientists, while 'physician-scientists' are an extremely rare breed.

Some years ago I was shown a building at one of our major universities. The founders of the institution and the architects had designed a structure which housed both the life science faculty and social scientists. A corridor connected the two wings. On both sides, the doors were shut, permanently. C. P. Snow's 'two cultures' had separated themselves. In thinking about interdisciplinary research, I could not help wondering if the critics of my proposal were indeed right. Petsko's column suggests that there is room for optimism. He returns to Robert Frost:

*'Something there is that dosen't love a wall
That wants it down.'*

Academic disciplines are not isolated in impregnable silos. They are separated by walls that can be broken.

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