The starting point of the Bologna Process was the Magna Charta Universitatum issued at the meeting of university rectors, celebrating the 900th anniversary of the University of Bologna – and thus of European universities – in 1988. But the actual Bologna Declaration was signed in 1999 by 29 European countries at Bologna, with the aim to create a European Area of Higher Education (EAHE) by 2010, in order to enhance the employability and mobility of citizens and to increase the international competitiveness of European higher education. The first two of the six declared objectives are:

1. Adoption of a common framework of readable and comparable degrees.
2. Introduction of a two-tier system of undergraduate and postgraduate degrees in all countries, with the first degree no shorter than three years and relevant to the labour market.

This was followed up by ministerial conferences in Prague (2001), Berlin (2003), Bergen (2005) and London (2007), in which 16 other European countries also joined. Thus all the European countries from the UK to Russia and from Scandinavian countries to Turkey are part of this EAHE now, totalling 46 countries after the independence of Montenegro, and with a total population over thrice that of USA. The Bergen declaration defines the three post-school cycles awarding (1) Bachelor's, (2) Master's and (3) Doctoral degrees. In most cases these will take 3, 2 and 3–4 years respectively. There have been many Bologna workshops throughout Europe to give detailed structure to the Bachelor's and Master's programmes in a coordinated manner. A survey of the adoption of the Bologna Process in various countries shows indeed that almost all of them have adopted the 3 + 2 years system for the two-tier B Sc–M Sc programme. It has been envisaged that this two-tier programme will also enhance exchange with American and Japanese students, who can come to Europe for the Master's degree; this was not possible in a single-tier system. Likewise, European students can go to US graduate schools after their B Sc or M Sc, depending on their calibre, as has been the case with Indian students for long.

In view of the above developments it will be false to claim that the proposed four-year BS will have better international compatibility than the present 3 + 2 years system. Indeed it will be ironical if our educational reforms process recommends abandoning the 3 + 2 years system at this time, when a similar process in Europe has converged on this very system as optimal in terms of employment, mobility, specialization and international exchange.

Note that the present two-tier programme of 3 + 2 years is perfectly compatible with the integrated five-year programme of the IITs, which students can join after a B Sc, or the dual M Sc–Ph D programme of our national institutes, which they can join either after their B Sc or M Sc. In contrast, the proposed four-year BS programme will be compatible with neither of these two quality academic programmes of our country, but only with the American system. This will evidently mean massive brain-drain of our young scholars to feed American universities at the cost of our own, notwithstanding the claim to the contrary[1].

Finally, let us look at the ground reality of our B Sc education programme. This is largely carried out at colleges with understaffed classes and under-equipped laboratories, while M Sc is taught at a few (relatively) better equipped colleges and universities. In the four-year BS programme these under-staffed and under-equipped colleges will be loaded with the fourth year of advanced (M Sc level) science course, which they cannot do justice to. This will inevitably lead to further degradation of our science education standard. Thus, by all accounts, the proposed American-style four-year BS programme will be detrimental to science education in India. It goes without saying that we need massive investment in our college and university system to improve the undergraduate science education programme. But it is no good to spend it on initiating a programme which will only feed American universities with our young scholars at the cost of our own scientific institutions. A much better way will be to invest massively in our undergraduate colleges for qualitative improvement in the present three-year B Sc teaching.

There should also be massive investment in our universities, with the specific provision of adding undergraduate (B Sc) teaching, which is missing from most of our university departments. This will give an opportunity to the academically motivated students to pursue undergraduate science course in a postgraduate/research milieu, like their counterparts in American/European universities.

1. Joint Science Education Panel, *Curr. Sci.*, 2008, **95**, 1411–1420.
2. Bologna Process: Wikipedia, the free encyclopedia portal.
3. Bologna for Pedestrians: The Council of Europe Internet Portal.
4. The Bologna Declaration – an explanation: Confederation of EU Rector's Conferences and Association of European Universities (Internet Portal).
5. The Bologna Process: Australian Education International (Australian Government Portal).

D. P. ROY

Homi Bhabha Centre for Science Education,
Tata Institute of Fundamental Research,
V.N. Purav Marg,
Mumbai 400 088, India
e-mail: dproy@tifr.res.in

The proposed 4-year B S programme

As I looked at the model syllabus for the proposed 4-year B S programme[1], I thought it was good. However, on mulling over it and trying to visualize students in the programme, I realized a potential problem. As mentioned in the position paper, students often take up the study of biology because they dislike mathematics and vice versa. Merely putting all the subjects in will not necessarily change their likes and dislikes.

One might argue that students who take up biology may well have got decent marks in mathematics and physics, for instance, in the 12th class, and therefore, if they are taught the subject in greater depth or by more qualified teachers, they may find it interesting. True. However, the high marks do not necessarily mean they have a feel for the subject, or actually understand what they have learnt. Feynman has talked of the 'fragility' of people's knowledge, and he was referring to undergraduates at the Massachusetts

Institute of Technology[2]! So, will it be necessary for students who wish to escape the tedium of some of the current Bachelor's courses to subject themselves to topics they have no talent and interest in? Would more choice help the situation?

Another point of view can be borrowed from Amartya Sen, who, in the context of primary education, has commented that a bad education is better than no education. Will even a poorly understood, or meagrely enjoyed, Bachelor's degree in the multiple disciplines be better than the monolithic programmes commonly encountered in the country today? For an answer we may have to wait for a few batches of students to complete their degree programme.

1. Joint Science Education Panel, Appendix III of the Position Paper on Restructuring post-school science teaching programmes', Indian Academy of Sciences, Bangalore, October 2008,

2. Feynman, R. P. and Leighton, R., *Surely You're Joking, Mr Feynman* (*Adventures of a Curious Character*), Vintage, 1992, p. 36.

GAYATRI SABERWAL

Institute of Bioinformatics and Applied Biotechnology,
G-05, Tech Park Mall, ITPB,
Bangalore 560 066, India
e-mail: gayatri@ibab.ac.in

When do we learn to properly advertise a post?

How well qualifications and job specifications are mentioned for a post in *Nature* and *Science*. For positions involving teaching, candidates are asked to submit a detailed teaching statement and philosophy, from their past services and for the future. The theory and laboratory courses to be taught and developed at various levels, viz. UG, PG, majors, non-majors, etc. semester-wise are clearly stated. Candidates are asked to mention their career objectives. On the research side the expertise required, areas to be developed, approaches to be used, technical and instrumentation skills required, goals to be accomplished, involvement of UG and graduate students in the research programmes, etc. are clearly stated. Further, even attitudinal requirements like unflappable temperament, impeccable interpersonal skills, commitment to UG teaching, quality of mind, etc. are mentioned. The responsibilities of the candidates and division of time and labour towards various activities like actual benchwork to be done, teaching of courses, supervision, etc. are indicated.

Another important component of foreign advertisements is that they also mention, right in the advertisement, what the institute is going to offer to the selected candidate in terms of office and laboratory space, equipment, start-up funds, annual operating budget, personal administrative support, etc.

In striking contrast are advertisements in our media, which are too flexible. As a result, candidates from a wide variety of backgrounds stake a claim. It is high time that apex bodies give necessary instructions to universities, etc. to advertise posts with clear-cut requirements.

A. S. RAO

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

Earth science technology courses

The editorial by Balaram[1] on 'The science of the earth' encompasses, compelling demand to replace earth science classical and traditional study with modern scientific concepts. His concerns are: few takers; work of the National Institutions most often does not seem in tune with international mainstream community; present scenario is a matter of serious concern; sudden emergence of meeting ground for a diverse array of interest groups, etc. Hence, modern programmes in our best institutions are worth considering. The well-articulated reawakening call of Narasimhan[2] on 'Dimensions of earth education', had succinctly enumerated and reiterated various facets presently relevant to India, with special emphasis on earth education. Ramanamurthy[3] has outlined 3D mapping at great depths by observing geological processes in real time, under the auspices of the Earth Scope Project, funded by the US National Science Foundation (operational by fall 2008).

Earth sciences is a natural science. Ever since civilization started humans have been observing nature's variations along with its manifestations, and the utility of this treatise which has been put to use since then. That is how, for example, based on surface reflections of anomalous variations, several mineral deposits were discovered and exploited. Such 'old workings' serve as direct indicators for geologists of the modern era. Ancient Indians had also developed appropriate technologies in mining, mineral processing and metallurgy. In due course of time earth sciences was christened as 'geology'. However, the fundamentals were based on traditional observation of nature.

Not being a pure science, the scientific foundation of geology was laid with the application of the doctrine of basic sciences as enunciated in physics, chemistry, botany and zoology. Further, in-depth, need-based applications had given birth to various sub-disciplines like geophysics, geochemistry, geobotany, including palaeobotany and palaeontology. Application of engineering expertise and technological adoptions is helpful for practising professionals. The major prospecting 'old working' surface indicators have almost exhausted. Hence survey of mineral