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### The Academies of Sciences in the Current Society (\*\*)

I would like first to say how glad I am to have been forced, by this request to address you, to reflect on what it is that each of our academies — and particularly the one over which I preside — is really doing. This is something that it is all too easy for each of us to take for granted, and the present occasion is an excellent opportunity for us to consider whether we are doing the right things.

When one looks at the scientific academies of the world, one feels that, in chemical terms, they form an amorphous body; in biological terms, they show polymorphism to an extraordinary degree; and, in many countries at least, processes analogous to biological evolution take place between different scientific bodies. Academies of science, as we all know, have very many different functions. One is the acquisition of new scientific knowledge, either — as in the early days of the Royal Society — through experiments performed in the academy itself, or by supporting research institutes, or by support of individual scientists, or by research grants. Another is the dissemination of scientific knowledge, verbally and in print, both between scientists themselves and from scientists to the public. The award of honours is an important aspect of many of our activities: the award of membership itself and the award of medals, prizes and honorific lectures. Some academies (such as The Royal Society) collect subscriptions from their members, and most receive benefactions from outside bodies. All, or almost all, get grants from their governments. Some distribute funds in the form of salaries to their members. Academies may establish standards and units for science and technology. They may give advice to government. Most or all are involved in international science, and this activity again can be subdivided in

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more than one way, according as its purpose is the advancement of science itself, or to help other nations, or to advance and improve international relations. Further, the mode in which international activities are carried on can be subdivided into relationships with academies of other nations, arrangements for travel and exchanges, relations with international organizations, and direct cooperation with other nations on particular projects. Yet another function of a national academy is to take the lead of specialist societies within the country on multi-disciplinary matters — I have in mind, for example, something that has been exercising us in Britain over the last few years: control of experiments on living animals. But most important of all are the more intangible aspects of our activities, in that we provide a forum for discussion between scientists so that a collective voice of the scientists in a country can speak on the promotion of science, the protection of science, the ethics of science, and the application of science toward industry and toward human welfare.

Now in most countries these functions are shared between many different bodies — there may be more than one academy, there are specialist societies for the numerous branches of science, there are independent bodies of many kinds, and there are government organizations. And the ways in which they are shared seem to be infinitely variable. It is perhaps paradoxical — I hope that Professor Velikhov will discuss this and perhaps contradict me — that in the country which adheres to dialectical principles there is a single, rather monolithic Academy, divided indeed into separate Academies for pure science, for medical science and for agricultural science, while in Britain we allow the dialectical process to proceed by having a wide range of more or less autonomous bodies which are in a sense continuously competing with each other for the functions they should perform. There are analogies, as I said before, between this process and biological evolution by natural selection. Now it seems to me that it is difficult, and indeed unsatisfactory, to attempt to combine all of these functions within a single organization, because many of them are in some degree incompatible with others. Should an academy be for professional scientists only, or should it aim to involve the general public? If for scientists, should it be very selective in its membership or should it be inclusive? Both of these things are desirable, but you cannot have both. Should it concentrate on the natural sciences only, or should it include the moral sciences and the whole of learning? If on natural science only, should it concentrate on pure science or include also the applied sciences? It is impossible to operate at full strength on both sides of each of these divides. Even more important, there is the incompatibility between maintaining the independence of a national academy and receiving all one's funds from government. As regards making public pronouncements, I think all of us are under pressure, both from our members and from outside bodies, to make pronouncements on behalf of science on a wide range of topics. This is clearly one of the things that we have to do, but it seems to me essential that

in order to preserve our credibility on matters where we are able to speak with authority, we should avoid speaking on matters where we have no special claim to be listened to any more than other intelligent members of the public.

The Royal Society in Britain has at one time or another exercised almost all of the functions which I have mentioned, but for lack of time I am going to skip what I was going to say about our history. I will come to the question of membership, and in this respect the Royal Society, I must admit, has always been elitist — we have never attempted to bring in all scientists. When we were founded in 1660, there was no well-defined profession of scientists and our Fellows were a mixture of serious practitioners of science as it then was and of serious amateurs. Although the Society collected a quite substantial fee from each Fellow every time he attended a meeting — a shilling then, which would have been the equivalent of perhaps five pounds or 20,000 lire nowadays — still the Society was in financial difficulties, and it admitted wealthy patrons as Fellows in order to improve its financial position. This led, at the end of the 18th and the beginning of the 19th century, to an acute division in the Society between on the one hand those Fellows who were wealthy amateurs and for whom the Society had more a social than a truly scientific function, and professional scientists on the other.

The social aspects of the Society really excluded action as a body representative of scientists. As a result, other organizations were formed. One was the Royal Institution, which was founded in 1800 and still flourishes in London; it did not really take over any of the major functions of the Royal Society, but it has done an excellent job, and still does, in the publicization of science, in science education, and in the famous laboratory which has been headed by so many famous scientists from Davy and Faraday to the Braggs and the present Director, Sir George Porter.

But things became even more serious by 1830 when there was a disputed election for the presidency of the Royal Society. The serious scientists put up the astronomer John Herschel as a candidate, while the amateurs put up one of the royal dukes, the Duke of Sussex. The amateurs won by a narrow margin, and reform of the Royal Society was postponed. Partly as a result the British Association for the Advancement of Sciences was founded in the next year, 1831. It was modelled on the German body, the Gesellschaft deutscher Naturforscher und Aerzte, which had been formed a few years before. Now, where the Royal Society was selective and indeed elitist in its membership, the British Association was inclusive: membership was open to every scientist and indeed to everyone interested in science, as it still is today. The Royal Society was concentrated on London; the British Association has held its annual meetings in different cities over the British Isles, and occasionally overseas. And for a number of years the British Association took over functions which properly the Royal Society ought to have performed, but which it had failed to perform as a result of this defeat of the professionals by the amateurs. For example, in the middle

of last century, the British Association for a time ran the meteorological observatory at Kew, it took a leading part in the establishment of electrical units and in the absolute determination of the ohm, it set up standards of screw threads, it published mathematical tables, it gave grants for research.

But the Royal Society reformed itself in 1847 by limiting the elections to a fixed annual number of persons selected purely on scientific achievement. The effect of this was not instantaneous. A few years later when the great exhibition of 1851 in London was over the then President of the Royal Society (the astronomer the Earl of Rosse) asked the Government for a site for a new building for the Royal Society on part of the ground where the exhibition had been held and asked for money for this purpose from the profits of the exhibition. The Government consulted Prince Albert, the Prince Consort, who replied that "to use the surplus in order to provide with better accommodation a society which as at present constituted has forfeited the sympathy of the generality of the public by its lethargic state and exclusive principles could not be thought of for a moment". However, the Royal Society did, over a couple of decades, recover its preeminent position, and it has since then been recognized as *the* national academy for science in Britain. It has never included the other branches of learning, which did not have their own academy until the British Academy was founded in 1900, and we now have these two parallel bodies.

The British Association for the Advancement of Science still exists and still performs a valuable function in informing the public of the advances of science and in providing a forum for very open discussion of matters of public importance in which the general public as well as scientists take part. This is a function which it would be difficult for the Royal Society to combine with its present activity as a highly informed body of eminent scientists who are well placed to give serious scientific advice. It would be impossible to combine this with the degree of popular involvement which is exemplified by the British Association.

I am sure there are analogous situations in other countries; in the United States for example the American Association for the Advancement of Science is roughly equivalent to our British Association, and they have learned bodies such as the American Philosophical Society and the American Academy for Arts and Sciences, which are indeed learned academies but do not have the national role which is performed by the National Academy of Sciences.

This matter of the overloading of the Royal Society with wealthy amateurs was an example of the difficulty that any body of scientists has in retaining independence from their paymasters. Nowadays there are not enough wealthy amateurs for them to be a menace to any academic body, but in most countries there is, I suppose, a tight-rope that we have to walk between, on the one hand, obtaining funds in order to perform the expensive function of the support of science, and on the other, maintaining our independence when we express our views. Some academies have remained poor but honest — this is true I think of the Royal Society of Canada, whose first centenary was celebrated earlier this

year; they do not even have the funds needed to be the body which adheres to International Unions.

Again, in Australia, although the Academy of Science is the adhering body and does receive government funds, these are on a scale which leaves the Academy in difficulties in providing the subscriptions. The system is so different in the U.S.S.R. and eastern Europe that I shall leave them to other speakers. In the case of the Royal Society it is true that about two-thirds of our funds, about four million pounds per year, comes from the Government, but nearly all of that passes through the Royal Society as direct support of research. This is in the form of what is called a "Parliamentary grant-in-aid" to the Royal Society; it began at £1000 per year and was raised to £5000 in 1876. This was then the only Government money available for scientific research. The amount was increased gradually up to the Second World War and much more rapidly since. But over this period other forms of government support of science have increased so much that the funds coming through the Royal Society are now a small fraction of the total government support for science which comes mainly through the Research Councils, through direct support of research by executive Departments, and through support of the Universities. This means that the government is able to change its policy for science without having to order the Royal Society to alter its policy, so although the Royal Society does not have much executive power by directly controlling research it has retained a degree of independence and influence which it would not possess if it were the channel for large-scale spending of government money. We have in English the proverb: "He who pays the piper calls the tune". The Research Councils in Britain are in an intermediate position. They are entirely government-funded, but they cherish the considerable degree of independence that they possess; again, it is a matter of a tight-rope.

I regard this question of independence as one of the essential matters for National Academies: they must be able to speak for the scientists who are their members without direct regard, indeed as far as possible without any regard, to what their governments or other paymasters may feel.

The other aspect of preserving the ability to speak on behalf of scientists is the matter of retaining credibility with the public: we shall not retain this credibility if we make pronouncements on topics where we have no special claim to be listened to. This, I feel, is one of the risks that we run. We are asked for advice, and in spite of being often blamed for most of the ills of the present world, scientists are still regarded as potential wise men who can provide a solution to every problem. But most of the acute problems are problems not of science but of politics, of decision how science should be applied. Every scientific discovery is capable both of good and of evil use, and the problems are how to ensure that science is used for good and not for ill. There is enormous difficulty in keeping these aspects separate. I will briefly tell a story from about two hundred years ago which illustrates the difficulty. Lightning conductors were invented by Benjamin Franklin, who was a fellow of the Royal Society, as

well as founder of the American Philosophical Society and a member of your Society, and he believed that a pointed lightning conductor was the most effective. But there was another theory that a pointed conductor would attract the strike of lightning and that the right thing was for lightning conductors to be in the shape of a sphere. You would think this is a purely technical matter which could not possibly become political. But with the advent of the War of Independence it came to be said, because Franklin was an American, that supporters of pointed lightning conductors were not loyal to the British Crown.

Feelings ran high, and lightning conductors on the royal palaces were changed from being pointed to being round. The Royal Society appointed several committees on this question, all of which came down in favour of points. The King called the then President of the Royal Society and asked if he could not influence them to a more patriotic decision, but he replied, "Sir, I give way to no man in my loyalty to your Majesty but I cannot reverse the laws and operations of nature". Well, we have equivalent problems now, and of course the most serious is the threat of nuclear war. There are clearly scientific and technical aspects of these problems and nobody would question that scientific academies have a duty in this respect to ensure that their public is informed of the facts, to ensure that good advice is given to their governments, and if necessary, to investigate aspects which are not sufficiently understood. But the difficult questions are the questions — essentially political and not scientific — of avoiding the use of these weapons. This is a matter on which some of us will be engaged later this week under the auspices of another of the Roman academies, the Pontifical Academy, but we shall there be in this dilemma of being scientists asked to pronounce on matters which are in no way scientific, and in which — I have to say, fortunately — scientists have little experience. They are questions of mistrust between nations and individuals, and of secrecy; fortunately, these things are still rare in science, and long may they remain so.

But my message is that the most important of the functions of an Academy are those of providing a forum in which scientists can discuss and speak out on matters essential to scientific activity. In this respect, you may ask: why is it right to have *national* academies. One can argue that these problems, like science itself, are international, and that these things should be dealt with by international bodies. I think this is not the right answer because most of the problems that a national academy may have to pronounce on are local problems. The scientific activities of a country are governed mostly by decisions of that country's own government, for example on the spending of money for research, and most of our problems are local problems, national rather than international, and we need a national body which is fully aware of the local situation and the local conditions of carrying on scientific activity in order to find the right answers.

The occasions for such expressions of opinion are perhaps rather rare, and it seems to me necessary for an academy that in addition to this essential function it should have some routine functions which it carries on all the time, perhaps

in the direct support of science or in international relations. What kind of functions these should be for a particular academy will depend, for example, on what other bodies exist in its country and on the tradition of division of effort between independent bodies and government, but some such function is needed in order for the academy to develop the coherence which it will need when the occasion arises for it to express the views of scientists on matters which are squarely within their competence. But it must not overload itself with routine functions; if it does, it will find that it is trying to do things which are incompatible with one another and it will find that it receives so much funding from government or other sources that it has lost its independence.

## DISCUSSION

### HERRI

Is there any relation or collaboration between the Royal Society and the British Academy — I mean as far as concerns what may be termed border sciences, for instance the history of the sciences, or the social consequences of the technical progress and so on.

### HUXLEY

Yes, there is regular cooperation between the Royal Society and the British Academy. We have every year a meeting at which the officers of the two bodies discuss matters of common interest. The Royal Society's regular scientific programme consists largely of discussion meetings; most of these are on straightforwardly scientific topics, but a certain number of them have been joint meetings of the Royal Society with the British Academy. These have been at intervals of one or two years, and topics have included technical methods in archeology, methods of dating, the emergence of Man, and linguistics and the origin of language. Yes, there is frequent collaboration in the borderline fields, and we do recognize the difficulties that arise from the existence of fields which are partly within the humanities, partly within the natural sciences.

### SIMPSON

I would like to ask if you would not have thought that the Royal Society might not have had a better chance of winning popular respect a hundred or a hundred and fifty years ago, if they had at that time opened their ranks to membership by interested and qualified scientists and not reserved fellowship of the Royal Society to those who had earned their place in ranks of original contributions to science.

### HUXLEY

They did of course already elect serious contributors to science. All the names in science of those days which are still remembered would have been Fellows of this Society, but in addition there was this very large number of amateurs of science who held the power in the Society, and who voted their own representatives on to the Council so that the officers and Council were not representative of the scientists who did indeed make up a substantial part of the Society. So it was really an internal division within the Society and one which originated at least in part through the need for financial support from wealthy

patrons. But were you suggesting that the Society ought to have opened its gates wider to scientists? (Yes.) Well, I think if the question was raised I am sure it would have been defeated by the non-scientists who held the power in the Society, though it is true that even after the Society was reformed it remained a rather small membership. Of course it represented a higher proportion of the working scientists then than it does now. This is a perennial problem and the Society repeatedly debates how much to expand. At the time the new Statutes were introduced in 1847, the annual number of elections was set at fifteen but this has been progressively raised and for the last ten years or so it has stood at forty. But of course even that number brings in only a small percentage of the active scientists in Britain.