

## The social irresponsibility of scientists

**Abstract:** The future of the world depends upon scientists – men and women who are constantly striving to advance our knowledge. Yet most of them claim to bear no responsibility for the consequences of their work: as J. Robert Oppenheimer, the “father” of the bombs that destroyed Hiroshima and Nagasaki, used to say, physics has known sin, but let’s not confuse the actor and the instrument. Today, scientists play a variety of roles: as researchers, experts, strategists, diplomats, in the military and in the business world, as industrialists or spies, even as traffickers or mercenaries; they are at home as advisers in government circles, military HQs and in board rooms. Many are both warriors and missionaries for peace, defining a community in denial which questions whether there is still a place for socially responsible science or whether the courage of individual “dissidents” like Einstein, Bohr and Sakharov remains the only model for resisting the temptations and pressures from the military-industrial complex they nourish but also rely on.

Let me say at the outset how impressed and moved I am to speak before you in the Bohr Institute.<sup>1</sup> The very title of my talk should not induce you to think that I believe that there are no scientists fully aware of their social responsibility. Among them certainly no one was more aware than Niels Bohr from the beginning of his involvement in nuclear research, all the more so in the building of the first nuclear bombs, then in his fight for an international nuclear agreement and on to full disarmament. No one could have given a greater example of commitment to conceive of and defend science as an institution that should be close to the values it claims to express, not only truth and universality, but concern for the fate and survival of humanity. He certainly is not alone as a paradigmatic example of scientists’ social responsibility, but I must also emphasise, from the outset, that as such an example he belongs among those I call the dissidents, I mean scientists whose behaviour and thoughts challenge the conformism of the institution, and thus they are indeed a minority.

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<sup>1</sup> 29 March 2007.

The conformist position is to claim that basic research has nothing to do with other values besides the pursuit of knowledge for its own sake, that science is neutral and completely separate from the political, economic and strategic challenges and threats faced by the world. The point I tried to stress in the book I published recently, *The Scientists - Between Power and Knowledge*, is that since the Industrial Revolution of the 19th century most scientists are in fact immersed in activities in which it became more and more difficult to dissociate basic research from applied research and even development.<sup>2</sup> Let me tell you a revealing anecdote. Because of this book I was interviewed by a journalist from a monthly French journal, *Ciel et espace (Sky and Space)*, who asked me to define the boundary between basic research and other kind of research activities. I answered, “Well, on one side you have cosmology, on the other astronomy.” I was thinking that what is going on in the cosmos is the realm of “pure” science in the traditional sense of the term, whereas astronomy today refers to space research, missiles, satellites, whether the peaceful Shuttle, the international space station or military intercontinental missiles or the “star wars” system. But, having read the recent *Memoirs* by Robert Dautray, the man who was behind the French H-bomb, I must admit that I was still naive and indeed wrong: there is a direct connection between looking at the combustion in the sun and that which is provoked in a thermonuclear bomb, so much so that Dautray could write, “I have been a ferryman between the sun and weapons.”<sup>3</sup>

For scientists who devote their efforts entirely to basic research, the only thing that matters is the pursuit of knowledge for its own sake, without any

<sup>2</sup> J.-J. Salomon, *Les scientifiques – Entre pouvoir et savoir*, Albin Michel, Paris, November 2006.

<sup>3</sup> R. Dautray, *Mémoires – Du Vel d’Hiv à la bombe H*, Odile Jacob, 2007, p. 231 and note 3, p. 331

concern for what repercussions it might have. And many who work in applied research have the same attitude: the effects of a discovery or an invention are not their business. If as Aristotle says, what sets human beings apart is the desire for knowledge, then research can truly be a passion. The scientific institution relates to the ideal of basic research, “pure and disinterested”, still conducted only in university laboratories.

The search for truth – for an understanding of phenomena, a passion for getting to grips with natural phenomena by expressing them through the language of mathematics in particular – undoubtedly still exists, and there is no greater happiness, as Stendhal said, than when one’s passion coincides with one’s professional occupation. However, it is a long time since research was just a job. There is no way of disguising the huge changes that have occurred to the scientific institution over the last half-century: changes in scale, **in who** the scientists are and where they work. The vast majority of researchers now work in industrial or military laboratories, and among them – whether they are scientists or engineers – there are those who do basic research very similar to that of their counterparts in universities. Despite this pre-industrial image — maybe ideology — of an activity that still claims, not unjustifiably, to be concerned with pure intellectual speculation, a love of truth and disinterestedness, the scientific institution is in fact closely dependent on industrial capitalism, supplying its innovations, updating its weapons systems, inspiring, shaping and providing the model for the management of firms of all kinds — private, public and international — while at the same time being sustained by their contracts and subsidies.

In order to understand the changes to science that have taken place, its growing involvement with the affairs of the world, we need to go back to the

early days of modern science, to the experimental science associated with Galileo, Bacon, Descartes, Newton. The context of its mission is well summed up in the Charter of the Royal Society of London (1662): its aim was “perfecting the knowledge of natural things and all useful arts”, while at the same time “*not meddling with Metaphysicks, Moralls and Politics*”. This proclaims – in addition to objectivity of methods and results – the independence and neutrality of science in relation not only to religious, political and economic power, but also to values other than its own. Yet the professionalisation and industrialisation of scientific research has increasingly placed scientists at the heart of history: this development became ever more rapid from the end of the 19th century as the distinctions became more and more blurred between theoretical knowledge and practical know-how, between basic and applied research, between science and technology, and therefore between universities, industry and the armed forces, as well as between the public and the private sectors.

The noun “scientist”— someone who *does* science — appeared for the first time in 1840 in a book by W. Whewell, but it took another 50 years for it to be widely adopted across Europe, replacing “*savant*” or “natural philosopher”. This change reflects a major cultural shift whereby philosophy stopped being a point of reference for science, if not its extension. The spread of the term confirms the transition from a *state* to a *function*, i.e. to a profession that increasingly distinguished itself, by its language, procedures and channels of communication, from the humanities.

The first part of my recent book is devoted to the history and evolution of this new profession, to its particularities (its standards that determine the requirements and forms of publication), its growth within and outside the

universities, as well as its wrong turnings linked to the increase in numbers of scientists – this in turn has led to an equally intense struggle for recognition (hence frauds such as the recent false claim of human cloning in South Korea and conflicts of interest connected with industrial contracts). This new profession now covers roles as varied as those of expert, strategist, diplomat, soldier, businessman, industrialist, spy, trafficker, mercenary, while some researchers are entirely at home in the corridors of power, in military HQs and/or board rooms — at the heart of the decision-making centres of the military-industrial complex.

The second part of my book is on the theme “Research scientists endangered by history”, which argues that most of them show as little detachment as members of any other profession from contingencies, pressures and involvement in politics or economics. It argues, too, that at the same time many of them do not care about the possible repercussions of their discoveries or innovations — in other words, they are in no way responsible for the consequences of their discoveries and innovations. The wars of the 20th century have made scientists indispensable to governments, and by the same token, they influence world affairs more and more. The First World War saw the mass-production of weapons without introducing any major innovations, apart from the use on the battlefield of poison gas, the contribution of Fritz Haber, who received the Nobel Prize in 1920 for his work on synthesising ammonia – undoubtedly a pioneer of what was to become the military-industrial complex.

In fact, some scientists aspire to exercise real power. One has only to recall the influence of eugenics — a false science, but an ideology that was all the more attractive because it developed in the 20th century against a

background of fears about the degeneration of the population (and of the White race) — first on legislation in the United States, Switzerland, Germany and Sweden (with the sterilisation of the “unfit” and “deviants”). In Antiquity, Plato aimed to alter what was transmitted biologically by means of changes to society, whereas more recently, biology was seen as the key to changing society (one thinks of Galton, relying on demography and genetics). Under the Nazis this “biopower” was applied to exterminating the mentally ill, to the experiments conducted in the concentration camps and the resort to industrial methods in the gas chambers to achieve the “final solution”. It is impossible to minimise the role played in all this by biologists, demographers, anthropologists, psychologists and doctors: to echo Hannah Arendt, it was not *harmless*, it was not a matter of scientists “led astray”, but often also it is the *ordinary* researchers, associated with the network of Kaiser Wilhelm Institutes (later Max Planck), who illustrate *the banality of evil* when the power of science coincides with the desire for domination on the part of a group or a nation.

It is striking — and worrying — to see eugenics shake off its bad reputation thanks to the development of molecular biology: genetic engineering, pre-implantation genetic diagnosis (PGD), therapeutic cloning (even more so reproductive cloning), are leading some people to revive the idea of creating a society cleansed of its genetic defects and abnormalities through the intervention of science. In the past this was done by coercion under totalitarian regimes, today it goes on under democratic ones. Thus Francis Crick, one of the three biologists awarded the Nobel Prize for their discovery of the double-helix structure of DNA, was able to say to a conference: “Why should people have the right to have children?” He suggested there should be a system of permits, so that parents who did not seem very suitable

genetically would not be allowed to have more than one or maybe two children, under certain conditions.<sup>4</sup> The fantasy of control over human reproduction is still there in what has been called “the search for the Holy Grail” with regard not only to PGD, but also to sequencing the genome. Hence the question raised by the philosopher Habermas: are we not sliding inexorably towards free-market eugenics? So much that Professor Didier Sicard, who chairs the French National Committee for Bio-ethics, gave a full-page interview in which he warned that the diffusion of PGD may threaten France to lead to such a free-market eugenism by invoking the “perfect child”. And still he concluded by saying that this scientific achievement is irreversible: one doesn’t stop progress.<sup>5</sup>

In the history of the politicisation of science, eugenics was the occasion for what could be called — by analogy, if you will pardon the barbarism — the *scientification* of politics: demographers, geneticists and doctors were called upon to determine policies. This politicisation occurred even more strongly under totalitarian régimes: one thinks of the division between Aryan and Jewish science in Nazi Germany, between proletarian and bourgeois science in the Soviet Union (culminating in the Lyssenko affair). All of this is a far cry from the vocation and the precepts expressed in the Charter of the Royal Society.

It was the Second World War that brought truly basic research onto the battlefield. In the words of J. Robert Oppenheimer, the scientist in charge of the Manhattan Project which was to develop the bombs dropped on Hiroshima and Nagasaki, “physics has known sin”. But in the same speech he insisted on the

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<sup>4</sup> F. Crick, “Eugenism and Genetics: Discussion”, in G. Wolstenholme (ed.), *Man and His Future*, CIBA Foundation, Little Brown, Boston, 1963, p. 274-275.

<sup>5</sup> *Le Monde*, 5 February 2007.

distinction between the actor and the instrument: “In the worst instance [the instrument’s claim to being an actor] is used as a sort of screen to justify the most casual, unscholarly and, in the last analysis, corrupt intrusions of scientists into other realms of which they have neither experience, nor knowledge, nor the patience to obtain it.”<sup>6</sup> Oppenheimer was a fascinating and contradictory figure. Some commentators have recently underlined the influence that the *Bhagavad-Gita* and the Vedic culture exerted on Oppenheimer (before the war he was a disciple of Arthur William Ryder, a Berkeley specialist in Sanskrit and Hindu philosophy).

In the Hindu poem, Prince Arjuna refuses to fight because he has recognised in the opposing army many relatives and masters. But the driver of his cart, Krishna (an avatar of Vishnu), instructs him to fight, since he belongs to the warrior caste, and thus his duty is to face the battle. Oppenheimer’s *dharma* implies that he has to do what a warrior has got to do, since the hand letting loose the arrow is not the one that kills, it is the Lord’s doing. In the *Gita*, the notion that the “fruits of the work” or “the fruits of action” — the consequences of what one does — is used repeatedly to emphasise that the arrow that kills is indeed in Vishnu’s hands: you are not responsible for the fruits of your action. It is your duty to get on with the work, and this suffices to overcome any sense of responsibility since the decision to launch the bomb is not your affair.

It is not that obvious that Oppenheimer was not part of the decision-making process which led to Hiroshima. On the contrary, two weeks before the dropping of the bomb, he urged the military leaders to make sure to explode the “gadget” at the right height and in the right weather conditions so as to create the

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<sup>6</sup> J. R. Oppenheimer, “Physics in the Contemporary World”, *Bulletin of the Atomic Scientists*, 4:3, March 1949, p. 67.

maximum damage from fire and blast. Despite announcing that physicists had known sin, he later told a national television audience that “when you play a meaningful part in bringing about the death of over 100,000 people and the injury of a comparable number, you naturally don’t think of that as — with ease”. Unease is felt, not real anguish; in fact, his detachment was that of Veda, and he had just done his job. As he said once, “When you come right down to it, the reason that we did the job is because it was an organic necessity. If you are a scientist, you cannot stop such a thing. If you are a scientist, you believe that it is good to find out how the world works [...] that it is good to turn over to mankind at large the greatest possible power to control the world.”<sup>7</sup>

We know that not all the scientists who took part in the Manhattan Project limited themselves to their technical expertise but instead tried to oppose the decision to launch the bomb. James Franck chaired a committee whose report in June 1945, prepared by Leo Szilard, argued against the atomic bombing of a city and suggested instead a demonstration on an uninhabited desert island. After the July 16 Trinity test, the first nuclear explosion over the New Mexico desert, a group of 68 other scientists, again led by Leo Szilard, signed a petition to President Truman urging that the government make greater efforts to avoid dropping the bomb on the Japanese population. And we know that behind this campaign by Szilard, Niels Bohr was already trying to inspire Roosevelt and Churchill to seek an international agreement that might rule out such a decision. In brief, some do believe that doing science is not just a technical matter, but that it implies assuming responsibility for “the fruits of their work”. It was only at the end of his life that Oppenheimer appeared somewhat distressed by what

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<sup>7</sup> For all these quotations, see James A. Hijiya, “The Gita of J. Robert Oppenheimer”, *American Philosophical Society*, APS Proceedings, vol. 144, 2, June 2000 ; and John Heilbron, “Oppenheimer’s Guru”, in *Reappraising Oppenheimer, Centennial Studies and Reflections* (C. Carson and D. A Hollinger, ed.), Berkeley Papers in History of Science, vol. 21, 2005.

the scientific-industrial-military complex was doing with what he was the first to have built.

In other words, scientists are both involved and not involved: as children say when they are caught doing something they shouldn't, it wasn't me, it was the others. I have called this "the community of denial", drawing on the personal accounts of many scientists who have worked on the development of the most sophisticated and awesome weapons systems and who count themselves, like Freeman Dyson, "on the side of both the warriors and the victims".

Dyson, a member of the Princeton Institute for Advanced Study, who in his youth took part with his friend Richard Feynman in the Manhattan Project, attached to a local peace movement and a consultant to the Defense Department — two roles, two commitments, two visions of a "nuclear ethics" that are poles part — turned this dichotomy or schizophrenia into a book that is remarkable and revealing for the way he discusses deterrence and the problems from the viewpoints of these two worlds to which he belongs equally. "The world of the warriors is the world I see when I go to Washington or California to consult the military people about their technical problems", a world dominated by men, both hawks and doves, generals and academics, who speak the same language, in the same way, deliberately, without emotion or elaborate arguments, applauding dry humour and abhorring all sentimentality. "The philosophical standpoint of the warriors is basically conservative, even when they consider themselves liberal or revolutionary. They accept the world with all its imperfections as given; their mission is to preserve and to ameliorate its imperfections in detail, not to rebuild it from the foundations." This is the world of John von Neumann,

Herman Kahn, Edward Teller and all the others for whom war and its threats and costs is a matter of quantitative calculations, where the delight in the “technical sweetness” is matched by the sense of political domination.<sup>8</sup>

By contrast, Dyson says, “the world of the victims is the world I see when I listen to my wife’s tales of childhood in wartime Germany, when we take our children to visit the concentration camp museum at Dachau, when we go to the theater and see Brecht’s *Mother Courage*, when we read John Hersey’s *Hiroshima* or Masuji Ibuse’s *Black Rain* [...] when we sit with a crowd of strangers in church and hear them pray for peace or when I dream my private dreams of Armageddon”. This is a world dominated by women and children, where the young people outnumber the older generation, where more attention is paid to poets than to mathematicians, the world of pacifists and ecologists, but also that of scientists whose respect for Nature and for life matches their passion for their subject. Two simultaneous persons in the same human being, in whom neither the style nor the substance of their arguments is the same and each plays by its own rules which are not shared by the other — a case of exceptional “double bind” according to the definition of the anthropologist Gregory Bateson, a situation in which someone compels himself to face two absolutely contradictory alternatives, so impossible to sustain that it leads to madness: “The warriors’ world describes the outcome of war in the language of exchange ratios and cost effectiveness; the victims’ world describes it in the language of comedy and tragedy.”

Such an ambivalence — contradiction, dichotomy or even schizophrenia — highlights the peculiar role that the scientists-warriors assume today in our

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<sup>8</sup> F. Dyson, *Weapons and Hope*, Harper and Row, New York, 1985, p. 4-5.

societies. And it is not enough to evoke their patriotism or ideology as the major spur for their behaviour! No one surely would question that they have to contribute, like any other citizen, to the defence of their country, maybe by working to renew the arsenals. Personally, from my own experience, I would be the last to claim that a country can do without the military and a defence policy to which scientists have to contribute. Moreover, few scientists proclaimed that **they** were, like Einstein, pacifists and called on the spirit of non-violence. However, Einstein himself admitted, like Gandhi, that the use of force is unavoidable when one is confronted by an enemy who pursues destruction of life *as an end in itself*.

The moral problem that these scientists face does not stem from the fact that they can be called upon in their laboratories, it stems first from the *very nature* of the weapon systems of mass destruction that they alone are able to measure, conceive of, invent, adjust – in short, from their gigantic capacity to destroy. Here we have many testimonies of researchers associated with the military-industrial complex who discovered, like sorcerers' apprentices, that they “went too far”. However, there is something else in this awareness: what made them warriors was not so much the sense of duty as the *irresistible pleasure* of research. In Freudian terms, the culture of death which may feed the military art finds in research devoted to weapons of mass destruction a true source of eroticisation and narcissism. And from such a standpoint, the notion of denial is not that they go too far, but that in their eyes they never go enough far.

The idea of a denial of reality comes from a French psychoanalyst, Michel Fain, and relates to a community united by its identification with something — a shared denial — to reinforce an individual denial: the opposition of two

people within the same person.<sup>9</sup> In short, this comes down to saying, “This is what I am not” as a means of describing who you really are. In this sense, the model for the role played today by some scientists is neither Frankenstein or Faust — a pact made with the Devil — nor Dr Jekyll and Mr Hyde, an instance of a dual personality. Instead it involves behaviour that *simultaneously* aims to achieve contradictory ends, yet this imputation is rejected. It is a prime example of the process of **denial** which Freud discussed in a short and perceptive text.<sup>10</sup>

Yet we need to bear in mind that scientists are alone able to manipulate natural phenomena, to understand and harness the secret of atoms and their nuclei — or genes and viruses, since today the military are no less interested in genetic engineering resulting from the progress of molecular biology — to the point where they can turn them into weapons of mass destruction. It was not Roosevelt who had the idea of a nuclear weapon, but Leo Szilard, who wrote the letter signed by Einstein to warn President Roosevelt of the possible threat of a Nazi atomic bomb. Nor was it Ronald Reagan who invented the notion of “star wars”, but Edward Teller who inspired and initiated it, just as he was at the source of the Super, the thermonuclear bomb. Herbert York, who was head of the Pentagon’s Advanced Research Projects Agency (ARPA) under several Presidents, described his “philosophy” (his word) as having no goal beyond innovation at any price: “Our working philosophy [...] called for always pushing at the technological extremes. We did not wait for higher government or military authorities to tell us what they wanted and only then seek to supply it. Instead, we set out

<sup>9</sup> See M. Fain, *Le désir de l'interprète*, Aubier-Montaigne, Paris, 1982.

<sup>10</sup> S. Freud, *Verneinung*, in *Gesammelte Werk*, XIV, p. 11-15. There is an outstanding discussion of this text (*La dénégation*) by the philosopher Jean Hyppolite, introduced and commented by the psychoanalyst Jacques Lacan in *La Psychanalyse*, n°1, PUF, Paris, p. 17-48.

from the start to construct nuclear explosive devices that had the smallest diameter, the lightest weight, the least investment in rare materials or the highest yield-to-weight ratio or that otherwise carried the state of the art beyond the currently explored frontiers.”<sup>11</sup>

To judge from what these scientists say, while on the one hand they take great pleasure in their research, they can also be seen turning into missionaries for peace, in particular through the meetings of Pugwash where they work to oppose proliferation and in favour of disarmament. Einstein said that those who had worked on the atom bomb were driven to promote peace as an expiation. The community of denial oscillates between Eros and Thanatos, between the instinct for pleasure — the “technical sweetness complex” that Oppenheimer himself acknowledged — and the culture of death that inspires the escalation of systems of weapons of mass destruction. Oppenheimer opposed Teller’s program for the superbomb not on moral grounds, but in the first place because he was convinced that the available atomic bombs were then enough to face the Soviet threat, and also because he thought such a program doomed to fail. “The program we had in 1947 was a tortured thing that you could well argue did not make a great deal of technical sense [...] The program in 1951 was technically so sweet that you could not argue about it. It was purely the military, the political and the humane problem of what you were going to do about it once you had it.”<sup>12</sup>

Again Dyson puts his finger honestly on the very sense of this denial. “The sin of the physicists at Los Alamos did not lie in their having built a lethal weapon. To have built the bomb, when their country was engaged in a

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<sup>11</sup> H.York, *Making Weapons, Talking Peace. A Physicist’s Odyssey from Hiroshima to Geneva*, Basic Books, New York, 1987, p. 75.

<sup>12</sup> *In the Matter of J. Robert Oppenheimer*, MIT Press, Cambridge, 1971, p. 81 and 251.

desperate war against Hitler's Germany was morally justifiable. But they did not just build the bomb. They enjoyed building it. They had the best time of their lives while building it. That, I believe, is what Oppie (Oppenheimer) had in mind when he said that they had sinned. And he was right."<sup>13</sup> In sum, on the one hand there was the thrill of the technical problem to be tackled and then of finding the solution, narcissism and sublimation, the pleasure and intoxication of research: since it is possible, it must be done with the irresistible enthusiasm which leads to the discovery of the New World. On the other hand, the twisting turns of history, the conflicting values and the responsibility carried by other people: what you are going to do about it once you have it is purely the military, the political and the humane problem which is beyond the researcher's Eros — no more the concern of the scientist's imagination than of his conscience.

Thus Herbert York proposed to General Eisenhower soon after his election to the White House a plan for a 20-megaton atomic bomb, to which Eisenhower replied, "The whole thing is crazy; something simply has to be done about it!" Similarly Sakharov, before he became a champion of human rights in the Soviet Union, suggested the development of an even larger nuclear device to be carried on a giant submarine which could attack from close to the coasts of America. To his great surprise, Admiral Tomin's response was: "The officers and men of my fleet are accustomed to fighting their enemies only in open battle." "I felt deeply uneasy", Sakharov says, "and I never mentioned the subject again to anyone."<sup>14</sup> It was Sakharov, too, who said that in tackling the H-bomb he had seen "the theoretician's paradise" in the physics of the atomic and nuclear explosions. This is what

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<sup>13</sup> F. Dyson, *Disturbing the Universe*, p. 53. Harper and Row, New York, 1979, p. 53.

<sup>14</sup> A. Sakharov, *Memoirs*, Knopf, New York, 1990, p. 96-97.

made Karl Popper consider him to be a war criminal for this part of his career.<sup>15</sup>

We see the same pleasure, the same eroticisation of research, in the case of Oppenheimer or of Dyson, who looked back on his research on the Orion project (an enormous nuclear-powered rocket that was never built because it could fall back to the ground and spread its radioactivity) as the happiest days of his life. “It was possible for us in 1958 to enjoy the thought of leaping into the sky with a trail of nuclear fireballs glowing behind us.” Later, once he had (as he said) changed and realised the importance of the environment, Orion seemed to him “a filthy creature leaving its radioactive mess behind it wherever it goes.”<sup>16</sup> Or take Ken Alibek, who was in charge of the Soviet Union’s *Biopreparat*, the network of laboratories developing biological weapons, who wrote with child-like innocence: “The results of my studies could be used to kill people, but I couldn’t figure out how to reconcile this knowledge with the pleasure I derived from research.”<sup>17</sup>

And when it isn’t pleasure, it’s the focus exclusively on the interest of the experiment, whatever its ultimate purpose. This is what made Werner von Braun, move happily from being a senior SS officer, to a mercenary building the V1 and V2 at the Dora death-camp, and finally to building the Saturn rocket for the Apollo program. He freely acknowledged: “All I really want is a rich uncle” — so, after Uncle Himmler, why not Uncle Sam? On what

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<sup>15</sup> K. Popper, *La leçon de ce siècle - Entretiens avec Giancarlo Bosetti*, Anatolia, Paris, 1993, p. 45.

<sup>16</sup> F. Dyson, *Disturbing the Universe*, Harper and Row, New York, 1979, p. 114-115.

<sup>17</sup> K. Alibek, and S. Handelman, *Biohazard: the chilling true story of the largest covert biological weapons program in the world – told from inside by the man who ran it* (and is now working in the US as an expert on Russian biological weapons), Delta, New York, 2000.

grounds should the scientist serve any other purpose other than its technical competence? Sydney Drell, who was deeply involved in military research, underlined clearly that scientific activity has nothing to do with morals: “As scientists, we are trained in, we are expert in, and we work in a field whose content is without moral values, such as the study of the laws and the building blocks of physical nature. But as human beings we must make a moral choice whether or how to involve ourselves with the Devil — the political process, government and weapons of war.”<sup>18</sup> In short, the Devil merely haunts society, not the scientist’s activity.

Yet the speech given by Sir Michael Atiyah — winner of the Fields Medal and the Abel Prize in 2004 — on his retirement from the presidency of the Royal Society reveals a deep concern about how the great majority of scientists might be able to regain the prestige that they have lost because of the equivocal nature of the roles they play in our societies. Criticizing the building up of the nuclear arsenal, he stressed that it had done so much to undermine their integrity: “Close collaboration with governments, 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. [...] 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 humility. It is no use complaining that the public is simply ill informed and needs re-educating”. The example he gave, among many others, clearly illustrates the direct responsibility of scientists in the development of a weapon and the way that they – creators and repairers, both instruments of death and champions of life,

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<sup>18</sup> S. Drell, *Facing the Threat of Nuclear Weapons*, University of Washington Press, Seattle, 1983. P. 58-59.

firemen/arsonists – are called upon to remedy the problem that they themselves have caused: "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 became an environmental disaster when peace follows. Ironically scientists are now faced with solving a problem of their own making."<sup>19</sup>

This problem — both an ethical and a political issue — is nonetheless regularly a matter of denial on the part of many scientists. There is no getting away from the fact that today very few scientists devote themselves to basic research without any thought of the objectives in the short or medium term. Nowadays, the vast majority conduct their research in laboratories in industry or for the military, and it is not easy for them to resist the pressures from the military-industrial complex whose needs they meet and on which they depend.

To resist or even to stand apart obviously carries a cost: the risk not only of cutting oneself off from the rest of the community, but also of not being able to take part any longer in scientific activity. Worse still, in a totalitarian régime, it could mean the threat of prison, torture, psychiatric hospital or death. The story told recently by Hussein Al-Shahristani offers a vivid picture: in 1979, having refused to work on a nuclear bomb for Saddam Hussein, he was tortured for 22 days and nights, and then spent more than 11 years in solitary confinement. He was eventually able to escape and settle in England until the régime fell.

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<sup>19</sup> Sir Michael Atiyah, Royal Society, *Society News*, 8 November 1995.

By definition, these examples of resistance are not a dime a dozen, but neither are they all that rare. One thinks of Norbert Wiener, Erwin Chargaff, Linus Pauling, Joseph Rotblat, Bertrand Russell. Chargaff in particular was a black sheep within the community as a result of denouncing his own links with the military and money (which meant that he was not put forward for the Nobel Prize that he richly deserved). He stressed “A scientist attempting a dialectical meditation on science is immediately faced with a dilemma: on the one side, the harmonious beauty of science, its orderliness, its attraction for the acute and searching mind; on the other side, the dehumanizing and cruel uses to which it has been put, the brutality of thinking and imagination to which it has given rise, the increasing arrogance of its practitioners.” In his view, everything comes down to a question of power: “If oratorios could kill, the Pentagon would long ago have supported musical research.”<sup>20</sup>

The spirit of resistance is not only a matter of saving honour, it also prevents any involvement in evil. This is why my book’s conclusion is entitled “In praise of dissidence”; I describe three cases that are all the more exemplary for the fact that their interventions in affairs of state were made precisely on the basis of and in line with the values that inspired their scientific approach. Paul Painlevé intervened in the Dreyfus case, demonstrating both the incompetence of Bertillon at the Préfecture de police in handling the statistics in the case and the forgery of the famous item 96 in the secret files. Painlevé was reproached for becoming involved in the affair not just as one of the intellectuals but acting in the very name of science.<sup>21</sup>

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<sup>20</sup> E. Chargaff, *Heracleitean Fire. Sketches from a Life Before Nature*, Rockefeller University Press, 1979, p. 118.

<sup>21</sup> See V. Duclert, « Paul Painlevé et l’affaire Dreyfus : l’engagement singulier d’un savant », *Paul Painlevé (1863-1933) : un savant en politique* (sous la direction de C. Fontanon et R. Frank), Presses universitaires de Rennes, 2005, p. 13-40.

The story of Sakharov, the darling of the Soviet régime, has become the symbol of the struggle against the increasing momentum of the nuclear arms race. He carried on the efforts of Niels Bohr to achieve an “open society” and became the champion defender of human rights at the cost of death threats, legal proceedings, harassment (he was not able to go to Stockholm to receive his Nobel Peace Prize), and finally exile 400 kilometres from Moscow, in almost total isolation and under constant police surveillance. In his Manifesto in 1968, he emphasised that he had relied on “the scientific method” in attacking the disorders of the world.<sup>22</sup>

My last case is Einstein, who embodies all the contradictions of a scientist irresistibly caught in the traps of history, simultaneously a citizen of the world, “a bohemian without a country” as he labelled himself, a fighter for peace convinced that the “absence of cunning” which he saw as typical of Nature’s system could serve as a model for reducing the cunning in the human system of collective relations (*Gott ist raffiniert, aber nicht bösig*). Faced with the barbarous behaviour that characterised the 20th century, he constantly criticised the “debasement of researchers subjected to the slavery of the nation-state” and dreamed of a supra-national global organisation inspired by the values of truth and co-operation proper to the scientific method.<sup>23</sup>

Niels Bohr was one of those who was fully aware of his social responsibility, both a citizen of the world and a Danish citizen. One can, one should, reflect today on what conditions must be met for a truly “civic”

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<sup>22</sup> See C. Rhéaume, *Sakharov: science, morale et politique*, Préface d’Elena Bonner, Presses de l’Université Laval, Montréal, 2004.

<sup>23</sup> A. Einstein, « Adresse à la société italienne pour le progrès de la science », *Œuvres choisies*, vol. 5, *Science, éthique, philosophie*, Seuil/CNRS, Paris, 1991, p. 175.

science to be possible – that is, one fully conscious of its social responsibility and prepared to live it as Niels Bohr did. In this regard, I cannot think of a finer *apologia* than that of Victor Weiskopf, a student and disciple of Bohr, who was the director of CERN after having taken part in the Manhattan Project: “All parts and all aspects of science belong together. Science cannot develop unless it is pursued for the sake of pure knowledge and insight. It will not survive unless it is used intensely and wisely for the betterment of humanity and not as an instrument of domination by one group over another. Human existence depends upon compassion and curiosity. Curiosity without compassion is inhuman. Compassion without curiosity is ineffectual.”<sup>24</sup>

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<sup>24</sup> Victor F. Weiskopf, *Physics in the Twentieth Century, Selected Essays*, MIT Press, Cambridge, 1972, p. 364.