# Freedom Creates **Knowledge**

Knowledge changes constantly as research probes the validity of existing knowledge and converts ignorance into new knowledge. Research may also create new ignorance by discovering entirely novel territories whose very existence we had not imagined. Our author analyzes the conditions most conducive to drawing back the curtains.

TEXT **GOTTFRIED SCHATZ**

Some forty years ago, bacteriologist George Packer Berry made a confession in a speech to his students at Harvard Medical School: "Our university has done its best to communicate to you the latest discoveries in medical science, but around half of what we have taught you is probably wrong. Unfortunately I am not able at this time to tell you which half." While his fellow professors nodded in agreement, the parents in the audience, who had paid handsomely for their children's education, were not amused. Like most of their fellow citizens, they expected science to produce guaranteed, grounded knowledge, to manage it carefully, and to pass it on to young people.

Researchers regard the knowledge they create as a byproduct

Politicians never tire of hailing knowledge as the raw material of new technologies and thus of progress and prosperity. Socially and politically, knowledge and science are synonyms – inseparable parts of a whole that share the same mission. Fulfilling this mission is expensive, so our society wants to steer the world of science and knowledge as precisely as it possibly can.

Yet this image of knowledge and science distorts reality and causes many of the problems European science is currently facing. We can resolve these problems only if we understand the difference between science and knowledge, and then foster each of them in distinct and appropriate ways. After all, science concerns itself less with *knowledge* than it does with *ignorance*. It tries to turn ignorance into knowledge – and considers this act of transformation more important than the result.

Most researchers regard the knowledge they generate almost as a byproduct of their work, and they are happy to leave its organization and management to others. From this perspective, a biochemistry textbook is not biochemistry but the history of biochemistry – a summary of what biochemists already know, or at least should know. Real biochemistry, in contrast, would be a surprising experimental result, an important suggestion from a colleague, or a lecture about a new discovery. Research scientists are

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truly at home, not in the warm embrace of certainty, but on the fringes, where knowledge stares ignorance in the face.

Still, in the reality of everyday science, most scientists devote the bulk of their time to managing and disseminating knowledge. Only a small minority work on turning ignorance into knowledge. Within this minority of researchers, only a tiny elite is destined to achieve the loftiest goal of science: creating new ignorance. In other words, discovering something we didn't even know we didn't know. When Gregor Mendel discovered the units of inheritance, Sigmund Freud the subconscious, Albert Einstein the principle of relativity, or Max Planck the constant that bears his name, they opened up mysterious new worlds of ignorance, the exploration of which wrought major changes in our view of ourselves and the world.

Science plays the part of the incorrigible revolutionary, fomenting creative unrest

Science is not a guardian of stability and order, but an incorrigible revolutionary fomenting creative unrest. It doesn't make our lives more orderly or peaceful, it makes them freer and more interesting. Just like innovative art, science disdains dogmas and unsettles us. No wonder, then, that totalitarian states have always repressed both. Russian poet Ossip Mandelstam is said to have responded to Stalin's cultural terror with these bitter words: "How fortunate we are that our state so loves poetry that it kills people for the sake of a poem." And in 1941, Ivan Maisky, the Soviet Ambassador to Great Britain, proclaimed without bitterness and with complete conviction: "There is no place in the USSR for pure science."

Knowledge is not a commodity to be neatly packed, labeled and put safely aside forever. It is more like a zoo of untamed animals: hurling themselves at the bars of the cages, they often tear them down, and occasionally produce unexpected offspring. Jean Paul Sartre said: "We do not make war. It is war that makes us." The same is true of knowledge. The onslaught of scientific research constantly changes the world of knowledge – and thus changes us. We may be able to temporarily manipulate knowledge, even falsify it, but in the long run, it is always stronger than we are. It obeys its own laws, which we can neither know precisely nor change. "Nothing is more powerful than an idea whose time has come": Victor Hugo may not have actually said that, but it is nonetheless true.

Although we have only limited ability to control it, knowledge is still a vital part of our genetic inheritance. We humans have not one, but two hereditary systems – one chemical and one cultural. The chemical system consists of threadlike DNA molecules and a few cellular structures; it determines what we can be. The cultural system consists of the transmission of knowledge and values; it determines what we then actually become.

Our chemical system barely distinguishes us from other mammals, but our cultural system is unique in nature. It gives us language, art, science and ethical responsibility. Both of these inheritance systems transmit knowledge from one generation to the next with great reliability, but they do make occasional mistakes.

Transmission errors in the chemical system – mutations – change our bodies, while transmission errors in the cultural system change how we think and behave. In the long run, such errors protect us from biological and cultural stasis, but in the short term, they can be catastrophic. When the error rate in the chemical system is too high (for example because of exposure to powerful radiation), a population or even an entire species can disappear forever. And when the error rate in the cultural system exceeds a certain level (for instance in revolutions or in long-lasting dictatorships), a culture can die.

In our evolution from animals to modern humans, the amount of knowledge stored in our chemical inheritance system has increased only modestly. Apes and mice both have almost as many genes as we humans do. In contrast, the knowledge stored in our cultural system has increased by many orders of magnitude – and is now threatening to overwhelm the transmission capacity of the system. In technology and in the natural sciences, data, knowledge and understanding have grown exponentially since the

middle of the 18th century, and even hyperbolically since the second half of the 20th century. At first sight, the digital revolution may seem to be enabling us to manage this explosion of information without effort: we can store, organize and analyze enormous amounts of data at unbelievable speeds and then transmit it all over the world. And even though electronic brains and storage media are currently approaching their physical limits, new inventions will almost certainly overcome them.

Yet such advances will not keep our knowledge safe, as today's digital storage media are not durable. Magnetic tapes, hard drives and optical devices can rarely store data safely for longer than a few decades. The Domesday Book, which was written for William the Conqueror in 1085 as a land register for his kingdom, can still be admired in its climate-controlled display case in Kew, but the digital version of 1986 has become largely unreadable. As we cannot yet store digital data for long periods, we must constantly "refresh" it by recopying – which is essentially transferring them from one sinking ship to another that will likewise sink soon.

Beyond its instability, digitally stored knowledge is also vulnerable to accidental or intentional corruption. It is child's play to alter digital data without leaving any traces. Today, photographs no longer prove anything at all, as they can be digitally manipulated in so many ways. In his dark vision of the future, *1984*, George Orwell described a totalitarian regime that doctors all reports about past and current events so thoroughly that the fabrications can no longer be detected later. I welcome the European Community's efforts to digitize our cultural heritage as exhaustively as possible, but I am also concerned about the vulnerability of such data. Pilate's cynical question, "What is truth?" is omnipresent in the digital world.

We scientists do not, however, find the facts that knowledge is never definitive and that it can't yet be stored safely in digital form as threatening as it may sound. As already mentioned, we have an ambiguous relationship with knowledge: we do everything we can to create it, but as soon as we have done so, we mistrust it and never stop calling it into question. The possession of knowledge is less important to us than the conviction that we can always generate it anew through observation and critical thinking.

Knowledge is a child of the past and, in a constantly changing world, can never guarantee us the future. This power is reserved for the eternal youth of scientific inquisitiveness, which searches the present for the hypotheses of the future. This process calls for people with new ideas who challenge existing knowledge and dogmas, for only those who swim against the current can discover new wellsprings of knowledge. It takes people who see what everyone sees, but then think what nobody has ever thought before. It takes people who intuitively recognize that the path from A to C does not lead through B, as everyone thinks it will, but through X or Z. All this demands intellectual courage – a researcher's most important gift.

Genuine researchers never hesitate to head into dangerous waters that promise new knowledge. American scholar John Augustus Shedd gave us researchers a good motto for our work: "A ship in harbor is safe, but that's not what ships are made for."

Knowledge is precious, but it shouldn't be overrated. By putting too much emphasis on knowledge, our schools, universities and political institutions stifle independent, critical thinking – the heart blood of science. Like all too many politicians, the public at large sees research as a strictly logical process in which researchers patiently put pieces together until the carefully planned building is complete. But innovative research is almost the exact opposite: it is intuitive; it can't be planned; it is full of surprises; it may even be chaotic – just like innovative art.

Innovative art and science are not strolls on carefully tended paths, but expeditions into uncharted wilderness, where artists and researchers often lose their way. In an orderly, peaceful world, the maps have already been drawn and the creative researchers are already elsewhere – somewhere their intuition has led them. >

Our schools, universities and research ministries place too one-sided an emphasis on knowledge

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Science in Europe suffers from the mistaken belief that research will be more innovative if it is given narrow, concrete goals. A fatal consequence of this misunderstanding is the official research programs that force researchers to concentrate on "relevant" problems: deforestation, AIDS, gender studies, cancer and climate change. Such politically motivated basic research is also referred to as "focused" research. Often, researchers are required to work as networks with partners who are "balanced" in terms of gender, language or geographic location. But it is absurd to expect basic research to be "focused," "relevant" or "interdisciplinary" and to be performed in mandatory networks.

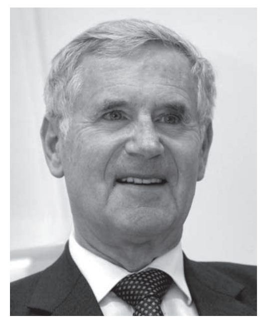
Innovative research creates its own goals and methods; if they are ordered top-down from the outset, then the research can never be innovative. Innovation can be planned only to a very limited extent, and is driven by contrarian individuals. This has nothing to do with scientific arrogance; rather, it is a consequence of the special laws and the fragility of human creativity.

## An overblown administration inevitably inhibits innovation

Most countries in Europe are busy expanding their scientific bureaucracies, many of which are now as complex as a Swiss watch, without, however, even remotely approaching the same precision. The purpose of an administration is to prevent exceptions, unexpected situations and mistakes, and to ensure that everything proceeds according to predetermined rules. For this reason, the management and dissemination of knowledge benefit greatly from an efficient scientific administration. But since exceptions, unexpected situations and mistakes are the very essence of innovative research, administration necessarily poses an obstacle to scientific discovery. An overblown administration therefore inevitably inhibits innovation. The same is true of the tendency to coordinate the work of individual researchers as seamlessly as possible. Organization is the enemy of innovation – and coordination the enemy of motivation.

If we wish to foster science in Europe, we must not forget that knowledge and science have different characters and inhabit different worlds. Science in Europe doesn't need elaborate "programs," but merely adherence to three simple rules. First, we must rigorously select the most talented researchers – even if such a selection contradicts a widespread but twisted understanding of democracy. Second, we must systematically give those talented people the necessary means to do their work – even if that means less money for run-of-the-mill research. And finally, we must allow them enough time and freedom to follow their own intuition and ideas. ◂

### THE AUTHOR



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It also appears in slightly modified form as an essay in the collected volume *Wa(h)re Wissenschaft* (Austrian Academy of Sciences, 2011).

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