

What else the three science academies could have deliberated?

The position paper¹ is a worthwhile document and will serve as a basic document for future deliberations. I discuss here the position paper keeping life science programmes in mind. At the outset, I may say that any programme offered by the elite institutes like IISc, IISER, etc. or universities would be much sought after by the students. Students will give importance to the institutes and not bother about the duration of the course or the specialization. Bright students pursuing the 4-year programme would be very happy as it would give them an opportunity to go abroad at the same time as their counterparts in BE/B Tech. Presently they are delayed by an year because of the 3 + 2 pattern.

After the science academies' initiative on Post-school Science Education, private institutions may find conducting the 4-year degree programme lucrative. Till now students have preferred the 3-year programme in disciplines such as Biotechnology/Biochemistry/Microbiology; it is quite possible that they may continue to prefer the same disciplines in a 4-year programme as well.

The position paper does not mention M Phil anywhere. What is the stand of the joint science education panel with reference to M Phil degree? While recommending a lateral exit with an M Sc or M Phil from an integrated Ph D programme, the authors² have made a statement, 'The difference between the two would be whether one has done a project (M Phil) or not (M Sc)'. It means that an M Sc degree may be earned purely by course work without any project work. In view of the large number of students involved, project work may be eliminated from the M Sc curriculum and replaced by some useful courses. But the problem is that presently M Sc with project work is the predominant pattern, and research institutes and foreign institutes prefer these students for Ph D. It is not clear at what level the position paper recommend specialization. On p. 1417 it is stated that B Sc degrees with specialization must be stopped and on p. 1418 it is stated that 'B S students will opt for a major subject in the last two years'. If there is no specialization then the degree can be conferred in a broad manner, i.e. B S (Life Sciences or Biology). If there is speciali-

zation then there are two ways of giving the degree. Say, for e.g. BS Life Sciences (Biochemistry) or BS (Biochemistry). In what way is the degree going to be conferred? There is a similar problem in offering the degree in integrated M Sc. The UGC's stipulation of a postgraduate (PG) degree in the relevant discipline for a lecturer's post means that specialization at PG level is required for a lecturer's post. Can M Sc Life sciences (Microbiology) be equated with M Sc (Microbiology)?

Take the analogy of BDS (Bachelor of Dental Surgery). Here students specialize soon after plus two and they read many subjects during the course. It is not unjustified to offer an undergraduate (UG) programme in century-old subjects like biochemistry or microbiology, etc.

In all different patterns; 3 + 2, 4 + 1, integrated 5-year M Sc, integrated Ph D after B Sc/BS, the total duration for finishing M Sc is the same, i.e. 5 years. While all programmes, B Sc, BS, M Sc and M Phil are time-bound programmes, the only programme which is not time bound but extremely variable is Ph D. Students are worried about this as they have to spend anywhere from 3 to 6 years to complete their Ph D. The academies have not expressed any concern with respect to the duration of Ph D. Many of our students go to Germany, Italy, etc. and finish their Ph D's in 3 years and subsequently carry out their postdoc in the developed West. Why cannot our reputed institutes give a Ph D in 3 years?

The desire 'to have a uniform pattern of post school education in the country' can be achieved only if education becomes entirely a state or central government subject and not concurrent. Keeping in view the numbers involved, how can the burden of UG, PG and Ph D's be shared among colleges, universities and research institutes? Over load of multiple responsibilities will decrease the efficiency of both the individual and the organization.

The position paper rightly state that 'there is a strong need for substantial improvement in the quality and quantity of teachers at college as well as university level'. For this to happen, the present mandatory credit hour load of teachers

has to be reduced and accordingly additional recruitment has to be made. Further, we may take a leaf out of the system prevailing in agricultural universities. They have segregated the faculty into three streams, viz. teaching, research and extension. Though the administration can transfer anyone from one stream into another, any indiscriminate transfer is found to be highly unproductive, because the three streams require specific talents, aptitudes and commitment. In the traditional universities also this system could be followed. A certain number of faculty could be earmarked exclusively for teaching. If their lecturers fall short of the requirement, they may be supplemented with a few additional lecturers from the faculty involved in active research. To take care of the lab practical's, separate faculty like the position of a Demonstrator (below the lecturer level) as in olden days could be restored. In addition, or alternatively, adequate number of technicians could be employed.

What type of administrative system can give the best deal to students, research scholars and faculty? The present administrative system is regarded as highly unfriendly.

The position paper has commented on colleges and universities but not on the state of affairs in the research institutes. How good and productive are they? Look at the MRC Lab in Cambridge. A single institute has won 29 Nobels till now! An annually recurring question is why our research institutes do not win Nobels? What is lacking? Funds? Expertise?

Venkatraman Ramakrishnan³ recently said that 'there is a lack of funds and world class laboratories to carry out research'. Paradoxically many of our research institutes in their advertisements mention that they have state of the art facilities, world class infrastructure, qualified and experienced faculty, etc. If so, then what is lacking?

Mashelkar⁴ commenting on Indian science blames the prevailing hierarchical system, and the lack of freedom for students and others in having a questioning attitude. He says that 'out-of-the-box' thinking and healthy irreverence should be promoted. The three academies should deliberate and present a position paper on why our institutes do not get Nobels

and/or contribute to S&T on par with the developed West.

To what extent can education be privatized? Presently, there is an impression that education is much too privatized and commercialized. It is unconvincing that governments, state or central, are not able to fund education. Last but not the least, the three academies should give

some suggestions for a good and happy schooling.

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3. Venkatraman Ramakrishnan, *The New Indian Express* (Tiruchirappalli edition), 23 December 2009, p. 1.

4. Mashelkar, R. A., *The Hindu* (Madurai edition), 14 December 2009.

ADHIKARLA S. RAO

*Department of Biotechnology,
Bharathidasan University,
Tiruchirappalli 620 024, India
e-mail: asraobio@yahoo.com*

Why Darwin would hate mobile phones more than cancers?

Change in the genetic material of a population of organisms and its accumulation over generations leads to the adaptive evolution of an organism and the origin of new species. The genetic pool of a sexually reproducing organism varies even between individuals of the same species. The forces of natural selection favour the variations which provide adaptive fitness whereas selection occurs against unfavourable variations. Over generations, the favourable traits are increasingly accumulated leading to increased adaptation of an organism to its surroundings. Hence, in addition to ensuring survival, the adaptation should also ensure efficient reproduction to pass on the favourable traits to successive generations and create newer variations. These explanations for evolution were put forth by Charles Darwin and have been confirmed with increasing evidence.

Since reproduction ensures successive generations with more evolved offspring, evolution can be seen as fertility averaged over a long period of time¹. The essential crux of sexual reproduction that leads to adaptive evolution is its ability to produce genetic variations². The genetic variability maximizes heterozygosity with each new generation². Heterozygosity is beneficial, as it decreases the incidence of genetic abnormalities and most importantly improves the fertility³. It is not known how heterozygosity increases fertility, but evidence from many organisms supports the association³. Therefore, it can be said that with evolution of an organism there also occurs an increase in its fertility. On the other side, the

increase in fertility can enhance rate of evolution by producing more offspring. Essentially, evolution and fertility can be called two sides of a coin that cannot be separated. Contrary to this, a decrease in fertility will lead to decrease in the rate of adaptive evolution.

During the last few decades, human male fertility has declined rapidly as evidenced by decrease in sperm count and semen volume due to changes in lifestyle and environmental conditions^{4,5}. This reduction in fertility is gradual and will continue as the environmental changes are getting worse. The reduced fertility has not affected human population growth, which indicates that fertility is still optimal. On the contrary, the gradual decrease of fertility may affect the rate of adaptive evolution of humans over the future generations.

One of the human technologies which adversely affect human fertility is mobile phone radiations. The mobile phone radiations affect sperm number, sperm density, sperm motility and sperm morphology leading to impaired fertility^{6–8}. All this damage can occur even when exposure is of a short duration. The decrease in cost of production of mobile phones and effective advertisement strategies has ensured that every individual can afford a personal mobile phone. The effects of mobile phone usage on male fertility are so striking that they have been even called the nemesis of modern man⁹. This means that human fertility is further decreasing which may adversely affect our adaptive evolution.

Mobile phone usage can be compared to cancer in terms of their effects on

human survival. Cancers are presently not treatable and can lead to mortality whereas mobile phone usage is presently not preventable and can lead to decreased fertility. A common man may perceive cancer as more dangerous than the mobile phone. However, Darwin would choose to kill the mobile phones over cancers as the former affects fertility (ultimately affects rate of adaptive evolution) while the latter usually strikes when fertility no longer matters (most cancers affect aged individuals).

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MADHUKAR SHIVAJIRAO DAMA*
RAJENDER SINGH

*Division of Endocrinology,
Central Drug Research Institute,
Council of Scientific and Industrial
Research,
Lucknow 226 001, India
e-mail: madhukar262@gmail.com