

## International Collaboration in Science

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It was in spring 1994 when, for the first time, I had a chance to get in closer personal contact with Professor Vladimir Prelog. Naturally, I highly respected him as a scientist and teacher ever since my attendance, as a student, of his unforgettable, inspiring lectures at ETH Zürich in the early fifties. I admire his unique combination of intuition, logic, knowledge, wit, kindness, and extraordinary vitality. And it is a great pleasure to meet him occasionally in the corridor or at the photocopier which is located directly in front of my office. I hope for many more occasions in the future to experience his friendliness, his advice, and his positive, benevolent outlook.

It was in spring 1994 when I brought myself to ask Professor Vladimir Prelog for coauthoring a private letter to the Swiss government, finally signed by five Swiss Nobel laureates, in the context of the projected Swiss participation in the 4th Framework Program of the European Union. We were sceptical, not regarding the indispensable international research collaboration in general, but regarding the diversion of precious Swiss research resources towards Brussels, being afraid that the benefit/cost ratio could be significantly reduced when large amounts were distributed on an European scale by an oversized and not particularly efficient bureaucracy.

I remember that Professor Prelog was initially quite reluctant to consider cosigning the letter. He recognized the dangers of misinterpretation in case the letter would inadvertently be publicized. And indeed, what he foresaw did happen later, in spite of the private nature of the letter. But Professor Prelog overcame his initial scruples and he signed, convinced that the spirit behind the letter was in favour of research quality, true research collaboration, and, after all, to the advantage of Switzerland and Europe.

The letter received an unexpected publicity and its authors were decried as short-sighted scientists trapped in their ivory tower, being afraid of losing their own research support, and being afraid of international competition. We were shocked by the gross public misinterpretation of our true intents. We were also shocked by the poor knowledge on the side of the press and the public how science functions and how much scientists struggle to be as honest and objective as possible even if the truth turns out to be to their personal disadvantage.

In the following, I would like to collect a few personal thoughts on collaboration in science. Perhaps, the models of international scientific collaboration may also be taken as metaphors for collaboration in other domains of human activities. Perhaps, it may even favourably influence the peaceful co-existence of nations and of population groups.

Human activities unfold in the span between individual aspirations and needs, and the responsibility towards and the respect for society. Society is providing the framework and the security necessary for the individual development. The individuals, on the other hand, carry responsibility and specific obligations in the societal framework. The mutual dependency between community and individuals applies to all forms of coexistence within families, communities, and states, but equally well to the science community. Without an equilibrium of giving and taking, very rapidly the one-sided profits, misinterpreted as liberty, will turn into a deadly handicap, deadly for an organization and, in the end, deadly also for the individual. Liberty means to deliberately do what needs to be done. Or to quote John Donne (1572–1631): »Who ever gives, takes liberty«.

Giving and taking is of fundamental importance in science. We all contribute to and take advantage of the miraculous scientific edifice. Translated into scientific language, giving and taking means writing and reading, or teaching and learning. Whenever we had a great idea or made a discovery, we want to communicate it, and whenever a great discovery has been made, we want to hear about it to become inspired for further progress. Most of what we use in our scientific work, we have borrowed from somewhere. Wilson Mizner (1876–1933) claimed: »If you steal from one authors, it's plagiarism; if you steal from many, it's research«. Proper quotations are of major importance for the proper functioning of the scientific circus.

Although science is deadly serious, it has also a playful component, like in a question and answer game. There is indeed a competitive sportive component involved: Who will be the first, and who will win the great prize? Competition is essential as a stimulus for extraordinary achievements. Nevertheless, cooperation and collaboration are even more important than competition. A very special form of collaboration is teaching. It is intimately connected to research and dissemination of research results. Teaching means to encourage and support unselfishly (young) scientists on their path

towards new breakthroughs and achievements. »The touchstone of knowledge is the ability to teach« (Auctoritates Aristotelis). Indeed, for a true scientist it is more important that his students get proper recognition rather than himself.

Only in very rare circumstances can a scientist perform his research independently. He is usually dependent on other scientists with specialization and knowledge in other fields. Most of the progress takes place along the interfaces, in interdisciplinary fields, and the collaboration between scientists in different disciplines is indispensable for true innovations. My own field, nuclear magnetic resonance (NMR), is an excellent example in this respect. It exploits a purely physical method that has found application in as divergent fields as solid state physics, mineralogy, organic chemistry, molecular biology, physiology, and clinical medicine. Much of the technology is common but the goals can be very different. Without extensive interdisciplinary collaboration, progress in applied NMR is impossible.

Science is by its innermost nature international. There are no national truths, and scientific results apply irrespective of the religious belief of the scientists. Although there may be no absolute ever lasting truths, even in science, scientists attempt as honestly as ever possible to search for the most universal formulation of facts and laws of nature. Scientists are usually capable of finding a common denominator in their discourses irrespective of their personal background. Science attempts to be objective by stripping the apparent facts from their irrelevant casual attributes and concentrating on the common features.

This implies immediately that science does not know any national borders. It had an international dimension ever since it became active, and in former centuries rather more international exchange of scientists took place than today in central Europe. The high standards of modern science in Switzerland would be unthinkable without the creative contributions of many highly gifted »foreign« scientists, such as Erasmus von Rotterdam, the family Bernoulli, Wolfgang Pauli, Leopold Ružička, and Vladimir Prelog.

The international collaboration in science and technology functions admirably well. Many scientific disciplines are very thinly dispersed across all possible countries and continents. Collaboration means in these cases invariably international cooperation. Especially today with the new powerful means of communication, such as E-mail, Fax, and Internet, it matters only little how far collaborators are geographically separated, although even the most sophisticated electronic device can not compete in its efficiency of communication with an occasional discussion under four eyes.

By far the most efficient way of international collaboration is by exchange of coworkers. Most of the close and fruitful collaborations among scientists result from extended stays in laboratories in a different country or continent. Personal contacts are invaluable. They are the foundation of a

common understanding. Travelling is therefore of greatest importance in science, especially more extended stays with an active involvement in a partner's laboratory.

International collaboration requires substantial financial means. It is thus highly welcome that politicians are actively supporting the international exchange of scientists. Many politicians have recognized that the erection of firm borders between nations leads sooner or later into disasters. Free transfer of people and goods is essential for keeping the system near equilibrium and to avoid the build-up of dangerous tensions. Supporting the international exchange of science and scientists is a good start towards open borders and open minds between different countries.

The question remains in which form the support of international scientific exchange and collaboration should optimally take place. In the past and present framework program of the European Union, the preferred organizational form is topical research programs which the different participating countries of the EU have agreed upon. The major activities are in the fields of information and communication technology, industrial technology, environment, bioscience and biotechnology, energy, transport, and socioeconomy. Within the postulated topical constraints, research groups are then sought which can convince the experts that they may significantly contribute to the selected topic. This is the typical »top-down approach« that is favoured by science politicians as it gives them an opportunity for exerting their influence by directing research into directions which they consider as being essential.

There is hardly much dispute among scientists whether the top-down or the bottom-up approach is more efficient in the longer run. So far, top science has invariably been initiated, in a bottom-up approach, by the scientists themselves, normally by a few highly creative and inventive individuals who served as bell-wether, not so much by words, but by deeds and achievements. To have the foresight for picking the proper fields that are important for human society and topics in which breakthroughs are still possible is enormously demanding and difficult. Only those actively struggling at the forefront, can, in lucky moments, foresee the future. For science politicians, it is very difficult, if not impossible, to pick the proper fields which are relevant on an international level and where a sufficient number of creative ideas are floating around.

Science lives not only from extremely hard work but also from lucky surprises. »The essence of science: ask an impertinent question, and you are on the way to a pertinent answer« (Jacob Bronowski, 1908–1974). The science support system requires a sufficiently flexible and liberal mode of operation which allows also support of creative outsiders with brilliant ideas that do not conform to the politically initiated programs. Open-ended research programs without topical constraints are needed within which collaborative

research initiatives are judged exclusively based on their originality and creative content in view of their benefit for the future of mankind. All-too-often, scientists who are forced into projects by monetary decoy-birds lose some of their scientific honesty, lower their standards, and produce activity without much relevant results. This should be avoided under all circumstances.

It is extraordinarily difficult to plan scientific research. The scientist learns from his mistakes and failures. »It is a good morning exercise for a research scientist to discard a pet hypothesis every day before breakfast. It keeps him young« (Konrad Lorenz, 1903–1989). The approaches have to be modified on the fly, and often also the goals change in the course of a research project.

There are organizational forms which favour a flexible bottom-up approach in the context of international cooperation. I would like to mention in particular COST (Cooperation in Science and Technology) and EUREKA. In the case of the COST actions, it is expected that the primary initiative for a research project arises entirely from creative scientists and engineers. In EUREKA, in addition, a close collaboration with industrial companies is required. Little money is involved in these two research network programs, and the financing is based almost entirely on local resources. Much less misuse is possible in such frameworks than in programs where financial resources lure hungry but not necessarily creative scientists to participate.

In the attempts to strengthen the European unity, care has also to be taken that not new artificial barriers are erected at the borders of the EU, disfavoured the contacts to the remainder of the world. This could do more harm to the European science than it would help in the longer run. Borders in general are a horror to free science. COST and EUREKA are open also to scientists from some countries outside of the European Union and help to bridge unnecessary barriers.

International topical research programs are certainly justified whenever an urgent public need arises for the solution of a grave problem with an international dimension. Examples are the environmental problems which do not stop at the national borders, or the energy problem whose solution determines upon the fate of mankind in the next few centuries. In these areas, international topical programs are welcome. However, particularly in the two mentioned cases, a restriction to central Europe does not make much sense. Research efforts with this kind of world-wide impact and urgency must be organized on a world-wide basis.

This kind of thoughts forms the background for the infamous letter to the Swiss government. It expressed concern regarding a science support system that could exert not only positive influences on the already existing network of fruitful international collaborations and may rather favour busy international officiousness.

I am sure that Professor Vladimir Prelog supports some of the basic thoughts expressed in this article. However, he would surely have formulated them in a more tolerant and benevolent manner, reflecting his wisdom acquired in a rich life and his uncounted fruitful interactions with people of all kinds and of all nations. I am sure that he would express his sincere hope that the ease of international collaboration in science could become a metaphor for the interaction among nations and human races. I am sure that the tragic events in his former home country are heart-rending for him. I am sure that even the highly deplorable past would not let him to condemn one or the other side, but that he would just express his sincere plea that everybody contributes as much as is in his power to change the situation to the better as fast as is possible. Let us hope that science contributes its share, and let's work ourselves towards this goal.

#### **SAŽETAK**

#### **Međunarodna suradnja u znanosti**

*Richard R. Ernst*

Razmišljanja o prirodi znanstvenog rada i edukacije u znanosti autor posvećuje Prof. V. Prelogu, analizirajući njegove stavove o suštinskoj i formalnoj internacionalizaciji znanosti, posebno unutar Europske zajednice. Potaknut tim stavovima, autor iznosi svoja zapažanja o stanju današnjem prirodnih znanosti i njihovu odnosu prema osnovnim moralnim i društvenim načelima zapadne civilizacije od antičkih vremena do danas.