The Making of Green Engineers

Sustainable Development and the Hybrid Imagination

Synthesis Lectures on Engineering

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Andrew Jamison
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Andrew Jamison
Aalborg University, Denmark

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ABSTRACT

This book discusses the ways in which engineering educators are responding to the challenges that confront their profession. On the one hand, there is an overarching *sustainability challenge:* the need for engineers to relate to the problems brought to light in the debates about environmental protection, resource depletion, and climate change. There are also a range of *societal challenges* that are due to the permeation of science and technology into ever more areas of our societies and everyday lives, and finally, there are the intrinsic *scientific and technological challenges* stemming from the emergence of new fields of "technosciences" that mix science and technology in new combinations.

In the book, the author discusses and exemplifies three contending response strategies on the part of engineers and engineering educators: a commercial strategy that links scientists and engineers into networks or systems of innovation; an academic strategy that reasserts the traditional values of science and engineering; and an integrative strategy that aims to combine scientific knowledge and engineering skills with cultural understanding and social responsibility by fostering what the author terms a "hybrid imagination."

Professor Jamison combines scholarly analysis with personal reflections drawing on over forty years of experience as a humanist teaching science and engineering students about the broader social, political and cultural contexts of their fields. The book has been written as part of the Program of Research on Opportunities and Challenges in Engineering Education in Denmark (PROCEED), funded by the Danish Strategic Research Council, for which Professor Jamison has served as coordinator.

KEYWORDS

sustainability, hybridity, engineering, higher education, technoscience, hubris

To Leo, Jette, Niels, and Steen —
Thanks for the memories

Contents

Imagination is not to be divorced from the facts: it is a way of illuminating the facts. It works by eliciting the general principles which apply to the facts, as they exist, and then by an intellectual survey of alternative possibilities which are consistent with those principles. It enables men to construct an intellectual vision of a new world, and it preserves the zest of life by the suggestion of satisfying purposes. .. The tragedy of the world is that those who are imaginative have but slight experience, and those who are experienced have feeble imaginations. Fools act on imagination without knowledge; pedants act on knowledge without imagination. The task of a university is to weld together imagination and experience.

Alfred North Whitehead, *The Aims of Education,* 1929

Preface

I have spent most of my working life teaching science and engineering students about the social, cultural and political aspects of their fields. I started with a course on "science and society" at the University of Copenhagen in the 1970s and early 1980s, and then served as director of studies and of a master's program in science and technology policy at the Research Policy Institute at the University of Lund until 1996, when I took up a post at Aalborg University, where I have been ever since (with a guest professorship at Malmö University College from 2003 to 2008).

Most of the teaching I have done through the years has concerned environmental politics in one way or another—which has been my main research interest—and, in more recent years, I have been doing my best to help students make sense of the amorphous quest for sustainable development. It has always been my conviction that scientists and engineers will be better able to use their knowledge and skills for beneficial purposes if they have been given the opportunity during their education to learn something about how science and technology have been used—and misused—in society, both in the past and in the present. When I came to Aalborg University in 1996 to serve as professor of technology and society, I said in my inaugural lecture that sustainable development would require changes in our values and way of life as much or even more than scientific and technological changes. As such, we needed to teach science and engineering students about those social, cultural and political aspects of sustainable development. I entitled my lecture, "How Can We Educate Green Engineers?" and this book is an attempt to provide an answer, based, to a large extent, on my own experiences.

In many respects, it has been harder than I had imagined it would be when I started out, and, to be frank, harder than it should have been. But the sad fact is that most of the science and engineering teachers with whom I have shared educational responsibility through the years, as well as their deans and department heads, have not been particularly interested in, and, at times, even strongly opposed to the kind of teaching that I have been trying to provide. There are powerful traditions and forms of habitual behavior—what I will be referring to in this book as "forces of habitus"—that have not been particularly easy to overcome. And in countries like Denmark and Sweden, where higher education is strongly influenced by the ruling parliamentary majorities, there are also political and ideological beliefs—and with them what I will be referring to as a "tendency to hubris"—that have served to constrain my efforts.

But there have been enough sympathetic colleagues and students through the years to keep me going, and I would like to thank them for their support and encouragement. In particular I would like to thank Mikael Hård, Leonardas Rinkevicius, Niels Mejlgaard and Jette Egelund Holgaard, for support and encouragement way beyond the call of duty. I first met Mikael in the early 1980s, and wherever he was, in Gothenburg, Trondheim or Darmstadt, he has asked me to give talks and

courses. The ideas and experiences that I present here owe a great deal to our collaborative works, *The Intellectual Appropriation of Technology* and *Hubris and Hybrids*. Much of my time during the past few years has been devoted to figuring out what we really meant with that title that he came up with!

The songlines that introduce each chapter are largely Leo's doing, since it was he who arranged for my amateurish lyrical efforts to be recorded in Kaunas in the spring of 2007 and even got me invited to sing at a music festival in Lithuania in 2008. Leonardas was my master's student in Lund in the early 1990s, and ever since, we have been colleagues and collaborators (as I discuss in chapter four). Niels was my PhD student in Aalborg and then stayed on to do some teaching in our nanotechnology program (which I refer to in chapter five). Jette and I have been trying together to turn engineering education green ever since she came to our department as a PhD student in 2000 (she is now my boss, having recently become the head of the section in our department where I have been working).

I would also like to thank my colleagues, and international advisers in PROCEED (the Program of Research on Opportunities and Challenges in Engineering Education in Denmark), funded by the Danish Strategic Research Council, that I have been coordinating since 2010. In particular, I would like to thank Steen Hyldgaard Christensen, who initiated the program and has been editor and collaborator in our various publications, not least in helping me produce the book of lectures, *A Hybrid Imagination: Science and Technology in Cultural Perspective*.

The book has been written as a contribution to the program—my personal PROCEEDings, so to speak, and I would therefore also like to thank all of those who have heard or read previous versions of these chapters at the various presentations that I have been making during the "outreach" phase of our program. The book draws on a number of recent articles that I have published, and I would therefore also like to thank all the editors and reviewers who were involved in the publishing process. I have done my best to make a coherent book out of these earlier efforts by rewriting and revising as much as possible, but as I like to say, one has only so many ideas in any one lifetime and it is a pity not to reuse them.

Andrew Jamison
Åkarp, Sweden
January 2013