

# Anniversary Address of the President of the Royal Society

*Sir Michael F. Atiyah*

The President's Anniversary Address to the Society provides an occasion for reflection on matters of importance to science, particularly those of the previous year. The address is a personal one, not a collective statement of Royal Society policy, but the restraints of office have to be borne in mind. The President has to face his fellow Officers and Council during the next year and he has to retain the confidence of the Fellowship. But these restrictions do not apply at his farewell address, his swan song which terminates his role before the evening is out. In other words, as an outgoing President, I can speak more freely and not weigh up my words with too much diplomatic tact. This is my last chance to emphasize the things I think are really important and to provide some food for thought for my successors.

Too often we have to react to external events, to short term crises, to financial cuts or to ministerial changes. In this semi-political world in which the scientific community has to operate we are in danger of losing our way and our identity. The scientific ethos becomes increasingly hard to discern. So today I would like to discuss some of the major issues of principle that we face.

As you all know this year is the 50th anniversary of the dropping of the atomic bomb on Japan. No other single event has so profoundly affected the relation between science and society. It has cast a very long shadow over the past 50 years.

The most immediate effect was to highlight in an awesome way the moral dilemma of scientists in relation to the military application of their discoveries. Many of those directly involved

in the development of the bomb went on to become strong advocates of restraint and responsibility in the nuclear arms race that ensued. This includes those in the Pugwash movement, notably Joseph Rotblat, the recipient of this year's Nobel Peace Prize. I am delighted that this well deserved recognition follows so soon after Professor Rotblat's election as a Fellow of the Royal Society.

The atomic bomb was unique in many respects, particularly in the speed with which a discovery in fundamental physics was put to use. A few short years transformed an abstruse piece of theoretical physics into the most devastating weapon the world had ever seen. No longer would scientists, conducting pure research for its own sake, be ignored on the grounds that their work was not relevant to the real world. The ivory tower was no longer a sanctuary.

The scale of the Los Alamos project, as a technological enterprise, brought scientists into the big money league. They were now involved in an operation costing vast sums and this continued, in the post-war years, with the peaceful development of atomic energy.

The days of the scientist as the poor scholar, dependent on a little enlightened philanthropy, were over. From now on science and big money were partners and, like other partnerships, this has produced tensions and crises. Rich friends are all very well but they can lead one to acquire expensive tastes.

If the technical triumph of the atomic bomb pushed scientists into the military-industrial complex it also initiated a hostile reaction from the general public. Atomic bombs were a menace and the scientists were responsible. Over the past 50 years this anti-science feeling has grown alarmingly, with environmental worries taking over from nuclear weapons as the driving force.

So, as we look back over the 50 years since Hiroshima, we can see that the atomic bomb ushered in a new era for the scientific commu-

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*At the Anniversary Meeting of the Royal Society, London, held on November 30, 1995, Sir Michael F. Atiyah, O. M., presented an address upon the completion of his term as president of the Royal Society. The "Anniversary Address by the President" originally appeared in Royal Society News, 8, 6, November 1995. Excerpts are reprinted here with permission of the Royal Society.*

nity. Close collaboration with government, both for military and for industrial purposes, has brought substantial material benefits. But this support has been bought at a price and public suspicion is one of the consequences.

We cannot turn the clock back and revert to our ivory towers. Science now occupies too important a position in modern life. The crucial question we scientists face is how to conduct our relations with government and industry so as to regain the confidence of the public. Here we need some humility. It is no use complaining that the public is simply ill-informed and needs re-educating. We have to examine our own position and see whether any of the criticisms levelled against us are valid. Have we sold out to the military-industrial complex? Do we pay sufficient attention to the way science is applied? Have we subverted the international idealism of science for narrow chauvinist aims?

Of course, all these are heavily loaded questions which many of us will feel unjustifiably impugn the integrity of scientists. Behind the scenes, and in the corridors of power, we may constantly be exercising a benign influence. But this will not impress a sceptical public. Scientists are too often thought of as a secretive elite, a sinister part of the establishment, part of "them", not part of "us". The only way to break down this suspicion and distrust is for scientists to speak out openly and freely, to criticize the establishment when necessary and to demonstrate that independence of thought really is the hallmark of a scientist.

So, in that spirit, let me return to Hiroshima and the atomic bomb. The 50th anniversary inevitably raised again the moral dilemma: was it justified, was it necessary? Even with hindsight there are no easy answers as the extensive correspondence in our daily newspapers so clearly demonstrated. What was important about that public debate, however, was that scientists were not all on one side; some were to be found on the side of the Bishops, if not of the Angels.

Now history, whether factual or mythical, is important: it shapes our attitudes and our thinking. But let me move on to the future, which is more under our control. Although nuclear weapons have not been used in battle since the end of World War II, they have been produced and stockpiled in vast quantities. The bulk of these weapons are held by Russia and the United States, but a number of other countries have significant quantities. China, the UK and France freely acknowledge their nuclear capability, but others are more clandestine.

Even before the collapse of communism in the Soviet Union, the arms race had been reversed and reductions in nuclear stockpiles were agreed between the USA and the USSR. The new politi-

cal climate offers an excellent opportunity of reducing the nuclear threat even further. The aim of totally eliminating nuclear weapons no longer seems an impossible dream. In working towards this goal scientists have a unique responsibility, and they can help in various ways.

On the technical side they can assist with the dismantling of weapons, the disposal of plutonium and the monitoring of security. On the political side they can keep reminding the public of the horrific nature of nuclear warfare and so maintain pressure on their Governments to continue along the disarmament route.

It would be good to report that the UK Government is in the forefront of those working for the reduction of nuclear weapons. Regrettably this is not the case. There seems to be no long-term vision, only a complacent reliance on the status quo.

Leaving aside the need to work for a more stable and secure future we might well ask questions about British policy over the past 50 years. The development, maintenance and enhancement of a British nuclear deterrent has been the consistent policy of successive Governments from both the major parties. Ernest Bevin was as enthusiastic a proponent as Margaret Thatcher and, at the present time, nuclear policy does not appear to be a matter of political controversy.

This is fortunate because it means that I, as a scientist, can state my views without becoming embroiled in partisan politics. So, let me venture a prediction. I believe history will show that the insistence on a UK nuclear capability was fundamentally misguided, a total waste of resources and a significant factor in our relative economic decline over the past 50 years.

The facts are easy to come by. Comparisons with Germany will show that both countries have devoted approximately the same fraction of their resources to Research and Development. However the division between civil and military R&D in the two countries is very different. Given this discrepancy, and the acknowledged importance of science and technology for modern industry, it would have required gross incompetence on the part of our German competitors if they had not derived a major economic benefit from this additional investment. Very similar remarks apply to Japan.

It may be argued that this economic sacrifice on the part of the UK was made altruistically in the interest of world peace. Perhaps, but I have yet to see this argument supported outside Britain and France.

The alternative justification, that nuclear weapons have given us extra political clout, is equally hard to substantiate. Unless you actually use nuclear weapons as a form of blackmail they are about as useful politically as an honorary de-

gree is academically. It is economic strength that underpins political influence and this is precisely what will have been sacrificed.

It has been said that Britain and, to a lesser extent, France have had difficulty in adjusting to the loss of empire. Nuclear status may have been seen by our Prime Ministers as a substitute, and as reward for being on the winning side in the war, psychologically understandable, but economically disastrous.

Nuclear weapons are just the most conspicuous part of our military arsenal, and by no means the only part which is crucially dependent on science and technology. So, even in the non-nuclear area, the Ministry of Defence, (MoD) employs many scientists and engineers who might in other circumstances be creating wealth for the nation.

A few years ago, after the fall of the Berlin Wall and the disappearance of the Russian military threat, there was much talk of the "Peace Dividend", the conversion of swords into ploughshares. The armed forces would be run down, resources would be saved and diverted into other more productive directions. In particular, the substantial effort that was going into military R&D would decrease with a corresponding increase in the civil expenditure on R&D. Unless I am very unobservant this does not seem to have happened to any significant extent. True, the MoD bill has gone down, but I have failed to detect any conscious policy on the redistribution of scientific resources.

I can understand the problem. Major changes cannot be expected overnight. The conversion of swords into ploughshares has always been a difficult business, and the conversion of swordsmen into ploughmen may be even trickier. Still I would like to see the "Peace Dividend" being turned into a reality.

There is at present great emphasis on the economic benefits that should be extracted from our scientific base. It seems quite consistent with this policy that we should be trying to divert some of our scientific resources from military to civilian purposes.

I realize that the manufacture and sale of armaments is part of the economy and considerable effort goes into persuading foreign governments to acquire British weapons. This is good for the balance of payments and provides employment in this country. To criticize our contribution to the arms trade might be deemed naive, unpatriotic and irresponsible. On the other hand, as a scientist, I cannot by my silence condone a policy which uses the scientific skills of this country to export potential death and destruction to poorer parts of the world, where

their scarce resources would be better employed on food and health.

For a short while, after the Gulf War, we heard much about a new world order in which the arms trade would be severely curtailed. Unfortunately the rhetoric has faded and it seems like business as usual. Our economies thrive by building up the Iraqs and Bosnias of the future.

I hope that a British Government will someday tackle this problem. Of course it has to be dealt with at the international level and by patient negotiation. But morality and our long-term interests point in the same direction.

Within this large picture one can identify specific problems which can be dealt with directly. At the present time attention is focused on anti-personnel mines and the continuing havoc they are causing in various parts of the world, long after official hostilities cease.

Traditional mines contained enough metal that they could be easily identified and recovered by metal detectors. Newer mines use little metal and are hard to detect. Presumably they were developed precisely for this purpose. An asset in military operations becomes an environmental disaster when peace follows. Ironically scientists are now faced with solving a problem of their own making. This is a technical problem dealing with the legacy of the past, but just as important are the diplomatic efforts now being made to ban the use of anti-personnel mines for the future. I regret that our Government, while supporting weaker steps, does not appear to be totally behind such a ban.

As I have made clear I believe scientists should speak out on matters such as these. It would be immoral not to, but, in addition, it shows the public that scientists are not always part of the official establishment and that they can maintain their independence. I recognize that not all scientists can speak with total freedom. Many are employed in institutions where outspoken comment is either forbidden or strongly discouraged. In addition many will have genuine and understandable conflicts of interest. Would I be so forthright if I worked for a munitions company? All the more reason therefore for those of us who are not inhibited by such constraints to speak freely and stimulate public debate.

I am glad to say that scientists can rise above personal advantage on moral issues. An example is provided by the large number of British scientists who publicly refused to have anything to do with the infamous "Star Wars" research of the Reagan era. The British Government of the time encouraged our scientists to apply for American funds for this purpose, but many refused because they believed the whole project was scientifically doubtful, economically wasteful, and politically destabilizing.

The atomic bomb is regretfully not the only weapon of mass annihilation that modern science has produced. Chemical and biological weapons can be just as lethal and terrifying. Fortunately a combination of public aversion and military doubt have now led to international treaties outlawing the development and use of such weapons. Unfortunately the verification and enforcement of the agreements is more difficult than with nuclear weapons. Scientists can however assist in this process, and I am glad to say that the Royal Society's Committee on Scientific Aspects of International Security has been actively involved in this area.

Science can be directed and applied to many different purposes. If scientists are unhappy about the worst aspects of military applications they can console themselves with the thought that medical advances save lives, or that the green revolution averted mass starvation. In between these two extremes are many other applications which may be morally neutral but commercially important. I find it an odd reflection on our society that some of the most sophisticated technology, resting on the contributions of our greatest intellects, finds its ultimate destiny in computer games.

Even in the medical field where the benefits of science are most transparent there are difficult social problems. From a global perspective the accusation is sometimes made that research is primarily directed to diseases of the rich. In a world economy dominated by a competitive free market philosophy it will require special efforts to redress the balance, to see that the health needs of the poor are not ignored.

The role of science as underpinning the industrial development of the future has been a main theme of recent Government policy and is behind the move of the Office of Science and Technology to the Department of Trade and Industry (DTI). While it is too early to predict the practical outcome of this on the support of scientific research it is hard to pretend that it has been received with enthusiasm by the scientific community. Even if there are no disastrous consequences the message does not seem right. To reduce science to such a subservient role is hardly reassuring. It is not that scientists are averse to their research being made use of by industry for the material benefit of society. It is true that we have a few eccentrics, like the late G. H. Hardy, who boasted that he had never done anything which was remotely useful—though he would be discomforted to know that bank security codes now use the prime numbers that he delighted in. No, the unease of scientists at finding themselves in the DTI is that science has a much bigger role, even in a utilitarian sense, than can be encompassed by the DTI. Health

and the environment are just two conspicuous examples.

But behind these bureaucratic arguments about which Department should be responsible for science lie some bigger issues. Scientists share an ethos which in earlier days would have said that they work for the glory of God and the benefit of all mankind. Even in our more secular age I can think of no better way of describing the scientific enterprise. Starting from this high ground various things follow. Scientists certainly have an interest in seeing that their work is not put to improper or wasteful uses and that its benefits are spread across the whole globe. They should speak up publicly in defence of what they believe so that the public does not identify them too closely with the vested interests of our society. Medical doctors, because of the Hippocratic oath, have always been held in high regard and the broader scientific community should aim for similar status.

Work for the glory of God is now translated as blue-skies research: not so grand, though it has the right heavenly flavour. This has the primary loyalty of the scientist and it is the fount of true knowledge, not some kind of minor entertainment designed to keep the workers happy. Turn this off and we shall no longer attract the creative intellects we need for the future. They will migrate to other lands or to other occupations, perhaps even to politics, with unpredictable consequences.

There is no doubt that getting the balance right between the unfettered pursuit of pure science and the harnessing of science for the benefit of society continues to be a major problem. In times of economic difficulty or financial stringency (and these seem to be perpetually with us) governments have a natural tendency to push, nudge or cajole scientists down the utilitarian path. Interestingly enough this attitude is not supported by many leaders of industry who see a clear distinction between the role of Government in supporting our basic infrastructure and their role in building on that for industrial application. This view is widely held in other countries and in the United States sixteen chief executives of major industrial companies recently issued a public statement to this effect.

I began by pointing out that, to retain public confidence, scientists should be seen to speak out on controversial issues even when this may involve criticism of or disagreement with the official "party line". I indicated that this might be difficult for those who are supported financially or otherwise by those in authority. I hope that the Royal Society, despite the fact that it was founded by a monarch and handles substantial public funds, will never feel unduly intimidated.