

Developing the social responsibility of scientists and engineers

John Avery, H.C. Ørsted Institute, University of Copenhagen

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The “Science and Society” course at the H.C. Ørsted Institute

I would like to begin by describing a course that has been given at the University of Copenhagen every year since 1989. The original title of the course was “Science, Ethics and Politics”, and it was started in response to the wishes of the students. The Department of Chemistry Study Council gave us permission to hold this course under the condition that neither the students who attended it nor the person who taught it should be given any credit for their efforts. The somewhat provocative title of the course attracted 35 enthusiastic students in 1989. We met during two consecutive hours each week during the autumn term, and our meetings consisted then, as they do today, of lectures (some of them given by the students), guest lectures, and book reports, supplemented by film and video presentations.

One of our first guest lecturers was Professor Ebba Lund, who had recently published a book on genetic engineering. At the time when she spoke to us, she was the head of the Danish government’s Committee for the Evaluation of New Technology. As it turned out, the two hours which we had available for our meeting were barely enough time for the spellbinding lecture which she gave on the promises and dangers of new techniques in biotechnology, a lecture which combined enormous knowledge with enormous wisdom.

In 1990, the name of the course was changed to “Science and Society” (Videnskab og Samfund), and biochemists were given 2 points for attending it by their Study Council. (Chemists, for some reason, were allowed only

1 point!) Also, the Biochemistry Study Council requested the Chemistry Department to give the course every year. "Science and Society" was thus officially recognized, but optional.

In 1990, a book was completed, designed for teaching the course. The book was entitled "Science and Society", and it was printed by the Ørsted Institute's press. It has now been revised and reprinted four times, and it has been used for courses given in England, Switzerland and Sweden, as well as in Denmark. The contents of the book are as follows:

- The Beginnings of Civilization
- Ancient Greece
- The Hellenistic Era
- Civilizations of the East
- Science in the Renaissance
- Galileo
- The Age of Reason
- The Industrial Revolution
- Evolution
- Victory Over Disease
- Electricity and Magnetism
- Atomic and Nuclear Physics
- Nuclear Fission
- Hiroshima and Nagasaki
- Gene Splicing
- Artificial Intelligence
- Caring for the Earth
- Looking Towards the Future

From this table of contents it can be seen that the book attempts to sketch the history of science and technology from earliest times to the present day. Part of the motive in presenting this material to our students has been to give them a broad background knowledge of their own scientific culture. I think that it is valuable for students to read about the lives of the great scientists, and about how they were led to their discoveries.

A second theme, which becomes increasingly important as the story nears modern times, is the enormous social impact of science and technology. For example, we discuss the social impact of the industrial revolution, the terrible

living and working conditions of many industrial workers during the 19th century, child labour, overpopulation and colonialism. This material is given as a paradigm, illustrating the fact that the rapid development of technology can throw society off balance initially, until the appropriate adjustments have been made in institutions, customs, attitudes and laws.

Another example of the great social impact of rapidly developing science and technology arises in connection with the history of the discovery of nuclear fission and the development of nuclear weapons. Despite the end of the Cold War, the problem of nuclear weapons continues to cast a dark shadow over the future of humanity. The danger of a large-scale thermonuclear exchange between the superpowers now seems to be somewhat reduced, but on the other hand, the danger of nuclear proliferation is greater today than it was a few years ago. There is a danger that nuclear weapons will be used in the Middle East conflict, in the conflict between India and Pakistan, by terrorists, or by organized criminals as an instrument of extortion. A new generation of students, taking their places as leaders of society, will have to find solutions to these problems.

The course on “Science and Society” also covers the history of genesplicing, and the ethical issues which the new techniques raise. Today molecular biology and genetic engineering are enormously exciting and rapidly-developing branches of science, rich with promise but at the same time clouded by dangers. In recent years, humans have taken evolution into their own hands. Will we have the wisdom to avoid the dangers of genetic engineering while taking advantage of the opportunities? More than three billion years of gradual biological evolution have finely-tuned communities of organisms, creating harmonious ecological systems. What will happen when humans introduce new organisms of their own invention? Will irreversible mistakes be made? The new generation will have to find answers to these questions, and their education must equip them to do so.

Another extremely important and rapidly-developing field is information technology. The history of computers is covered in the course, and the students are encouraged to think about the constantly increasing social and economic impact of information technology. How can we take advantage of automation, and at the same time avoid technological unemployment? How can we avoid a division of society into those who are able to follow the new and increasingly complex developments and those who are unable to do so? These are questions which our future citizens will have to answer.

The ecological effects of the world's rapidly growing population are also discussed, as well as the ecological impact of economic growth. New thinking is needed if a future society is to be sustainable. Our students need background information about ecological problems, about the value of biological diversity, and about the depletion of nonrenewable resources.

Tomorrow's society will be a global society, and the institutions of world law and world government will need to be strengthened in order to guarantee peace and basic human rights throughout the world. Living at a critical time in history, our students need an education that will equip them to meet the challenge of building a stable and peaceful world. Since 1989, the "Science and Society" course at the H.C. Ørsted Institute of the University of Copenhagen has tried to give its students some background in these problems.

Claus Emmeche and the nationwide philosophy course

Meanwhile, at the Niels Bohr Institute (another part of the University of Copenhagen), another course was initiated by Prof. Claus Emmeche. This second course was called "Theory of Science", and in Prof. Emmeche's words, its purpose has been "to investigate the character of scientific knowledge as a special form of knowledge; the potential and limits of natural science; similarities and differences between different sciences; their contribution to general conceptions of the world including the relation between man and nature; specific theories of science; science studies; and ethical issues related to scientific research". It can be seen from this description of its purpose, that Prof. Emmeche's course has been aimed primarily at philosophical and epistemological issues related to science, although discussion of ethical problems has also been part of the curriculum.

On the 12th of February, 2000, one of the major Danish newspapers ("Politiken") published an essay written by Claus Emmeche, together with Simo Køppe and Frederik Stjernfelt, two other professors at the University of Copenhagen. This essay pleaded for the reintroduction of the philosophy course that had been a compulsory part of the university's science curriculum since 1675, only to be abolished in 1968 in connection with the general student revolt. Emmeche, Køppe and Stjernfelt argued that a new version of the traditional philosophy course was desirable in order to support the modern tendency towards interdisciplinary research, and to prevent young researchers from being inhibited by a lack of a general scientific overview.

Two weeks after the publication of the essay by Claus Emmeche and his coauthors, four members of the Danish Parliament put forward a proposal supporting the reintroduction of a compulsory philosophy course for all science and engineering students in Denmark. At almost the same time, I wrote to the Minister of Education, Margrethe Vestager, describing our “Science and Society” course and pleading for the reintroduction of a nationwide course philosophy as part of the compulsory curriculum for scientists and engineers. My argument was that such a philosophy course could help to develop the students’ sense of social responsibility, without which the rapid development of science and technology might be harmful rather than beneficial.

In October, 2000, the Danish Rector’s Conference, which included the heads of all institutions of higher education in the country, formally accepted the proposal for reintroducing a nationwide philosophy course, and they later joined the Minister of Education in making concrete proposals for how this should be accomplished. Starting in the autumn of 2004, this nationwide compulsory course became a reality. The exact curriculum of the course is decided by the local study councils in each discipline. Thus there is considerable variation in content.

I am happy to say that Dr. Tom Børsen Hansen, a young associate of Prof. Emmeche, has succeeded in introducing ethical issues and global problems related to science as part of the new philosophy course as it is taught to students of chemistry, biochemistry and nanoscience at the University of Copenhagen. My hope is that these issues will also be discussed in the course as it is taught elsewhere in the country, since it is becoming increasingly apparent that today’s lightning-like development of science-based technology is beneficial to our planet only if research and applications are guided by social and ecological wisdom.