

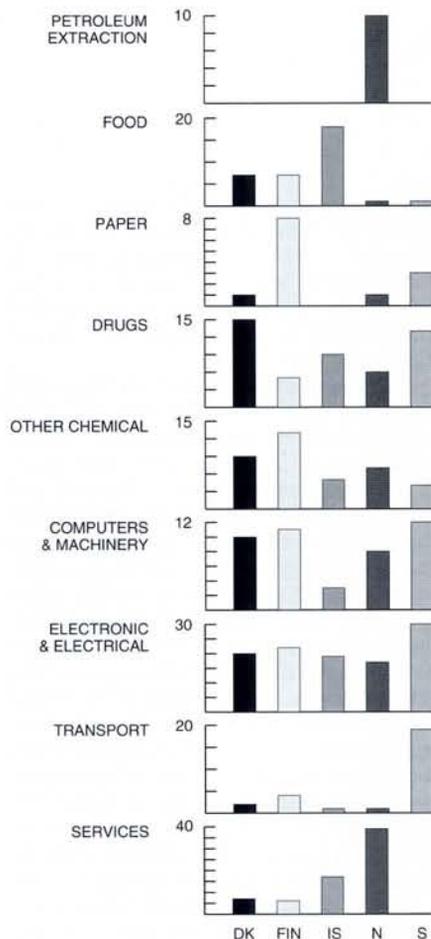
**Nordic industrial R&D spending:** total R&D in the business enterprise sector in 1991. Selected branches as a percentage of the total for each country (DK - Denmark; FIN - Finland; IS - Iceland; N - Norway; S - Sweden). Norway's large share of service industries can be explained by its many industrial R&D institutes; service industries in Sweden are not accounted for.

item of high priority and receives a modest budget increase in 1996. True to the trends of our times, special emphasis will be placed on the "usefulness" of all activities for the Nordic area. Fortunately, Nordita provides good value for the money in this respect as well.

Maintaining good relations with, and support of, the newly independent Baltic states will remain an area of high priority to all Nordic countries. Collaboration with the Baltic region and with north-west Russia figures prominently on the agenda for Nordic co-operation. Nordita and the Nordic universities have during the past few years increased considerably the exchange of physics students and researchers, and arranged summer schools and lecture courses involving Baltic students. To further develop the collaboration with this region, Nordita is establishing a "Nordic-Baltic" committee. With members from both the Nordic and the Baltic countries who are physicists, it will

advise the Nordita Board. The established collaborations with the well-known physics centres in the St. Petersburg area will of course continue.

Nordic governments are aware that scientific competitiveness is crucial for their nations' success and for tomorrow's welfare. Regardless of their EU membership status, all the Nordic countries participate in the EU science programmes and strive to increase their scientific collaboration with the rest of Europe. As a regional institute with a broad range of interests in physics research and excellent international connections, Nordita has a special significance. It also maintains close links with its German neighbour, the DESY laboratory in Hamburg, and welcomes possibilities for closer cooperation with other centres. European collaboration in theoretical physics will continue to increase, with Nordita having a vital role to play, especially in the northern European region.



## INDUSTRIAL R&D COOPERATION

Ove Poulsen

Executive Director, Nordic Industrial Fund, Oslo

The private business sector is the main performer of research and development in the Nordic countries (51000 MSKR in 1991 where 1 SKR = 1 Swedish kronor = 0.10 ECU). Only Iceland stands out with less than 50% of total R&D spent in the private sector. In terms of R&D manpower, the percentage of total full-time equivalents (FTEs) spent in industry was about 57 percent in 1991, with above average amounts (about 60 percent) in Denmark and Sweden. Denmark, Finland and Iceland have seen a constant increase in their R&D FTEs as compared with Norway and Sweden, where they have decreased since 1987. The importance to each of the five countries of selected knowledge-based industries is clearly seen in the figure above. All devote the largest amounts of R&D resources to industries related to microelectronics. But for other fields, the distribution differs greatly between the five countries, depending on the emphasis placed on their basic industry.

Nordic R&D collaboration of industrial relevance is mainly organized at the institutional level through support of industrial R&D by the *Nordic Industrial Fund* (NIF). Founded in 1973 by the governments of the five Nordic countries, it reports to the Nordic Council of Ministers. The NIF's main objective is to strengthen the position and competitiveness of Nordic industry by stimulating technological and industrial development. The Fund does this by:

- identifying and encouraging Nordic R&D programmes and projects;
- funding Nordic R&D projects;

- stimulating the growth of technological and industrial networks.

The Fund's total grant budget amounted to 73.7 MNKR (1 NKR = 1 Norwegian kronor = 0.12 ECU) in 1994. All organizations and enterprises in the Nordic region can apply for financial support for R&D projects of industrial relevance. Applications must contain a clear statement of an enterprise's intention to collaborate with companies in at least two Nordic countries.

The NIF's executive body is a Steering Committee which is assisted by an Executive Director and a secretariat comprising about 15 professionals in technology and business. Like any other organization, the NIF has had its ups and downs. During the last decade, relatively large capital transfers to the Fund from the Nordic Council of Ministers have been necessary to meet increasing R&D and investment costs. One successful result has been the Nordic Biotechnology R&D Programme which ended in 1994 at the same time as two other R&D programmes (Industrial Environment; Materials Technology). The biotechnology programme involved around 300 scientists — full or part time — in industry and research institutions and resulted in the formation of three new biotechnology companies, some 20 patents, 30 Ph.D.s. theses, and 700 scientific articles.

### Focussing on Basic Industry

In 1992, the Nordic Council of Ministers decided that the NIF would focus activities in 1993-96 on:

- new technologies in the food industry;
- new technologies in the wood and paper industries;
- lightweight structures.

Accordingly, the Fund granted 73.7 MNKR in 1994 (85.2 MNKR in 1993) to 125 technological and industrial collaboration projects in these areas through four industrial R&D programmes (*NordFood*, *NordList*, *Nordic Wood*, *NordPulp*) which are essentially co-financed by industry on a 50/50 basis. More than 1200 companies and R&D centres are participating, and each project involves an average of 3-4 Nordic countries. The projects in which the NIF participates had a total budget of 260 MNKR in 1994 (323 MNKR in 1993). Its support amounted to an average of 28%, with industry covering 49% and national R&D bodies the remainder. Research institutes and universities received the largest share of NIF's funds (70% in 1994).

Some 16% of the NIF's total grant budget was allocated in 1994 to so-called independent projects unrelated to the priority areas. This is to ensure the Fund's ability to support industrial or institutional R&D efforts that are of significance for industry but lie outside the NIF programme framework.

*Nordfood*, the Nordic R&D programme for the food industry, was initiated in December 1993 "to contribute to the continued competitiveness of the food industry in a changing market by ensuring that a 'critical mass' is attained in selected research areas". Of the programme's total budget of approximately 260 MNKR, NIF financed 30% and national R&D bodies 20% (industry provided the re-

maining 50%). NordFood's research areas include food packaging, quality control, information technologies and data analysis, food hygiene, and new methods and processes. Its 30 projects involve independent collaboration by participants from all the Nordic countries.

*NordList*, the programme for lightweight structures (with 23% of the 1994 NIF grant budget), aims to make Nordic industry more competitive in sectors in which high levels of expertise already exist. This goal will be achieved by encouraging industry and leading research centres to collaborate in the development of design and production technologies and methods of material selection which are expected to play a key role in industrial applications related to lightweight structures within the next seven years. The entire lifecycle of products is being evaluated with respect to resource issues and the environment. The aspects involved include production of raw materials, production of products, use of products and recycling. The techniques that have been developed are now being adapted in a separate comprehensive project which was initiated in 1994.

*Nordic Wood*, for the wood industry, and *NordPap*, for the pulp and paper industry, together received 35% of the NIF grant budget in 1994. *Nordic Wood* aims to "... improve the competitiveness of Nordic wood relative to substitute materials like steel and plastics". Started in 1994, there are six priorities (wood and the environment; improving the properties of wood; wood as an engineering material; order and delivery precision; new markets and new products; and new production systems).

*NordPap* deals with new technology for the pulp and paper industry and has four sub-programmes (properties of virgin fibre and recycled fibre; modern bleaching technology; paper as an information-carrying medium; European standards). The participants once again come from all the Nordic countries and most of the companies active in the pulp and paper industry are involved. Research is mainly carried out in universities and in industrial research institutes. The total planned budgets are approximately 135 MNKR for *Nordic Wood* and 120 MNKR for *NordPulp*, with both having the usual breakdown of 50% industry/30% NIF/20% national.

#### Other Initiatives

Several other R&D institutions and programmes exist under the auspices of the Nordic Council of Ministers, but two deserve special mention in the context of Nordic industrial research. The *Nordic Investment Bank* (NIB) was established 1976 by the five Nordic countries to attract international capital to the Nordic area. It offers, on normal commercial conditions, financial loans and guarantees to investment projects involving at least two Nordic countries. Second, there

is a close academic cooperation between Nordic universities that includes exchange and training programmes for graduate students and research staff. Academic cooperation sometimes take place on network basis but is usually organized by institutions such as the *Nordic Research Academy*, the *Nordic Research Council's Cooperation Committee*, the *Nordic Rectors Conference*,

*etc.* A continuation of the very successful *Nordic Industrial Ph.D. Programme* is currently under consideration. Strengthening collaboration with industry in western Europe has been one of NIF's aims. This will assume increasing importance as the Fund moves its focus from primarily Nordic cooperation following the decision of some countries to join the European Union.

## SCIENTIFIC COOPERATION WITH THE THIRD WORLD

Lennart Hasselgren

Director, International Program in the Physical Sciences, Uppsala

The *International Program in the Physical Sciences* (IPPS) was created in 1961 as the International Seminar in Physics (the name changed to the present one in 1987). Based at Uppsala University, as a special unit belonging to the Faculty of Science and Technology, it focuses on establishing viable research teams in selected developing countries in Latin America, Africa and Asia. There are at present about 30 projects in research areas which should be chosen by the countries themselves and involve physics or related fields.

The IPPS does not represent the only support given by Nordic countries to physics in developing countries. For example, the Norwegian universities' *Committee for Development, Research and Education*, funds activities in Botswana, Uganda and Tanzania and there are projects directly supported by the *Swedish Agency for Research Cooperation with Developing Countries* (SAREC); additional support is also found within general aid programmes. However, the IPPS as an organization plays a unique role since it is based on establishing long-term links with advanced research teams. The IPPS is therefore not oriented towards individuals, and the long-term goals often entail cooperation for 10 years or more.

Links at the research level are the core element of the IPPS. They essentially involve North-South cooperation with research groups based mainly in the Nordic countries, and South-South cooperation where we identify regional advanced groups to serve as hosts.

As the IPPS is mainly concerned with countries where physics and related fields are very weak one is talking about capacity building, with most of the IPPS projects in universities. Consequently, within the projects supported the IPPS assists in developing M.Sc. and Ph.D. programmes based on the sandwich model where as much of the work as possible is done at the home institute, with a supervisor from the host institute. Whenever possible, degrees should be awarded by the home institute. Most African universities with whom we co-operate in fact seek such an arrangement to ensure good quality theses. But this need is often the same in regions that may be looked upon as being relatively strong. Thus, the first Ph.Ds to graduate in physics in Peru and Ecuador came from sandwich programmes sponsored by IPPS.

#### A Nordic Approach is Natural

The IPPS's use of research capacity in all the Nordic countries is not organized formally by a government body such as the Nordic Council. It developed instead at the beginning of the 1980s in a natural and informal way since physicists in the Nordic countries are used to cooperation, and because the Nordic countries have rather similar views regarding aid to developing countries. There is, for example, a general willingness to support the long-term development of scientific infrastructure.

Several practical considerations perhaps explain why this Nordic cooperation deve-

L. Hasselgren, third from the left, stepped down in March 1995 as the Chairman of the EPS Interdivisional Group of Physics for Development (IGPD). He is seen here with (from the left) P. Brault, the IGPD Secretary, A. Suzor Weiner, who chairs the Group, and J.J. Steyaert, the Vice-Chair.

