SISSA – International School for Advanced Studies
Journal of Science Communication
ISSN 1824 – 2049
http://jcom.sissa.it/

Comment

John Ziman

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What pushed His Excellency Enrico Fermi, acclaimed Academician of Italy entitled to a state car and driver, to leave Italy all of a sudden in December 1938 in order to reach New York, after a short stop in Stockholm for the ceremony that celebrated him as a Nobel laureate for physics, and to accept a job as a simple physics lecturer at the Columbia University?

A few weeks earlier, the Italian fascist government led by Benito Mussolini had approved its racial laws. Fermi's wife, Laura Capon, was a Jew. Without any doubt, the newly-established and dangerous Italian situation ranks among the causes for the dramatic decision made by Fermi.

Yet this was not exactly the crucial reason. After all, the wife of a recently-nominated Nobel laureate and Academician of Italy (who, after all, did not occupy a public post), did not have much to fear from Mussolini's racial laws. The main reason urging the most important atomic physician in the world to leave Italy must have been a different one. Fermi had realised that in order to carry on his pioneering research he needed funds and facilities Mussolini could not provide. An internal force was changing physics, requiring more and more resources and far better organisation. The United States of America appeared as a country capable of providing physicists with these resources and this organisation, whilst fascist Italy did not.

Incidentally, while the Italian physicist was flying to the new world, the Berlin laboratories of Otto Hahn were bearing witness to the discovery of the uranium nucleus. What followed is a well-known story. Enrico Fermi was to play an essential role in what is referred to as the *Manhattan Project*, which only a few years later would turn a fundamental physics discovery into the deadliest weapon of mass destruction ever conceived by mankind.

This story is familiar even among the general public. But there are two aspects historical popularisation has not specifically dealt with. Firstly, Enrico Fermi – considered as one of the pioneers of group work in physics, having gathered in the late twenties and early thirties five or six people to work together (referred to as "*i ragazzi di via Panisperna*", the "Via Panisperna fellows") – ended up in the forties working on a single technical project that gathered thousands of scientists and engineers and even hundreds of thousands of factory workers. Secondly, this community of academic scientists, technicians and industrial workers was actually working on commission: it had been given a precise task and huge endowments by the President of the United States of America himself.

ermi's passage from Italy to the US may be rightly regarded as a metaphor for a transition between one scientific era to another. It was one of the dramatic shifts in the social history of science. An era in which science need only limited resources gave way to a time in which huge resources were required. An era in which science could make do with a skimpy, self-centered social organisation gave way to time in which it demanded a lavish and complex social organisation, open towards society.

This shift was not limited to the relations between science and the army. In the US a similar change was soon to take place also in a strictly civilian realm. On July the 25th 1945, twelve days before the Hiroshima bombing, the United States Government Printing Office sent to the newly-elected US President, Harry S. Truman, a report entitled *Science: The Endless Frontier* signed by Vannevar Bush, the mathematician and engineer who was in charge of the Office of Scientific Research and Development and of the Manhattan project itself.

The report claimed that academic science had acquired and would acquire still a more and more strategic value. It could and should help the US not only to improve military security, but also to increase the health and the economic well-being of its citizens. In order to achieve this, a federal agency was needed to fix the objectives and the methods to be followed for the best «basic research in colleges, universities and research institutes, both in medicine and natural sciences».

In short, even in times of peace and for civilian purposes, the government must invested in academic science.

The consequences of the Bush report were tremendous. Not only was the agency actually founded (albeit only in 1950): what changed dramatically was the federal government's attitude towards science. Investments in the scientific, academic and industrial, civilian and military system as a whole increased in an unprecedented way in American history. And, most likely, even in human history.

A few figures will support this thesis. In 1930, as stated by Vannevar Bush himself, the United States of America invested 140 million dollars in scientific research and technological development (R&D). Ten years later, in 1940, this investment would have recorded a more-than-twofold increase: 309 million dollars.

Taking inflation into account, this means that in 1930 the US invested in science and technology 1.5 billion dollars (2005 dollars) and that over a decade it more than doubled its investments in real terms, reaching about 4 billion dollars (2005 dollars) in 1940.

Later on, when the previously planned agency was born in 1953 under the name of National Science Foundation (NSF), the total US investment in R&D reached approximately 30 billion dollars: nearly a tenfold real-term increase in comparison with 1940. Quite a stride. Or rather, an authentic turning-point. It took a further fifty years to complete another duplication in numbers: today, the US investments in R&D amount approximately to 300 billion dollars per year.

Still in 1953, the NSF management was not entrusted to a person appointed by the scientific community, as desired by Vannevar Bush. On the contrary, it was entrusted to a person appointed by the political authority, the President of the United States, as explicitly imposed by Truman himself after a startling dispute with the Congress.

So, between 1945 and 1953 another transition took place: the expense for scientific research was no longer marginal in the economy of this World War II-winning country and became a macroeconomic data. Investments in R&D could then be measured by GDP units and not by more diminutive figures. And the "Autonomous Republic of Science" maintained unprecedented relations with political institutions in times of peace. Consequently, the American scientific community – and, in a rapid sequence, the scientific communities of most of the industrialised world– had an exceptional quantity of resources at its disposal. All of this in exchange of a (slight) surrender of autonomy and the availability to work on large nationally-relevant projects commissioned by the State.

To say that similar processes in qualitative terms had previously taken place outside the US does not carry any weight. As in Germany or in Italy, for example – in the latter thanks to the action promoted by Vito Volterra. Indeed, it is quantity that counts here, not quality.

The quantity of resources and the massive size of the manpower employed made the scientific community that emerged from this process, launched in the US and rapidly spread all over the industrialised world, a *new* scientific community. Literally brand new. After World War II, the number of living and working scientists was higher than the total sum of the scientists ever lived in the previous ages.

This was a truly dramatic turn. Its size and consequences can probably compare only to two events in the social history of science. The 17th century saw the occurrence of what is often referred to as the "scientific revolution" and the birth of the "Republic of Science", as named by Paolo Rossi. And the 19th century saw the institutionalisation of the scientific community in universities and the consequent birth of "academic science".

This third "dramatic turn" occurred in the aftermath of the Second World War has been analysed by many, although only a few have been able to fully understand its importance. Certainly John Ziman is one of them, being the first to deal with "collectivised science" and the novelties it brought about. The term "collectivised" means that the working method of scientists is no longer centred on the individual (or small groups), but on large collectives. But it also means that the role played by the scientists' work, although counting on a substantial epistemological autonomy, falls within a wider national interest. Science – even academic science – becomes a part of a larger enterprise.

An outstanding intuition for a physicist without a specific education on social science. While this age transition was still in progress, John Ziman recognised some of its aspects that had not been grasped yet, not even by professional sociologists. At least, not with the same clear vision. These aspects are: science is a social institution; the scientific system is an evolutionary system; the Second World War made

science enter – owing to internal and external forces – a new development phase, characterised by great resources, large research groups and the collapse of the old ivory tower. A demise unavoidably implying a scientific activity management enlarged to heterogeneous groups of "non-experts", a deeper interpenetration made also of conflicts between science and society, and the unprecedented fact that crucial decisions for the development of science are taken by scientists in collaboration with other social groups of "non-expert" people.

Unlike from the majority of scholars – although similarly to major scholars – Ziman showed his personal participation, and sometimes his suffering, in describing this process. He was not a sterile analyst. He was an involved protagonist of this change. But this does not dimish his analysis skills.

Indeed, Ziman was among the first to realise this new phase of the change, the one he defined by the term «post-academic transition». This means that around 1980 the market breaks into the scientific evolutionary system. Along with its additional resources. And its culture. Thanks to Margaret Thatcher in the UK, of course. But also and above all thanks to the approval of the *Bayh-Dole Act* and some patent-related sentences by the Supreme Court of the United States.

Once again, the United States was a forerunner and a leader at the same time. This new model found many followers around the world.

And once again Ziman fully realised the scale of the irruption by market instruments, and by a market culture in particular, into the "Republic of Science". He understood that for the first time it was making its members face the competition between the ancient Merton's scheme of values (CUDOS), and a new pragmatic and utilitarian scheme (PLACE). A competition which today is more active than ever and remains unsolved.

This is why the "Republic of Science" features important vestiges of an ancient scientists' working method together with powerful injections of a new *market-oriented* – so to speak – working method.

Although John Ziman showed once again he experienced this transition with pain, this does not impoverish the clear vision of his analysis, but rather enriches it. His view is still slightly more advanced than the one emerging from the community of Science and Technology Studies.

But this physicist gifted with a great sociological intuition had much to teach also to those dealing specifically with science communication. More than others he highlighted that science is a social institution based on two pillars: the study of nature and the communication of its results.

The former is the "private" phase of science (also when it is carried out by groups and even by large groups of scientists). The latter is the "public" phase. Ziman has the merit of having insisted that the first phase of the scientific activity, the one producing new knowledge, is not enough: without the second "public" phase, without the communication on the newly-acquired knowledge, there is no science. Communication is the real connective tissue of the "Republic of Science".

Yet apparently many historians and nearly all of the science philosophers have not realised it.

But there is still one aspect that Ziman did not fully understand. And this is the new role that science communication addressed to a public (to various audiences) of "non-experts" has acquired, especially in the era of collectivised and post-academic science.

Indeed, when the crucial decisions for the development of science were taken essentially within the ivory tower, by the members of the "invisible colleges" – as it happened during the academic era – then communicating science to a "non-expert" audience could rightly be regarded as an unessential addition to the general system of science communication. Indeed, the only relevant communication was essentially peer-to-peer communication: from expert to expert.

But after the collapse of the ivory tower, after the doors and the windows of the "Republic of Science" were opened to politics, economy, society, then science communication between "experts" and "non-experts", even science communication from "non-expert" to "non-expert", without even a slight hint of the role played by experts, has acquired a crucial role. It affects significantly the development of science and society.

This type of communication should not be experienced with suffering or ill-concealed endurance, as many scientists still do and as Ziman apparently did. On the contrary, it should be accepted and interpreted in a creative and dynamic way. If this communication is enhanced, in all of its joints and nerves, everyone will benefit from it. Experts and "non-experts". Science and society.

Erio Tosatti, in this special issue devoted to our friend and master John Ziman, talks to us about the man and the physicist, who, at the International Centre for Theoretical Physics (ICTP) founded in Trieste

by Abdus Salam and Paolo Budinich, found a suitable way to make science not for the benefit of someone in particular, but for all of humankind.

Ana María Vara tells about the way John Ziman became an *insider* not only in the community of physicists, but also in the young community dealing with "science and society".

Helga Nowotny tells about the way John Ziman remained substantially an *outsider* in both communities. His research path was too original, his character was too refractory to any pre-determined epistemological rule to fit in rigid discipline divisions. But this original feature is precisely what is needed to understand the new and complex dynamics driving science and society.

Translated by Massimo Caregnato

Notes and references

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