The role of the EFB Working Party on Education in the European network

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The European Federation of Biotechnology is the principal body coordinating activities in biotechnology in Europe, including the EFTA and Central/Eastern countries as well as the EC Member States. Formed in 1978, it is administered by its General Assembly, Executive Committee and Science Advisory Committee. The latter operates through a number of Working Parties and Task Groups; Working Parties, currently ten, having been established to develop programmes in various areas of biotechnology while the five present Task Groups have more specific, usually shorter-term, aims.

The EFB Working Party on Education was one of the first EFB Working Parties formed in 1979 and is the sole body linking those concerned with higher level education in biotechnology throughout the wider Europe. Currently it has 29 full members representing almost all of the Western and Central/Eastern European countries together with 19 personal corresponding members.

The Working Party's main role has been, and continues to be, to promote higher level education and training in biotechnology through various internal and external networking activities. Since its establishment it has provided a much-appreciated mechanism for linking its members for collaboration and exchange of information, students and fellows. With the opening up of the Central and Eastern European countries the scope of the Working Party has broadened and underlined the importance of effective communication in the field of biotechnological education and training throughout Europe. The Europe-wide and European Commission-supported meeting on "Manpower and Training Needs for Biotechnology in Europe in the 90s" in December 1990 was a most successful example of its broader, external networking activities.

This meeting foreshadowed many of the topics in this Symposium and with which the EFB Working Party is directly concerned:

* biotechnology's fundamental characteristics of the generally high skill and qualification levels of the majority of its personnel and its high level multidisciplinary and academia-industry linked nature
* the recruitment problems in a range of specialities, coupled with a sufficiency of those trained in genetic engineering and general biotechnology courses in some countries and a shortfall in technician training
* the need for aid for southern and central/eastern European countries for staff and student training and mobility
* the need for the harmonisation and equivalence of qualifications throughout Europe, and particularly of the PhD training period
* the global internationalisation of biotechnology, encouraged in Europe by the development of the Single Market
* the crucial importance of the general public's understanding and acceptance of biotechnology for its continuing development
The opportunities which biotechnology offers cannot be realised unless the essential human resources are available. Fundamental research, technology transfer, industrial innovation and marketing all demand high skill levels of the majority of its personnel in a wide range of inter-linked disciplines.

The major change which has taken place in biotechnology during recent years is the move from “technology push” to “market pull”. Companies are progressing from R&D to market-and product-driven activities and the use of biotechnological techniques is extending beyond pharmaceutical and diagnostic products ever more widely through the traditional major food and drink industries, agriculture and environmental protection and reclamation.

As has been shown by various surveys (1-9), nearly all biotechnology companies share the opinion with most universities that, in the large multi-disciplinary field of biotechnology, university education should not aim for the education of generalists (who know too little about too many disciplines). A clear preference has been expressed for specialists in one, or perhaps two, of the disciplines underpinning biotechnology with enough background knowledge of the other disciplines to allow them to interact effectively. In addition, an evident demand exists for postdoctoral, dedicated, on-the-job, advanced short courses for both young and experienced personnel, for example, in aspects of management, economy and public relations.

The main future areas of industry demand for trained specialists and dedicated courses are likely to be in:

**Cell biology/microbial physiology**

The growth in large-scale mammalian cell culture will mean a continuing need for cell biologists, and as, for example, the survey concluded by the EFB Working Party on Microbial Physiology confirmed, the developing areas of microbial biotechnology (agriculture, speciality chemicals, pharmaceuticals, etc) will strain the already short supply of microbial physiologists and fermentation microbiologists in many European countries.

**Bioanalytical chemistry**

Analytical chemistry, long relegated to the quality control laboratory, has joined with cell biology into bioanalytical chemistry providing the new analytical methods required by biotechnology to optimise cell growth, etc whereby a special need exists for direct monitoring equipment with the aid of various enzyme electrodes.

**Protein engineering**

Protein engineering for the design, modification and construction of proteins will become increasingly important for industrial, clinical and agricultural applications. Expertise in the area is strongly represented in some European countries, but lacking in others, and even in the former there is concern about the ability of Industry to benefit due to insufficient training in the supporting sciences.

**Bioprocess engineering and protein separation**

Bioprocess engineers are the key personnel in the bringing of products by scale-up from the research bench into commercial production. Special attention is needed for the downstream processing in particular of proteins and for integrated process control. There is, and will continue to be, increasing demand for chemical, mechanical and electronic bioprocess engineers, particularly those who can bridge the gap between these areas of engineering and the basic biosciences.

**Agricultural and environmental biotechnology**

The major challenge for mankind in the next century is to sustain a much larger population on a planet with limited resources and with care for its environment, the challenge being greatest in the urban areas of developing countries with their exponential population increases. The plant, animal and environmental biotechnologies offer opportunities at many different levels of biological complexity. Plant biotechnology is now developing with consequent rapidly growing
demand for personnel and training in areas ranging from molecular design, through genetic stock improvement, micro-propagation, regulation of growth and performance, novel foods, manipulation and handling of food and non-food products, pest and disease control, nutrient management, to information technology and process design. Such technologies as environmental contaminant monitoring, diagnostics and bioremediation are starting to bring products to market and are expected to grow rapidly during the next decade with consequent demand for microbiologists, molecular biologists, chemists, chemical engineers and other diagnostics development specialists.

Quality control/assurance (QC/QA), regulatory affairs & intellectual property rights (IPR)
The transition from R&D to production brings with it a critical need for the development of systems for quality and compliance control, and for protecting and exploiting biotechnology inventions. Hence there will be strong demand for QC/QA microbiologists, chemists and quality engineers combining with demand for skilled QC/QA staff from the traditional drug and device industries. As regulatory matters become ever more complex, particularly with the continuing approval of a series of European Commission directives and their implementation in national legislation, the necessity for expert advice, desirably in-house, becomes pressing and will lead to increasing demand for regulatory affairs specialists. Protection and exploitation of intellectual property rights on biotechnology inventions through patents and licensing agreements is the key to return on research investment, commercial success and continuing research and development, and will lead similarly to increasing demand for legally-trained specialists familiar with biotechnology. There is, however, no direct route into most of these specialisms from academia, training being through advanced short courses coupled with "on-the-job" experience.

Bioinformatics
Bioinformatics involves three main areas: hardware and software design, development of algorithms for nucleic acid and protein sequence information processing and design of information handling systems for biotechnology-based companies and research centres. While the numbers of skilled personnel required are presently not large, their recruitment is already difficult and will become more so as demand increases for those with computing skills combined with training in the life sciences and chemistry.

Technical sales and marketing
The progressively increasing number and volume of biotechnology products coming to market is already creating demand for technical sales and marketing professionals who can relate to the sciences. As the trend continues, this will be the fastest growing area of demand for personnel in commercial biotechnology, likely to exceed in number that for R&D staff over the next decade.

Management
The greatest single need expressed by established biotechnology-based companies after advanced updating and public relations training is for management training, both at company and project/laboratory levels, for human resource development. Most presently available management training programmes and courses have been found to be too general and inadequately related to the specific contexts and needs in the different sectors of the biotechnology-based industries. Provisions for training of this kind (and its funding) are urgently required, particularly by small and medium-sized companies which lack the expertise for in-house training and find it difficult to fund or release staff for external training.

Public perception
The growth of biotechnology in Europe and the maintenance of its international competitiveness depends not only upon successful research and development but also upon the existence of a healthy relationship between the biotechnology community and the general public. If products do not sell, or are not expected to sell, they are not produced and the foregoing investment in R&D is wasted or not undertaken. It is the market which decides. At
present, public awareness and understanding across the European community is extremely patchy and, in some areas, public concern about some areas of biotechnology appears to be growing. In a recent survey of biotechnology industrialists, training of staff in relation to the public perception of biotechnology was ranked highest in priority over all other forms of training.

Such training is urgently required in the various forms of communication, oral, written and visual, for the different audiences - the general public, journalists, educationalists, politicians and policy makers, consumers, environmental groups, etc. Indeed, a number of large biotechnology companies already have significant programmes for education of the general public about biotechnology. Their philosophy is that a well-informed public can weigh the advantages against the disadvantages and make up its own mind.

The future European networking role of the EFB Working Party on Education

Networking is the main role of the Working Party, both internally and externally throughout the wider Europe. Needless to say, it will continue to provide an important link for its members for collaboration in various ways and for exchange of information, staff members and students.

New, however, is the emphasis being given to external networking. The aim is to bring together the expertise of the members of the EFB Working Party on Education in advanced-level course design, teaching techniques and organisation together with the specialised expertise of the members of other EFB Working Parties and Task Groups throughout Europe. This concept was discussed at the previous meetings of the senior EFB committees in November 1992 in Madrid where it received a great deal of support which we much appreciated.

A programme is therefore being planned for a series of high level, advanced short courses at various centres throughout Europe in key areas of biotechnology where the needs are of high priority and the skills fundamental and often lacking. Each course will be designed and carried out in close collaboration with the other EFB Working Parties and Task Groups, initially with the Working Parties on Biosafety, Microbial Physiology and Bioreactor Performance and the Task Group on Public Perceptions of Biotechnology. Application has been made under the EC COMETT programme for funding support for these courses. Courses are designed for R&D staff and teachers in academic institutions and companies, especially small and medium-sized, and also from Southern, Central and Eastern European countries. Each course will provide a model in terms of content, teaching techniques and resource materials, together with a course handbook, which can be used in other similar courses.

The overall objective, therefore, is to extend the networking role of the Working Party by combining it with the expertise of the other EFB Working Parties and Task Groups and their networks throughout Europe.

REFERENCES