Some deleterious consequences of birth of new disciplines in science: the case of biology

The birth of a 'new' discipline increasingly creates frenzy. The funding agencies (rightly so) encourage Indian scientists to work in the emerging area. While it suits many people, for some the 'thrust areas' become 'thrusted areas'. The latter happens as selection pressures (much like with species) operate and many areas wither away. Sometimes, some old areas get lucky. The area of protein structure underwent a swift renaissance when the need for protein refolding arose[1]. In fact, luck favoured it again since many neurodegenerative diseases were found to result from protein aggregation as a result of protein misfolding[1]. Many other areas have not been so lucky. A few months ago, an editorial in this journal[2] touched upon synthetic biology and how physiology and biochemistry, the much older disciplines, had a similar overview of the biological systems. Politicians survive by coining catchy slogans; scientists more slyly discover materials science or nanotechnology or bioinformatics. Funds ('vote banks') have to be won; 'schools' have to be created. Both politicians and scientists are necessary in society and both should survive and normally do thrive if they are lucky.

Unfortunately, we have not seriously looked at two unintentional consequences of this. The first concerns the quality of manpower in Indian science. Sometime back, in a meeting related to nanotechnology, a young scientist mentioned that in a selection for research associates that he had participated in, he was appalled that most of the candidates knew neither physics, chemistry, maths or biology. Many claimed to have done courses in either bioinformatics or nanotechnology, or something similar. I felt reassured. I thought my being disgruntled about the background of my potential Ph D students was a part of my ageing process. (In this country when you become old, you are either viewed as 'mature wine' or 'vinegar' depending upon the extent of your networking.)

I think the downslide started sometime back. Many years ago, a senior person from an industry which wanted to diversify into biotechnology wanted to recruit a student trained in my laboratory. I was naturally perplexed as he seemed to be extremely keen. The person said that he was a professor of molecular biology till recently and could have his pick if he wanted cloning expertise. However he had failed to find a person who knew how to do an enzyme assay! It amused me considerably at that time. Lately, I feel sad about it. I get a large number of applications for JRF/SRF/RA positions from those who also appear to be ignorant of the area.

We used to have a large number of excellent research groups in enzymology, including protein purification. With the overemphasis on molecular biology, we have let them wither away. What do I mean by overemphasis? I am reminded of a story I read about the former Prime Minister, the late O. Charan Singh. At one time, some farmers complained to him that on his advice they had switched over to growing sugarcane. However, the price of sugarcane had decreased considerably and they had lost money. Charan Singh in his characteristic style pointed to the top of his head and said that you have left out this space. You should have grown sugarcane here too! This is what thrust areas sometimes do! We need to retain some perspective; instead we get carried away. I think this is what we are doing with bioinformatics and nanotechnology.

I think we need to wake up before it is too late. We have some wise and distinguished people who are in charge of education in this country. Can they please pay heed to the wise American saying, 'Do not fix it if it ain't broke'. I thought that I went through a bad education system. What we are now offering our young people in the name of bioinformatics, nanotechnology, etc. is worse. The quality of our manpower in biological science will go from bad to worse if we do not do something about it soon. We need to ensure proper education by retaining exposure to basic chemistry, physics and mathematics.

The second issue is the quality of peer review. Whether peer review is a necessary evil or not is debatable. However, peer review at present is an integral part of the process by which journals decide whether to publish or reject an article. The number of journals is rising alarmingly. Finding referees is increasingly difficult. Now, Elsevier journals offer free use of '*Scopus*' for a limited period to every referee. In the good old days, it was comparatively easy for an editor to identify a sub-area and a corresponding referee. It is no longer so. Part of the problem (other than the obviously happy reason that science is growing at a rapid rate) is as follows.

Let us take an example where all the work on enzyme immobilization could be published. Till a few years ago, there were only a handful of journals: *Enzyme and Microbial Technology*, *Biotechnology and Bioengineering*, *Applied Biochemistry and Biotechnology* and the journal formerly called *Applied Biocatalysis* and currently called *Biocatalysis and Biotransformation*. With the advent of biotechnology, *Analytical Biochemistry* also would publish it. Today, most of the journals devoted to polymer science, catalysis, materials science, nanotechnology and even organic chemistry would publish a paper on immobilized enzymes (if it is properly 'tweaked'). How familiar will the editor be with the area or people working in it? One recent example made me realize the seriousness of the situation. The *Journal of American Chemical Society* is a respectable one. (To those whom it matters, its impact factor is around 9.023.) A recent paper in that journal[3] dealing with nanotechnology mentions that 'the BSA protein remained bioactive after the conjugation with the Ag_2S nanoparticles. This was based on results from the modified Lowry procedure, a commonly used total protein analysis method…'. Now, for readers who belong to other disciplines, the horror may not be obvious. The 'Lowry procedure' just measures how much protein there is. The author is aware of that and says so. It cannot say anything about the biological activity of the protein. For that, an appropriate assay would have to be carried out. Even worse, BSA is neither an enzyme nor a hormone. It has no easily measurable biological activity. So what does bioactive mean here? How did this happen? Maybe the referee was not a mere biochemist by training; he was probably trained in materials science or nanotechnology. So, perhaps we can rejoice that damage is not limited to our country. The problem is that after other countries wake up, we invariably would have a lag phase in catching up.

Long ago, I read an article by Chargaff. It was a reminiscence chapter in a volume of an *Annual Review of Biochemistry*[4]. For those readers unfamiliar with his name, it is acknowledged that but for his work on the base composition of nucleic acids, the 'double helix' would probably not have been discovered. It talked of the difference in the background of scientists (Chargaff was a professor at Columbia University, USA) educated in USA and Europe. The latter were exposed to art and music, ancient languages, etc. While I would not suggest that we include Greek/Latin/music in our M Sc courses, it may help if we just do something about these half-baked courses which churn out young people who do not know much of science. It is obviously a 'genie out of bottle' situation. However, we can ensure that the genie behaves less as a Frankenstein and more as a genie of the magical lamp of Alladin.

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Indian and Chinese papers in *Nature*

India and China, the rapidly emerging global scientific research players, have been compared on their research output in various disciplines[1–3]. Here, we look at the contribution of both the countries in *Nature*.

Nature, founded in 1869, publishes about 800 papers a year, has an impact factor of 34.480 and is among the leading scientific journals in the world. Its high impact factor and multidisciplinary nature has made it a sought after journal by scientists and researchers. The contributions of India and China in *Nature* have been traced through the *Science Citation Index-Expanded* for the period 1945 till date.

Table 1 shows that the number of publications that include research papers, correspondences, reviews, etc. is more or less similar for the two countries. But China is way ahead of India in terms of the average citations per paper and the *h*-index.

Table 1. Publications from India and China in *Nature*

	India	China
No. of publications	572	588
No. of citations	23,404	75,688
Average citations	40.92	128.72
h-index	77	137

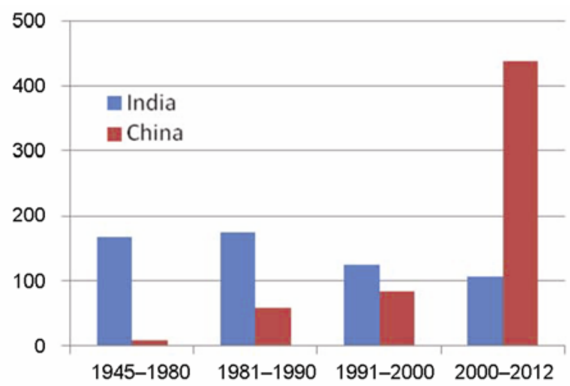

Figure 1. Growth of publications.

Whereas the research output of India has been generally on the rise, the number of papers published in *Nature* has dropped during 2000–2012 (106 publications) from the previous decades. However, China has hurtled ahead during the same period (Figure 1).

The Nature Publishing Index Asia-Pacific tracks research published in *Nature* journals from the Asia-Pacific region during the past 12 months and is updated weekly. This Index has placed China at the second and India at the seventh position in terms of the number of articles published[4].

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