

Comentario

Commencement Day[§]

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Dear Co-graduates:

A scientist at a commencement day who finds himself a situation such as the one I am in, may be expected by his younger—actually very much younger—graduation colleagues to say a few words about himself, and perhaps to make some remarks that could be taken as support for that old but controversial hypothesis, according to which growing older parallels the growth of wisdom. Or he might tell them something useful, for instance, explain “how to be successful as a scientist”. Let me on the spot make an attempt to support the hypothesis alluded to above and change this question into one that is not so harshly success-oriented, one that touches a little more on the human side, for instance: “how to succeed in composing and sustaining a full and happy life while being a scientist?”.

Do I imply that personal happiness in a scientist's life is more important than his science? Of course, it is. Nevertheless, let's reflect for a while. Take great art: would we dare to offset its creations against personal aspects of an artist's life? When it comes to contributions to mankind's cultural legacy—and in this respect great art and great science are sisters—we intuitively hesitate to make a judgement. Needless to say, in our own lives, in our own science, in yours as well as in mine, things are much simpler, by reasons which are obvious. Yet: science remains science and, therefore, traces of that hesitation may persist.

No matter how I ponder the question, I arrive at what living in our time makes all of us feel strongly: Hands off when it comes to assigning, not to speak of regulating, other people's personal values, science notwithstanding. The complexity of the determinants of personal lives forbids it. Violating this, would point to a dark perspective. “Totalitarianism is the denial of complexity” a political thinker once said. And so I

hasten to withdraw my more general version of the question, declare failure in my attempt to provide support for the controversial hypothesis, and modestly return to the simple question: “How to be good as a scientist”?

First, and above all: you have discovered yourself being happy in doing science. If you were to find yourself to have actually fallen in love with it, or even to have, in a way, already become addicted to it—the better. It's a great thing, and yet, quite natural, to fall in love with science. Once, at least once, brainwaves of yours must have conveyed to you that extraordinary joy which overtakes you the very moment you realise that you have made a scientific discovery.

The determinants of your attachment to science are partially to be traced to your genes —what a precious gift, enjoy it, and mind the obligations that go with it—partially it was the care for you by your parents —remain grateful—and, finally, by your teachers, so to say the chaperones in the expression of your intellectual and professional phenotype. Some of you want to become teachers of science. To teach, and to work with, graduate students is one of the greatest privileges a scientist can have. Great too are the responsibilities. One of them, perhaps the most important, is to create in a research group an atmosphere that makes the laboratory for each Ph. D. student a sort of academic paradise for a few happy years, perhaps the happiest she or he has known that far. These years are going to be indelibly imprinted on their paths as scientists, and so frighteningly much for their future can possibly decide itself during this time.

Research on chemical synthesis of complex natural products is often compared with mountain climbing. In Switzerland, mountaineering is not an uncommon sport of young and strong people. Myself, I did not belong to them; however, in interviews with students applying for Ph. D. work in my research group at ETH (Swiss Federal Institute of Technology), whenever I found out that the candidate was a devoted mountaineer I immediately tended to accept him. Why? Because a mountaineer must *a priori* have a set of virtues, without them he may not long survive, and a Professor of Chemistry is all too happy when he detects these very same virtues in his Ph. D. students, because an experimental chemist, in fact, any experimental scientist, should have them all:

[§] Commencement speech presented by Professor Albert Eschenmoser on May 19, 2000, on the occasion of being conferred an Honorary Doctoral Degree by The Scripps Research Institute. This speech was presented at the Doctoral Program Graduation Ceremony at Scripps. The introduction given for Professor Albert Eschenmoser on that occasion has been published [Sorensen, E. *Helv. Chim. Acta* **2000**, 83, 1673-1677].

- willingness to accept great challenges;
- enthusiasm paired with discipline and coolheadedness for when it gets critical;
- courage, but paired with caution and precision in execution (imagine a sloppy mountaineer; he would have fallen long before the interview);
- perseverance in pursuing a route once selected;
- good judgement about what is possible and what is not.

Here, I better interrupt this list of virtues and quote instead a paradoxical statement that I heard for the first time from a highly creative engineer: “The truly great things are often accomplished by people who do not know in advance that, what they are going to achieve, is impossible”.

Should you aim at doing great things? Who am I, to tell you, whether you should? Nevertheless, for your setting out on a path in pure or applied science, what I would like to tell you, is this: do not primarily seek success, go for the science, seek knowledge and insight, and success will be bestowed upon you. And also, do not frantically run after a brilliant career, work as hard as you can, and the career will, and then let it, happen to you. I know this may be not exactly the way by which, *e.g.* politicians pursue their goals. Of course, politics and science are so vastly divergent worlds, that their behavioral imperatives must be different. Yet, which scientist would never have attempted to imagine how it would be to live in a world in which politics were to follow the principles and ideals of science. The scientist's major obligation and, in essence, his only responsibility is to tell the truth. Having said this, I shall refrain from falling into the trap of overlooking the complexities of that other world.

Creative work has a special rank in the pecking order of human activities. The respect we have for it is related to the insight that human creativity belongs to the most precious things in our world. We are not supposed to worship it; but to neglect or to waste it, is a sort of sin. It encumbers its bearers with the obligation which venerable old scriptures have spoken of. Of course, this kind of moral imperative is not but a very soft cultural overtone of a huge ground wave that drives human creativity, a ground wave the origin and punch of which naturalists —naturally— locate in the depths of biological evolution. What really drives this wave is, however, a question that may stay with us for a long time, if not forever. (In case you are tempted to give a quick answer, then remember the virtues of the mountaineers and resist the temptation; for instance, humans could not possibly have been selected, thus far at least, for the capability to think of string theory).

A majority of you may be going to accept a job in industry, where not necessarily science, but technology is the challenge. Let me come to technology.

I must start with a confession. Over many years at the ETH (mind the name: Swiss Federal Institute of Technology), I exposed in my chemistry teaching, very regrettably indeed, an attitude towards technology that perhaps can be best described as the attitude of a “science snob”: explicitly demonstrating desinterest, playing upon my ignorance, occa-

sionally even denigrating what supposedly was “no longer science, but just technology”. I had to grow reasonably old in order to recognize and understand how narrow-minded and uninformed that attitude was, rigorously unscientific too, irrespective of the fact that it was, at that time, not uncommon among scientists. You may recall that controversial hypothesis mentioned at the beginning: here, at least, you have some support for it.

Technology —the making of material or mental objects for a purpose, objects that have not existed before but are designed on the basis of existing scientific knowledge—a field of human endeavour that in its potential to offer opportunities for human creativity possibly exceeds all the others. If there were a citation index that would differentiate, count, and weigh contemporary achievements in natural science and in technology, chances are that the latter would come out on top. It is a truism, however, that natural science and technology are in general interlocked in such an inextricable feed-forward-feed-back relationship that the attempt to disentangle them in real life is pointless. Yet, let's look up to the Hubble telescope, how that extraordinary object superbly exemplifies the entanglement of these two realms of human creativity: the technological object, designed on the basis of scientific knowledge acquired over centuries, making possible —through its existence— discoveries in outer space that are science at its purest. Discovery and Design are the two poles between which Science and Technology are thriving. We discover and we design because we want to know and we want to create. At last, it may well turn that, fundamentally, humans do science for the sake of being able to create.

While in praise of technology, allow me to come back to chemistry: We often speak of “The Art and Science of Chemical Synthesis”, a phrase encountered in laudations. In fact, there can be great art in chemical synthesis, but the art does not really refer to the science; what it refers to, is the design of the synthesis, but the design of a synthesis is an act of technological creativity. The science in chemical synthesis is the harsh and non-artistic battle for new knowledge to be fought in those steps where the design turns out to be incomplete, or to have gone wrong. And indeed, if we think of it: Art and Technology are much closer neighbors than Art and Science are within that triangle of these three great domains of human creativity.

To spend a life somewhere within that triangle can be wonderful. Go ahead and enjoy it, with my congratulations and best wishes.