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ESSAYS ON SCIENCE AND SOCIETY:

From the World of Science to the World of Research?

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In the last century and a half, scientific development has been breathtaking, but the understanding of this progress has dramatically changed. It is characterized by the transition from the culture of "science" to the culture of "research." Science is certainty; research is uncertainty. Science is supposed to be cold, straight, and detached; research is warm, involving, and risky. Science puts an end to the vagaries of human disputes; research creates controversies. Science produces objectivity by escaping as much as possible from the shackles of ideology, passions, and emotions; research feeds on all of those to render objects of inquiry familiar.

There is a philosophy of science, but unfortunately there is no philosophy of research. There are many representations and clichés for grasping science and its myths; yet very little has been done to illuminate research. An association was created 150 years ago for the advancement of science, but what would an Association for the Advancement of Research look like?

Science and society cannot be separated, they depend on the same foundation. They are like two branches of power defined by the same constitution:* If you alter the separation of powers, you immediately alter both the view of what science is and of what society can do. This is probably what has changed most since the beginning of the AAAS. Science and research relate in different ways to the rest of culture.

In the traditional model, society was like the flesh of a peach, and science its hard pit. Science was surrounded by a society that remained foreign to the workings of the scientific method: Society

could reject or accept the results of science; it could be inimical or friendly toward its practical consequences. But there was no direct connection between scientific results and the larger context of society, which could do no more than slow down or speed up the advancement of an autonomous science. Galileo deals with the fate of falling bodies in one palace, while in another palace cardinals and philosophers deal with the fate of human souls.

The only way for science to disseminate its results, its ethics, and its methods was by educating as many members of the general public as possible. It is because young America was unfriendly toward science that the AAAS was created in the first place. How different are the connections nowadays between research and society!

ESSAYS ON SCIENCE AND SOCIETY
150 YEARS • 1848-1998

Consider the group of patients who created a French association for the treatment of muscular dystrophy (AFM) that raised $80 million in charity through a telethon. Because the disease that triggers the handicap has a genetic origin, for 15 years now the AFM has invested heavily in molecular biology. To the great surprise of the French scientific institutions, this charity for a while funded more basic research on the human genome than the French government. The money was used to develop novel ways to map chromosomes, and scientists published some of the first maps of the genome.† Once this was done, they disbanded the laboratories they had built for mapping chromosomes and turned all their efforts to exploring genetic therapy, even though it might be considered a risky endeavor.

The very building at Ivry, south of Paris, where the AFM has its headquarters, illustrates the limit of a metaphor that would separate science from a society left outside: on the first floor, patients in wheelchairs; on the next floor, laboratories; on the third, administration. Everywhere posters mark the next telethon while contributors visit the premises. Where is the science? Where is the society? They are now entangled to the point where they cannot be separated any longer. More extraordinary, patients turned genetic determinism (which, in many domains, is used as a way to render nature even more deterministic) into an instrument of unexpected freedom.

As has recently been shown for other diseases, novel ways to map chromosomes, and scientists published some of the first maps of the genome.‡ many decisions are now made by the patients, their families, and their representatives. Patients now routinely generate their own science policy. In these examples, the nature of society becomes clearly different from what it was in the traditional model. The patients did not wait for results to trickle down from science into their daily lives, with no option other than to be open-minded or close-minded about progress toward a cure for the disease. They did not expect genes, viruses, or vaccines to transform their subjective suffering into an objective determination. They took over. They tailored a science policy adjusted to what they perceived as their needs. Far from expecting certainty from science, they accepted that they must share risk in research. Surely the word "patient" never meant so much action and so little patience!

How best to express this New Deal between research and society? The notion of "collective experiment" could help capture the new spirit of the times.§ When the AAAS was founded, there was no doubt in the mind of the "scientists"--then still a new word--that science could resolve, bit by bit, most of the ills of society. The advancement of science was thus seen as the retreat of poverty, superstition, and other human follies. At the very least, the more science advanced, the better. This yearning for modernity, the juvenile ardor with which people embraced the cause of science, was due to this absolute certainty. It was thought that the confusing mixture of passion and objectivity would yield to a future in which humanity would no longer confuse facts and values, objectivity and subjectivity. The formidable energy of most scientists came from this conviction that they were marching toward a modernity that set the archaic past apart from the enlightened future.

There is no use minimizing the distance that separates us from our glorious forebears. How different things look a century and a half later! Who believes anymore in this unalloyed calling for science? The transformation of society by science has produced, to be sure, many beautiful ruins, but not a better society.

We should, however, be careful not to misinterpret the yawning gap between expectations and fulfilments. There are many people who say that the dreams of science have failed, that modernization has exhausted itself, that ills have resulted where goods were expected, and that Time's arrow no longer thrusts forward toward progress--that it now resembles more a dish of spaghetti than a straight route to the next century. There is no future for science, one might say. Science should be exposed and fiercely debunked as one of the many illusions destroyed by this most corrosive of all centuries. After the death of God, the flight from reason.

My interpretation is entirely different, and I take my cue from fieldwork in our tiny field called science studies. Science might be dead, but then long live research! I believe Time's arrow exists, but it distinguishes the past from the future in a new way. In the past, things and people were entangled; in the future, they will be even more entangled than ever before!

No one, for instance, believes that ecological controversies will die away to a point where we will no longer have to take care of the environment.|| Activists as well as scientists and politicians do not expect science to decrease the complex web of their lives. On the contrary, they expect research to multiply the number of entities with which they have to deal in their collective life.

It is at this juncture that the notion of "collective experiment" acquires its full meaning. Europe has lived, for several years now, under the shadow of the so-called mad cow disease. Progress is expected in all scientific matters connected with epidemiology, nonconventional proteins, veterinary surveillance, traceability of meat, and trade legislation, but no one expects to disentangle for good a core of scientific facts from the social context of ideologies, tastes, and values. On the contrary, everyone expects unexpected consequences to arise, whatever is done to the complex web of meat, ministers, bones, proteins, virus, and beefeaters!⊥

That is what has changed most. Science does not enter a chaotic society to put order into it anymore, to simplify its composition, and to put an end to its controversies. It does enter it, but to add new, uncertain ingredients (such as the beautiful and unexpected prions that earned S. B. Prusiner a Nobel Prize last year) to all the other ingredients that make up the collective experiments. When scientists add their findings to the mix, they do not put an end to politics; they add new ingredients to the collective process. To the many spokespersons who already represent humans and their needs, they also add more spokespersons who represent--how should I say it?--nonhumans and their needs.

In a recent review article in *Science*,[#] for example, scientists are speaking in the name of the Gulf Stream, which they claim threatens to disappear because of changes in the salinity of the Atlantic Ocean. Such an article is typical of the New Deal between research and society I am trying to define: A new entity, of gigantic proportions, enters the collective experiment and has to be added to the list of those that constitute the society of humans and nonhumans together. In addition to the prions, we now have the Gulf Stream! Who would have anticipated that human progress would have become so all-embracing? Only one thing is as sure as death and taxes: There will be more of these strange beasts in the future.

With the benefit of hindsight, we now understand that the very definition of society that had been used until now as a foil for science was ill-conceived from the start. The adjective "social" has been used to weaken science's claim to truth and certainty. And if you say that science is socially constructed, that is considered wrong by scientists. This tug-of-war between science and society,

where one gains what the other loses, is no longer the only game in town. There is now an alternative. To the old slogan of science--the more disconnected a discipline from society, the better--now resonates a more realistic call for action: The more connected a scientific discipline, the better.

Yes, this might mean that we have to modify our epistemology, adjust our political institutions, and subvert our definition of the social sciences. If we consider Galileo alone in his cell muttering, "And yet it moves!" with the recent meeting at Kyoto--where heads of states, lobbyists, and scientists were assembled together in the same palace to discuss the Earth--we measure the difference between science and research.**

Scientists now have the choice of maintaining a 19th-century ideal of science or elaborating--with all of us, the hoi polloi--an ideal of research better adjusted to the collective experiment on which we are all embarked.

In 150 years, all the ills have had plenty of time to flee from the wide-opened Pandora's box. Only one thing remains inside: hope. It might be just the right time to fetch it.

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PAGE TOP