Fellowships in nuclear science and technology: Applying the knowledge

Nearly 1200 scientists, engineers, and specialists receive training each year under IAEA-supported fellowships and scientific visits

by John P. Colton

Over the past three decades, the combined, co-ordinated efforts of people in dozens of countries have been responsible for the selection, placement, and training of more than 16 000 engineers, scientists, specialists, and technicians under the IAEA's programme for fellowships and scientific visitors.

The numbers alone tell only part of the story. Many of these "alumni" of this co-operative training programme today are managing institutions and agencies in their home countries where nuclear technologies are being used for peaceful applications. Others are in senior positions at international organizations, including the IAEA.

Since its initiation in 1958, the programme has passed through various evolutionary stages. Training today is strongly oriented towards practical learning related to the use of nuclear techniques rather than theoretical studies. Individual training for fellows, for example, is designed to provide an in-depth understanding of a particular technology, whereas the training of scientific visitors reflects the growing interest in the application and commercialization of applied nuclear technologies. The programme covers such subjects as physical and chemical sciences, the use of radioisotopes in marine biology and industrial applications, nuclear power and safety, radiation protection, agriculture, and health.

Over the past quarter century, donor countries have financially supported — at a total cost of more than US $120 million — the training of fellows and scientific visitors from more than 95 IAEA Member States.

Mr Colton is Head of the IAEA Fellowships and Training Section in the Department of Technical Co-operation. A more comprehensive report on the programme is featured in the 1994 edition of the *IAEA Yearbook*, available for purchase from the IAEA Division of Publications.

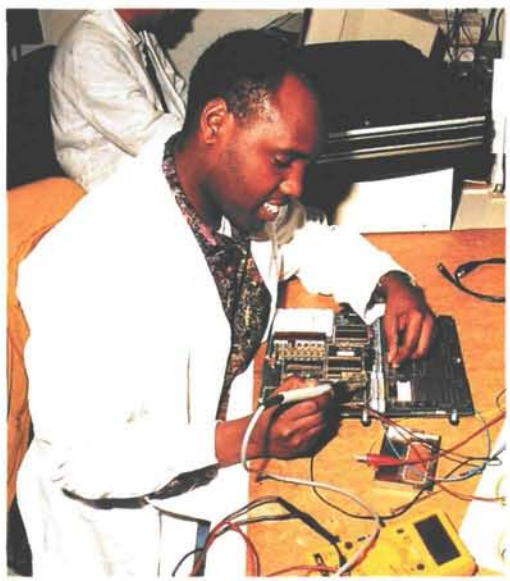
This article reviews the programme, from the standpoint of its historical development, co-operative framework among nominating and host countries, the selection criteria, and plans and expectations for the coming years.

Historical development and trends

Throughout the years, the experiences gained by IAEA trainees have fostered the transfer of scientific and theoretical aspects of nuclear technologies. As importantly, they have given managerial and leadership support to their home institutes and organizations. Interviews with hundreds of fellows and scientific visitors confirm the fact that one of the most important benefits of the training is the practical aspect — to see how something is accomplished, and to apply that knowledge for the benefit of others.

One does not have to look far to find managers who once received IAEA support during their time of education and training. A large number of trainees have become senior leaders in the national and international communities. Within the IAEA's own technical co-operation department, for example, a significant percentage of Directors and Section Heads are former IAEA fellows. Other IAEA technical departments also have senior officers who received technical training with the IAEA's assistance. Additionally, many heads of national atomic energy authorities and institutes have benefitted from the Agency's training programme during their careers. Also interesting to note is that several members of the IAEA Board of Governors and their primary staff members are among the distinguished alumni of the fellowship and scientific visitors programme.

The programme has gone through various stages of development. During the late 1950s and early 1960s, countries principally were interested in having individual scientists receive



Scenes from IAEA-supported training of scientific fellows and visitors. Training covers a range of nuclear applications in fields of electricity production, food and agriculture, health and medicine, and industry and earth sciences, for example.

NORTH AND LATIN AMERICA: 1043/1396

***North America:* 0**/898

Canada: **0**/277
United States: **0**/621

***Latin America:* 1043**/498

Argentina: **115**/116
Bolivia: **23**/0
Brazil: **137**/116
Chile: **86**/45
Colombia: **57**/10
Costa Rica: **31**/10
Cuba: **120**/39
Dominican Republic: **22**/0
Ecuador: **82**/5
El Salvador: **17**/2
Guatemala: **57**/23
Haiti: **1**/0
Honduras: **0**/1
Jamaica: **4**/0
Mexico: **101**/94
Nicaragua: **15**/0
Panama: **20**/1
Paraguay: **17**/0
Peru: **62**/1
Uruguay: **31**/23
Venezuela: **45**/12

ASIA AND PACIFIC: 1701/683

Australia: **0**/134
Bangladesh: **131**/4
China: **329**/59
Democratic People's Republic of Korea: **30**/0
India: **3**/162
Indonesia: **186**/31
Japan: **0**/106
Korea, Rep. of: **116**/23
Malaysia: **130**/44
Mongolia: **82**/0
Myanmar: **35**/1
New Zealand: **0**/5
Pakistan: **149**/39
Philippines: **86**/7
Singapore: **11**/0
Sri Lanka: **49**/1
Thailand: **167**/62
UK (Hong Kong): **6**/4
Viet Nam: **191**/1

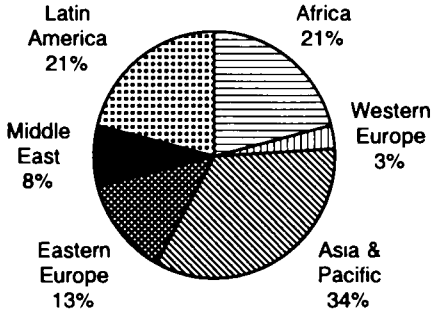
Regional Overview 1989-93: IAEA Fellowships and Scientific Visitors

The tables on this and the facing page provide a regional overview of the countries of origin and the training sites of IAEA-supported fellows and scientific visitors. The number of IAEA fellowships and scientific visits placed from each country (i.e. where fellows and scientists came from) is in bold face. The number of fellowships and scientific visits that each country, or institution, hosted (i.e. where the training was provided) is in normal typeface.

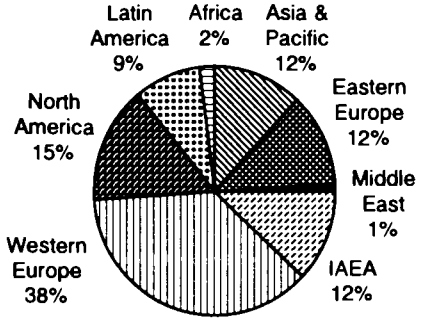
All told during the 1989-93 period, countries requested 4905 fellowships and scientific visits. During the same period, countries hosted the training of 5835 fellows and scientific visitors. (The numbers are not equal for various reasons, such as the fact that scientific visitors may average two to three visits in different countries.)

The graphs below illustrate the respective shares by region. Evident is that developing countries in a number of regions are hosting a significant number of training sessions.

Where fellows came from
(percent by region)



Where fellows were trained
(percent by region)



WESTERN EUROPE: 138/2940

Austria: **0**/126
Belgium: **0**/106
Denmark: **0**/57
Finland: **0**/53
France: **0**/343
Germany: **0**/460
Greece: **29**/23
Iceland: **0**/4
Ireland: **2**/4
Italy: **0**/117
Monaco: **0**/7
Netherlands: **0**/113
Norway: **0**/18
Portugal: **24**/9
Spain: **1**/120
Sweden: **0**/93
Switzerland: **0**/25
Turkey: **82**/7
United Kingdom: **0**/516
European Nuclear Research Centre: **0**/36
IAEA: **0**/703

EASTERN EUROPE: 638/690

Albania: **56**/0
Belarus: **4**/0
Bulgaria: **150**/15
Croatia: **3**/0
Cyprus: **10**/0
Czechoslovakia (former): **51**/59
Czech Republic: **10**/0
Former Yugoslav Republic of Macedonia: **1**/0
Germany (former GDR): **0**/20
Hungary: **79**/257
Poland: **101**/140
Romania: **127**/4
Russian Federation: **0**/52
Slovak Republic: **7**/0
Slovenia: **3**/7
Ukraine: **12**/7
USSR (former): **0**/90
Yugoslavia (former): **24**/39

AFRICA: 1012/93

Algeria: **67**/6
Burkina Faso: **0**/7
Cameroon: **26**/0
Côte d'Ivoire: **18**/2
Egypt: **158**/47
Ethiopia: **44**/0
Ghana: **67**/5
Kenya: 49/8
Madagascar: **21**/0
Mali: **26**/0
Mauritius: **7**/0
Morocco: **79**/4
Namibia: **2**/0
Niger: **23**/1
Nigeria: **134**/2
Senegal: **17**/1
Sierra Leone: **16**/0
South Africa: **0**/5
Sudan: **72**/1
Tunisia: **34**/2
Tanzania: **54**/2
Uganda: **24**/0
Zaire: **24**/0
Zambia: **39**/0
Zimbabwe: **11**/0

MIDDLE EAST: 373/33

Afghanistan: **8**/0
Iran: **124**/2
Iraq: **19**/0
Israel: **0**/20
Jordan: **45**/1
Kuwait: **0**/2
Lebanon: **1**/0
Libyan Arab Jamahiriya: **83**/0
Saudi Arabia: **15**/1
Syria: **76**/7
United Arab Emirates: **1**/0
Yemen: **1**/0

academic training. Assistance was given to those countries who were creating a broad theoretical base in all scientific fields, but concentrating primarily on nuclear power applications and the fuel cycle.

In the intervening three decades, national needs and expectations have matured, and today's training programme focuses mainly on applied technologies. This is in keeping with overall IAEA policies requiring that its programmes are closely tied to national goals and objectives. And rather than importing general nuclear expertise, as used to be the case, countries now are interested in locally cultivating their own.

Significant modifications in the ways and means of implementing training also have taken place. The application format used to be simply a personal history form including a statement as to the type of training being requested. Most candidates had even been accepted by the host institutes before asking for IAEA assistance. Their own national nuclear authorities played little or no role in the entire nomination and placement process. Requests were reviewed by a small group of IAEA staff members and awarded mainly on the merits of each candidate's personal qualifications. In a few cases, the IAEA became involved with host countries, but in the majority of cases, the fellows were on their own when it came to, for example, obtaining visas, making travel arrangements, or corresponding with host institutes. Often, as they lacked institutional endorsement or support, the candidates had no work position to return to and had to find jobs once they returned to their home country.

The greater emphasis on locally produced expertise has helped to change this picture. National authorities now actively participate in the nomination process, determine the priorities of training and commit full support by salary continuation and re-employment rights. The host countries respond faster to proposals for training, assist with visa requests, qualify and monitor host institutes for adequacy and quality of training, and arrange most of the administrative support. The IAEA, for its part, has developed new procedures for review, evaluation, selection, placement, and training support. These modified procedures and support mechanisms assist the IAEA in implementing its goals of meeting the requesting country's needs in a timely, cost effective, and quality manner.

The IAEA technical co-operation process. The placement of fellowships and scientific visitors is part of the IAEA's overall process of providing technical assistance to developing countries. The IAEA responds to national requests for training assistance on a 2-year cycle. The requests are submitted by governmental authorities in the form of a technical co-operation project. The project document is reviewed and evaluated by the IAEA's Division of Technical Co-operation Programmes in consultation with technical officers (specialists in the technology) and the Division of Technical Co-operation Implementation (specialists in equipment purchase, placement of fellows and scientific visitors, and contracting experts). Recommended projects are submitted to the Board of Governors for approval following a review by the Board's Technical Assistance and Co-operation Committee. Once it approves the 2-year cycle programme, the Board authorizes project funding on an annual basis (i.e., the programme for 1993-94 has funds approved in December 1993 for 1994). The project normally consists of requests for expert services, equipment purchases, fellowships and scientific visitors, and training courses.

For the 1995-96 programme cycle, approximately 1000 new project requests were submitted, and it can be expected that about half of them will be approved. The component for fellowships and scientific visits normally represents about 20% to 25% of the total resources allocated to the project. For 1994, this component was budgeted at more than US $18 million including approximately US $8 million carried over from prior years. More funds typically are available because of the continuing nature of fellowship training and the possibility of carrying over funds.

Fellowships and scientific visitors: Selection and training

Support supplied through the IAEA' s technical co-operation training programme has played a key role in advancing the peaceful applications of the atom. Training normally takes the form of attendance at academic institutions, participation in research groups, on-the-job training in a specific technology, short visits to research facilities, or combinations of these. The host countries and their institutes are thus integral to the process of technology transfer.

Placement of fellows and scientists was relatively easy during the IAEA's early years, when most requests were for advanced university studies. The maturing of research and industrial institutions in developing countries, however, has shifted emphasis towards more specialized practical training. This interest in applied technology is seldom matched by existing university courses and therefore special arrangements have to be made with host institutions. While this has made placement more difficult and time con-

suming, the end result is that training becomes more valuable in terms of technology transfer.

Selection criteria. Applicants to the IAEA's fellowship programme must be well qualified and motivated. In addition, the IAEA evaluates applications to ensure that the objectives of the training are clearly identified; the type of training being sought is explained and that proposed host institutes are identified; the national supporting commitments are stated; and, that both the candidate and national authority assure that the benefits of the training will be implemented within the requesting country. An additional factor is language certification. Experience has shown that in approximately one-third of all cases, language is the major limitation to successful training. Language capability is so important that many countries have established their own minimum language levels which must be met before they will accept training candidates.

During the review, selection, and placement process, about 40% of the candidates will not be selected or will be withdrawn from the process. Typically, this is because requirements have not been met, the status of the applicant has changed, or a suitable host country has not been found. Main specific reasons include the lack of professional or language skills; equivalent training is available in the home country; the requests are not related to a technical co-operation programme; and, the request is outside of the Agency's sphere of responsibility.

Not surprisingly, communication has become increasingly important in the selection process in light of improved telecommunications capabilities. This fact elevates the nominating country's role, since it must monitor the status of its applicants to keep the IAEA promptly and properly informed, and to prevent time and resources from being wasted. Much effort, for example, has been expended in the past on placing some candidates, only to find out later that they were either no longer available for training, had accepted other opportunities, or had changed professional positions.

The requesting authorities and the fellow are notified as soon as the fellowship is awarded and again when an acceptable host institution indicates that it is prepared to supply the requested training. The IAEA then sends a letter of appointment to the candidate, providing information on the proposed study programme and other details concerning the stipend, allowances, and insurance coverage, for instance. Also sent is guidance concerning travel and visa arrangements and preparing for the stay in the host country.

Overall the time span between the IAEA's receipt of a nomination and the placement offer has been shortened considerably. The average time from receipt of the application until award, subject to successful placement of the fellowship is about two to three months, down from eight months in 1990. Placement negotiations with host countries are averaging four months, down from six in 1990. Thus, the average time from the receipt of the application until the start of training is approximately 10 months, significantly below the average 18 months in 1990.

Developing countries as hosts. Increasingly, developing countries are serving as the hosts for fellowship training and scientific visits. A number of these countries have established the technological base needed to supply quality training. Often, the training can be done at lower costs. Additionally, the training conditions in developing countries are frequently more representative of those in the trainee's home institute.

Future plans and expectations

By the year 2000, an estimated 100 IAEA Member States are expected to request technical assistance, including fellowships and scientific visits. In 1958, just after the IAEA came into being, only 11 countries received technical assistance. Today, 85 countries do.

Given the projected growth of requests, the number of IAEA fellows and scientific visitors that are trained each year should increase to between 1400 and 1600 by the end of this decade. If these projections hold, they will push the total number of IAEA-trained fellows and scientists to more than 25 000 by the year 2000. The type of training offered will remain predominately short and intense, and include applied on-the-job training. Advanced academic training will continue to be made available for those from lesser developed countries where there is a need to establish a firm base of human resources in support of technological development.

If past is prologue, the IAEA's support of training opportunities for scientists, engineers, specialists, and technicians from developing countries will remain a valuable component of efforts to effectively transfer the atom's many peaceful applications. In the process, it will help develop a good many of tomorrow's national and international leaders in the nuclear field. ❐