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New Models for the Academies of Sciences (**)

It is certainly most appropriate to discuss the role of the academies here in Rome since these very special bodies represent a cultural heritage dating back to the Renaissance, which began in our beautiful host country. Thus, the academies play an important role as bearers of culture which means that their members assume a great responsibility. How are we fulfilling our obligations? Let me quote a Swedish authority on the history of learning, the late professor Sten Lindroth, when he described the strength of the 18th Century Royal Swedish Academy of Sciences: "The Academy took her place right in the center of the society, was carried by the spirit of the time which she also supported. The perfect harmony between her program and the needs of the society characterized the Academy of that time". I guess that this was typical for many 18th Century academies. Is this going to characterize the 21st Century academies whereby the scientists may promote science, defend the freedom of science and have a significant influence on society. How are we going to meet the challenge?

As Sir Andrew Huxley indicated in his talk about the Royal Society the academies are genetically different. They fulfill their obligations in different ways, although they are all established to promote science and defend the freedom of science. The Royal Swedish Academy of Sciences was founded 1739 — Linnaeus being one of the founders — and was formed on the patterns of the Royal Society and of L'Académie des Sciences. Nevertheless, there were, and still are, significant differences between these learned societies. I guess that we all like to defend the individuality of our academies, which may add to their charm and maybe also to the strength of their joint efforts.

In the Swedish Academy of Sciences one may be promoted from the position

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of President to the position of Secretary General and not the other way round — much to the surprise of my foreign colleagues. Since I have made this inverted carrier during a ten year period when my Academy went through a phase of activation, I was asked by our distinguished host, Professor Marini-Bettòlo, to report some of my experiences. Consequently, my talk, to a certain degree, reflects my personal view.

Thus, I am not going to give a detailed account of the organization of the Royal Swedish Academy of Sciences and her routine activities, but preferably describe some projects which were carried out during this 10 year period and which may be of interest for our discussion on the modelling of future academy activities. Needless to say, I am going to refer to a small academy in a small western country with a mixed economy. Here I should add that the Academy also has a mixed economy — like many of her sister academies — based on untied governamental support and interests from endowments, the latter, however, being mainly earmarked for grants, prizes and research support in certain scientific fields.

The Academy was established in order to promote natural sciences and is a free, independent, nongovernmental society. As such she signs agreements with foreign academies for scientific exchange and I may mention that as President of the Academy I signed a bilateral agreement with the DDR Academy before diplomatic relations were established between the two countries. At present scientific exchange takes place under the agreements with a dozen countries.

The Royal Swedish Academy of Sciences represents Sweden in the International Council of Scientific Unions (ICSU) and at present the Secretary of ICSU is a member of our Academy and so is also the Chairman of the ICSU organization for Free Circulation of Scientists, the secretariat of which is situated in the Academy.

Preparedness, flexibility and openness

In order to reduce the average age of the members and to obtain a reasonably high proportion of members representing current research in the universities and research institutions of the country the rule was introduced to elect a new fellow when a member reaches the age of 65, the latter remaining a full member. According to the statutes the members under 65 years of age should not exceed 139 and at present the total number of members is 260. This rule does not apply to the foreign members, the number of which should not exceed the number of Swedish fellows under 65 years of age. As I see it the rule mentioned would imply that the membership should not be regarded as honorary only, but the fellows should feel the duty to serve the Academy actively in a dynamic program.

Apart from representing scientific excellence the Academy — in my opinion — should develop three characteristics: preparedness, flexibility and openness. Preparedness to take up new projects of importance for society when scientific

judgement is necessary or wanted and flexibility to allow for a quick start of national and international projects. I know that many would stress the importance of a stability in the performance of the Academy. I agree, but we should not be too rigid and I guess that many of us may be able to give examples of occasions when we missed the train. Finally, the Academy should act with the highest possible degree of openness. It should not be a closed society like an old gentlemen's club, a characterization which stands for a philosophy that in my opinion one has to defeat.

Natural science and technology have become more and more the foundations of modern society, influencing every aspect of the daily life of individuals and of the society as a whole. The resulting growth of specialization and sophistication increases the gap between specialists and laymen and makes communication difficult. A mutual lack of understanding may cause distrust and impair the fertile integration of scientific competence and social, political and humanistic ambitions. Here the academies have a most important mission.

When I took over the position as head of the Academy I had the feeling that she should make better use of her strength represented by the extraordinary profusion of expert knowledge. Especially since during the last decades there has developed in society an increasing demand for scientific judgement, based on knowledge from many disciplines. The fact that the primary objective of an academy of sciences is to promote basic sciences and excellence should not prevent her from dealing with such — often highly controversial — questions where scientific, often multidisciplinary, assessments are necessary. During the 1970s the Academy acted on several such issues within a broad range of quite different topics such as: nitrogen as an essential life factor and a growing environmental hazard, chlorinated phenoxy acids and their dioxines (mode of action, health risks and environmental effects), war as an environmental factor, the DNA-hybrid technology and its use and the use of chlorinated fluorocarbons in spray gases as a threat to the ozone layer. In the last-mentioned case the Academy made a recommendation to the Ministry of Agriculture resulting in a partial prohibition of the use of these substances. In this context I should add that in Sweden the Academy belongs to those bodies which routinely are asked by the Government to give their evaluation of official governmental studies on topics which fall within their area of expertise. The Academy has the option to respond to these studies or refrain from doing so.

To pursue such projects, usually ad hoc committees were set up, their preparatory work in most cases resulting in hard working conferences or symposia on a national or international level. The individual contributions of the participants were delivered in advance and formed the basis for the discussions resulting in conclusions and recommendations which immediately after the conference were presented to a large audience for public debate among scientists, politicians, decision-makers and representatives of the mass media. In many of these cases the Academy used large official facilities in the center of the city, *e.g.* in the Parliament House, because of the importance of the issue for society and the interest

shown by the public. Since questions of the type mentioned above are rather controversial and under the influence of different interests and pressure groups in the society, activities of this kind were often followed by hot debates in the press.

In some cases we combine professional meetings, conferences between scientists and politicians, popular lectures, popular publications and exhibitions together with "open door" demonstrations of laboratories, research institutes and research vessels. For instance, such a broad project including these various activities was carried through simultaneously in Stockholm and Gothenburg — together with the Gothenburg university — in an effort to disseminate information about marine research, Sweden being a country surrounded by very sensitive coastal waters. In other cases the material was made into publications to be used in adult education and in study groups in schools. Some lecture series have also been arranged in cooperation with adult education organizations, for instance on topics like modern astronomy and meteorology.

Activities of the kind referred to also give the Academy opportunities to inform a broad public about the frontiers of research in the different fields of the natural sciences concerned.

In order to enhance the dialogue between the scientific community and representatives of the Government responsible for the research policy in Sweden the Academy in recent years has invited the minister of research and his staff to present the budget for the coming years. These presentations take place in the Academy every year. Scientists and representatives of the universities, research institutes and research councils are invited to take part in the meeting, during which research policy questions of current interest are discussed.

In recent years the question concerning the responsibility of the scientists for the consequences of research has been very much discussed. Technological applications of scientific results have caused great changes in society and science and technology have been more or less accused of causing many of the crises of our time. This is a phenomenon which is less noticeable in the socialistic countries and in the LD countries where science is still met by hope and expectations.

Ethical problems involved in the activities and structures of the scientific world have been raised and debated with increasing frequency during recent years. There is a growing conviction among scientists that they themselves must cope with such problems and that they cannot remain isolated when they meet the ethical problems, but have to tackle them within the broad and general context of society as a whole, in a dialogue with the rest of their fellow citizens. This general issue was treated in a Nobel Symposium arranged by the Academy under the title "Ethics in Science Policy" and reported in Nobel Symposium volume in 1979.

Obviously a well equipped information secretariat is a necessary instrument. Therefore, in 1973 such a secretariat was established as one of the offices under the Secretary General, with an Information Secretary representing a link to the

mass media. Naturally, this secretariat has an important task in connection with the announcement to the international mass media of the decisions on the Nobel Prizes in physics and chemistry and the Prize in Economic Sciences in Memory of Alfred Nobel.

In his introduction Professor Marini-Bettòlo took up the question: Should publication of scientific journals of the classical type still be taken care of by academies? Here I would like to mention that the Royal Swedish Academy of Sciences reduced the number of journals of that type in part by ceasing to publish some journals representing fields better taken care of by other organizations and partly by fusion with other journals on a Scandinavian, European or international level. One has to adapt to the needs of the time and not carry on projects that require artificial respiration.

Energy, environment and natural resources

The increasing gap between the professionals and the politicians is especially dangerous when dealing with questions which concern energy, environment and natural resources. In this context let me mention a project which the Academy took up ten years ago and which has turned out successfully: the publication of the international journal Ambio. The journal was started by the Academy in 1972, *i.e.* the same year the United Nations conference on the Human Environment took place in Stockholm, organized on the governmental level and resulting in the establishment of UNEP. Ambio is a bimonthly international journal published by the Academy and dedicated to recent work on interrelated fields of environmental management, technology and natural sciences. The journal is directed not only to experts but also to scientists in other fields and to other groups of interested readers, for instance politicians and decision-makers. At present, there are nearly 4000 subscribers in 110 different countries. Certain issues are dedicated to specific themes, *e.g.* Energy in Society, Water, World Population, the latter served as working material of the Swedish delegation at the United Nations World Population Conference in Bucharest in 1974. Topics like the Baltic Sea and the North Sea — two of the most polluted seas in the world — have also been treated as well as the problems of the Mediterranean. This last issue was first published in English and then also in French and Spanish. In many of these cases the issues were produced in cooperation with other organizations like UNEP, UNESCO, Nobel Foundation, IUCN and SIPRI. As mentioned above a special issue was dedicated to War as an Environmental Factor and one of the recent issues, The Aftermath, dealt with the environmental effects of a global nuclear war. This last one is being translated into German, French and Japanese. It has already appeared in Swedish. Several issues have had a large international impact and have been extensively covered by the world press. Our experiences indicate that this type of periodical represents an appropriate and important activity of the Academy.

As mentioned, the Academy during the early 1970s took up problems con-

cerning energy and environment in conferences, symposia and publications. These problems were also discussed in a series of international Pugwash-conferences, one of which expressed the need for an administratively flexible, international research center for problems concerning the use of energy and its effect on our environment. The view was expressed that such an institute ought to be primarily concerned with long-term issues of international importance and that the research should be carried out independent of national and international pressure groups. Therefore such an institute should be set up under a free and independent non-governmental organization with a first rate international reputation. For that reason the Pugwash meeting in 1975 pointed to the Royal Swedish Academy of Sciences.

Shortly afterwards the Academy received a donation for such a purpose mainly because of her open activities in this field. The Academy had *e.g.* organized three international conferences in succession on various aspects of energy use, natural resources and environment. Thanks to the Beijer donation in 1977 the Academy was enabled to start an institution for research in energy and ecology and to erect a building in connection with the main building in Stockholm. The Institute is now acting as one of the Academy's six research institutes. The international character was marked by setting up an International Scientific Board and by selecting the head (an Englishman)among a great number of foreign and Swedish candidates.

The Institute is now active in three broadly interrelated teams.

1) Energy Risk Management, involving Sweden, Canada, Great Britain, USA and West Germany comprises an assessment of the usefulness of various energy risk studies and their influence on the opinion and decision-making in society. Other studies include European oil strategies and work on environmental implication of coal use.

2) The European Transition from Oil, a study of the potential for economical cooperation and cooperation in the energy sector between oil exporting and oil importing countries.

3) Improvement of Energy Utilization in Developing Countries. Together with the energy ministry in Kenya the Institute has carried out an extensive energy study: "The Kenya Fuelwood Project". The results can be transferred to other developing countries with similar problems and have been met with great international interest as a basic model for energy planning in developing countries. Several African countries have shown their interest in the study like Ethiopia, Zimbabwe and the Seychelles and the nine SADCC countries in Africa, where already a set of preliminary investigations have taken place. The project demonstrates the pattern on which such an international institute can act: about 30 scientists from various countries have taken part in this multidisciplinary international project at the Institute and at its office in Nairobi. It has been financed not only by the Institute but also by contributions from a consortium of international aid organizations in the Netherlands, West Germany and the USA.

In five years the Institute has developed into an international center for research on questions concerning energy resources and environment. The international flexible network of research fellows has made possible a cost effective activity and the Institute has been able to treat a wider spectrum of problems than many larger institutes with a large permanent research staff.

This illustrates how an open attitude, flexibility and a series of initiatives in a certain direction relatively fast may result in the establishment of a research institute for which an academy offers the right climate ready to deal with research projects of current interest.

Support of research in developing countries

In his introduction Professor Marini-Bettôlo pointed to the necessity of directing our interest towards the problems of the third world and so did also Professor Chagas who described the tasks of the academies in developing countries against the background of very special needs. In the last years several academies have given attention to these problems. I like to refer to the United Nations Conference on Science and Technology for Development in Vienna 1979 (UNCSTD). Through the national committees of ICSU several academies indirectly took part in the preparation of the material. Encouraged by the Secretary General of UNESCO, Dr. M'Bow and upon a request from the Swedish National Committee for UNCSTD the Royal Swedish Academy of Sciences, as a nongovernmental organization, prepared additional material on the five main topics, and to those five we added a sixth on education and information. The UNCSTD meeting did not give the results that we wished. However, it "must not be the end, but a beginning".

I also like to point to some very special international projects to promote research in developing countries like the International Foundation for Science (IFS) and the International Centre for Insect Physiology and Ecology (ICIPE).

The Royal Swedish Academy of Engineering Sciences played an important role in the creation of IFS, which was founded in 1972. It is a nongovernmental organization based on scientific academies and research councils in 58 countries, of which two thirds are in developing and one third in the industrial parts of the world. The Foundation provides young scientists of outstanding merit in developing countries with financial support for their research projects in the fields of natural and social sciences and in technology. During the initial period I served on the grant committee of IFS and it has been most interesting to follow the development of its activities. At present ten countries and UNESCO contribute to the Foundation's budget, normally by government grants through academies or research councils. The annual budget for 1981 was slightly more than 2 million US dollars. Since 1974 up to January 1982 468 grants were awarded for research in 69 countries in Asia, Africa and Latin America.

ICIPE was established in Nairobi in 1970 by a group of academies and similar organizations. It represents a center of excellence where research scientists

from all over the world work together on problems in insect biology and where young African scientists and technicians receive special training in entomological research in a wide sense, a topic of great importance in the tropics. For the acquisition of financial support for the erection of the laboratory buildings in Nairobi and out in the field the efforts of the academies in Holland, Norway and Sweden played a decisive role. At present the core program comprises studies on crop-borers, livestock ticks and tse-tse as well as investigations on plant resistance to insect attacks, medical vectors in relation to rural health and insect pathology and pest management. Research training is an important part of the program of the center, which has a professional staff of about fifty persons and a budget of about 5.5 million US dollars based on contributions from various international aid organizations.

The Royal Swedish Academy of Sciences took a very active part in the building up of this center and as a representative of the Academy I had the pleasure to serve the center during more than one decade both as a board member and as Chairman of the international interacademic umbrella organization. I feel that our experiences from projects of that type are most valuable for future planning of activities of real benefit to the third world.

The international research projects of the Beijer Institute aiming at an improvement of energy utilization in developing countries have already been described.

In order to promote research into the origin and evolution of the human species the Academy joined, as one of the founders, the Louis Leakey Memorial Institute connected with the National Museum of Kenya in Nairobi. The Institute was opened 1977 and it was thought that the establishment of such an institute would offer a unique potential for contributing a significant new dimension to the scientific and cultural development of Africa. At the same time it can make possible a distinctive African contribution to the entire human community rather than using Africa simply as a source of basic material for research carried on outside Africa.

It has become evident that the broader aspects of man's evolution have to be based on expertise from a variety of specializations. Therefore, the Academy also arranged an international Nobel Symposium in 1978 at which the state of knowledge on human origins and early prehistory was reviewed by scientists representing various fields and coming from Africa, America, Asia and Europe ("Current Arguments on Early Man", 1980). The reports presented on research in various geographical areas emphasized the necessity of approaching the various problems in a multidisciplinary way. An extension of these activities is the establishment of the International Program on the Study of Human Origins (IPSHO) for which the Louis Leakey Memorial Institute may serve as one of the centers providing facilities for projects within the program. It is to be hoped that the academies will take interest in this international program.

Research expeditions

Another project worth mentioning because of its very special character was carried out in cooperation between the Academy and two other Swedish societies of similar status and resulted in an Arctic Research Expedition. It took place June-October 1980 with international participation in atmospheric chemistry, marine biology, geology, physical and chemical oceanography, marine geology, climatology and glaciology. One of the state ice breakers, the YMER, was made available — also lending the name to the expedition: YMER 80. The vessel was staffed by Swedish marines and the project obtained financial support from Government, research councils and private foundations. The expedition, covering waters from 78° to 82° latitude between 15°W and 50°E longitude, was carried out in two phases and the participants were divided in two groups taking part in succession; all together 119 scientists, 43 non-Swedes and 76 from Sweden. Apart from gathering a great many data which are now being worked on, the expedition also resulted in the setting up of a standing committee for polar research which forms the basis for Swedish long-term activity in this field.

International cooperation in astrophysics

Contrary to many other academies the Royal Swedish Academy of Sciences sponsors research institutes and unlike the academies in the socialistic countries which are responsible for the major research activities, she only runs a limited number. This has been the case ever since her early life in the 18th Century. As a rule initiatives were taken in response to current needs on different occasions and in various fields. In many cases the institutes thus established grew fast and widened their activities thus becoming more apt to be fitted into a university organization or to form an organization of their own. Thereby the Academy was successively left free to take new initiatives and start new institutes without the burden of the administration of a series of heavy institutes which now serve the society under other principals. I have already described the establishment of the Beijer Institute for research in energy and ecology as one of the Academy's research institutes. At present there are a total of six: three of them are field stations, one in marine biology on the Swedish west coast, one in subarctic research north of the Arctic Circle and one in astrophysics on the Canary Island, La Palma. The last-mentioned station in optical solar and stellar research is an offspring of the Stockholm University which latter was started by the Academy in 1746 and handed over to the University in 1972. The Academy's station represents the Swedish unit in the large Spanish International Observatory on The Canary Islands in which Great Britain, Denmark, Spain and Sweden and now West Germany take part and which now offers excellent possibilities for international solar and stellar research in a superb astronomic climate. The center's work is based on an agreement between the research councils in England, Spain and West Germany, the Government Research Secretariat in Denmark and

the Academy in Sweden. Thanks to the preparedness and flexibility of the Academy, the Swedish unit was built up rapidly so that much of the effects of the fast inflation could be avoided. The head of the Swedish unit is now engaged in the planning for the next international step, *i.e.* in the preparatory discussions concerning the so-called Large European Solar Telescope (LEST). A design study for this "Next Generation Solar Telescope" has been finished and a Foundation is being created for the further implementation of this project with the Academy as a member. This gives another example of the catalytic role an academy may play in the creation of an international research organization. With the Institute of Astrophysics on La Palma and the Beijer Institute for Research in Energy and Ecology as examples I have tried to illustrate the Academy's policy in setting up research institutes fitting in to international research of current interest.

In reply to Professor Marini Bettolo's main question "Are academies going to be necessary in the future?" my answer is: Yes! There is an increasing centralization in society and the influence of free institutions and organizations diminishes. Governments are acquiring more and more control over our economic lives, as well as over production, education, science and technical development. Centralization is accompanied by bureaucratization. Therefore, the academies have a most important mission in supporting and standing up for a healthy pluralism in society. But as scientists we live in a world and not just in a country. Consequently as scientists and members of our academies we have to solve the problems together: stand up for science, the freedom of science and the free circulation of scientists between countries to the benefit and well-being of humanity.