Jeff's View
Networks, fretworks

In March 2000 the science ministers of the European Union (EU) met in Lisbon and declared that within ten years the EU should be "the world's most competitive and dynamic knowledge-based economy". Yes, sure – and in 1893 US law makers proclaimed that the metric system should be "the country's fundamental standard of length and mass". I don't know what you say to such proclamations, but I know what my Uncle Paul would have said. A peasant's son who had made it to head-waiter at a posh New York City club, he could spot bull through a brick wall. "Fat chance," he would have said, "sounds to me just like them thoisty wise guys at the club". Vintage Brooklyn, Uncle Paul was.

He was also usually right. It is indeed unlikely that within the next seven years our *European Research Area* will outdistance the USA in science and technology. If anything, we seem to be falling further behind. Yet we have so much going for us. We have the same living standard as the USA, about the same per capita income, and perhaps the better general education. We even publish more scientific papers than the USA. In spite of all this, I would guess that at least two thirds of all truly fundamental biomedical innovations come from the USA. Why?

Some of the reasons are well known: antiquated university structures, exclusion of women, and lack of money. But Europe also suffers from serious misconceptions about how science works. Many of our research programs implicitly assume that fundamental discoveries can be planned; that research is more efficient if the scientists are told what to do, and how to do it; and that coordination, cooperation and evaluation can replace first-rate single brains.

As Europe's best scientists lack a platform for participating in European science policy, these misconceptions have contaminated our science establishment and are strangling scientific innovation. Because we scientists have not done enough to fight these misconceptions, the general public sees science as a logical, organized and even pedantic exercise in which the scientists patiently put stone upon stone until the meticulously planned building is finished. Yet good science is exactly the opposite: it rarely follows a planned course, but is intuitive, full of surprises, and sometimes even chaotic. Scientific exploration is an expedition into the unknown – just like good art. The greater a scientific or artistic innovation, the more it surprises us. How could anyone try to plan it?

If you want to know Europe's answer to this question, read the instructions for applying to one of its official research programs. Many of these intend to promote basic research in an area which happens to be fashionable: neurobiology, cancer, information processing, or gender studies. And genomics, of course. Many of them stipulate that your must collaborate with other research groups – you must form a NETWORK. Usually you must also make sure that the members of your network represent a politically correct balance of geography and gender. You are encouraged to budget a part of the funds for administrative purposes, and for good reason: once the Network is under way, it will generate a daunting mountain of paper. The application is a harbinger of things to come. It must give all the details on every participant and may easily top a hundred pages. Everyone must describe in great detail what will be done during the next three or even five years, even though everyone hopes that unexpected discoveries will soon make the research plan obsolete. Some application forms even ask for 'milestones' – a time-table for the discoveries to come. Milestones may facilitate short-term technology development for which the road has already been mapped, because the basic knowledge is available. But how can one demand milestones for an unknown road? In fundamental long-term research, milestones are ridiculous.

In spite of all these hurdles, scientists will play along with such official network programs because they cannot afford to ignore the carrot dangling in front of their nose. Of course, most of them will not really change their research to fit the bill, but will only custom-tailor their application. If they are biologists, they will promise to combat ageing, prevent Alzheimer's disease, or cure cancer. But bending the truth undermines public trust in science and the scientists. Also, it makes scientists become cynical. A radio journalist recently interviewed one of my friends who had just landed several millions for his network project. My friend is an eminent scientist and as critical of enforced networks as I am, yet he praised the program into the sky. "What else could I have done?" he apologized to me later. "Should I have said that giving me all that money was a bad idea?"

For young scientists trying to establish their own identity, official networks are rarely helpful. Young researchers want to show what they can do on their own, and may not always be eager to share their latest ideas with more established colleagues. When twenty-two top young biologists were recently asked whether they thought that their country's official network program helped them in their career, twenty-one of them answered "no". Network research also resists serious quality control, because a large group of scientists will nearly always produce some publishable results, and because the evaluations rarely ask the right question. They usually assess a network's accomplishments, yet the real question is whether the funds would have been more effective had they been given to individuals without any strings attached. Because this question is virtually impossible to answer, most network evaluations are bound to be inconclusive – they are like experiments without a valid control.

The folly of such mandatory network schemes struck me forcefully last year, when helping another country evaluate applications for a Genomics Network Program. I have always enjoyed serving on grant panels or prize committees, because you can try to make sure that creative scientists get the award, and mediocre ones don't. Spending a day on a good committee makes you feel useful and virtuous. But that long day on the network panel left most of us on the committee depressed. We knew the applicants personally and were pained to see how they tried to dupe us by posing as genomics experts. We were prepared to overlook these antics, but had a hard

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time to rank the applications. Is an application submitted by six average scientists better or worse than one by four bad and two excellent ones? I opted for the latter, but not everyone shared my view. In the end, we struck out the weak parts of the applications and tried to strengthen the good parts by recommending additional studies, or the recruitment of other scientists. Instead of judging the applications, we were rewriting them! To cap it all, we had to reject the only application we were all excited about, because it did not meet the narrow specifications of the network program. We ended up doing a bad job, because we were not allowed to do a good one. Everything was upside down.

Telling creative minds what to work on, or how to do it, is a sure way to prevent exciting new things from happening – in science as well as art. Most of us would agree that the best way to hear good music is to pick good musicians. Why not follow this simple recipe also in science? Here is the answer given by the position paper of October 14, 2000 on the *European Research Space*: "European research efforts should be focused on a more limited number of priorities which should be the subject to a political choice on the basis of objective assessment criteria". In a 1941 interview for *Nature* magazine, the Soviet Ambassador to Great Britain, Michailovich Maisky, said it more succinctly: "In the Soviet Union there is no place for pure science."

There is nothing *inherently* wrong with scientific networks. On the contrary, they can be powerful instruments of scientific innovation. Science is intensely social and thrives on contacts and collaborations. The World-Wide Web, the network *par excellence*, is the brainchild of scientists at CERN who wanted to stay in close touch with their colleagues around the globe. Another classic is the spontaneous collaboration between James Watson and Francis Crick on the structure of DNA. Networks can be particularly useful for technology development and clinical research, where many different approaches must be focused on a defined objective. Collaborations and networks are part of a scientist's daily life, but they should be allowed to form spontaneously and only when needed. Trying to enforce them is against the way scientists think and work. Scientists want to cast nets, not to be caught in them.

How *do* scientists get their ideas? What makes some of them see what everyone sees, and think what nobody has thought before? I do not know, but the mystery of the process has always awed me. Perhaps some of us have retained the gift of a child's playful ways – making up crazy words, or putting a hat on backwards. Perhaps it takes this child-like freshness to see that the way from A to C does not lead through B, but through X or W. Scientific and artistic creativity issue from the same mysterious springs deep down in us, which dry up quickly when we make them into a communal water supply. That's why truly fundamental discoveries nearly always come from talented individuals, and not from organized groups.

If we want new ideas, we should select the best brains, give them what they need, and then let them find their own way. This simple policy does not reflect submission to scientific arrogance, but respect for the vulnerability of human creativity.

Enforced networks are only a symptom of a more fundamental problem – Europe's tendency to micromanage innovation. The root of this problem is the fact that Europe's best scientists do not shape Europe's research policies. Good scientists instinctively know that an effective science policy must be willing to step back and let creative minds find their own way – even if the way appears unconventional and risky. They know that there is no innovation without mistakes. If evolution had shunned mistakes, we would still be bacteria. Typical administrators, however, are trained to *avoid* mistakes, because it is their *raison d'être* to execute decisions from higher up smoothly and according to regulations. If administrators are not given clear guidelines, they take over by default and run things their way. They will leave nothing to chance and, with the best of intentions, over-regulate and inhibit innovation. That's what has happened to most of our EU science programs. They are being strangled by a Byzantine bureaucracy, because so many of our best scientists have turned their back on science politics. They prefer to stay at the bench or in the library, and relegate science politics to second-rate scientists or to administrators. We should all heed the following advice: "It is essential for men of science to take an interest in the administration of their own affairs or else the professional civil servant will step in – and then the Lord help you." That's the great physicist Lord Ernest Rutherford speaking – more than three quarters of a century ago. Or, as Uncle Paul would have said: "You gotta do it yourself, or it won't voik!"

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