

A note on science, humanities and the world problems

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Abstract

The evolution of the relations between science and humanities during the last two centuries is briefly reviewed. It is argued that the ambivalence of science, it can cure and also kill, is one of the major reasons for the misunderstandings between the two cultures, which are, in their turn, a serious obstacle for the solution of the main problems of the world. The fresh reflection on this question is a pressing necessity to go through what probably will be a very difficult 21st Century.

Introduction

When speaking about science and humanities, it is unavoidable to remind C. P. Snow¹, who coined the expression “the two cultures” from its unique position to understand the problem — he was both physicist and novelist for several years, scientist at day and writer at dusk. We should really consider more than two cultures, including the social sciences and the arts, for example. However, the discussion is simpler if we speak of just two without losing any important aspect of the question. Note that we must understand that culture is anything that, transcending the pure biology, is aroused by the daily action of living. This is the meaning of the statement: anything that is not nature is culture.

Indeed, culture is what follows the nature and continues the biological evolution giving rise to *homo sapiens*, along a second evolutionary phase of social type, which runs for at least several tens of thousand years. One of the forces that pulls strongly in this process is science, what happens not only thanks to its practical applications that improve our lives, but also because of the new perspectives on the universe, the matter and the life that is continuously offering us. So anyone who claim the title of humanist — for whom nothing human can be alien — must be permanently open to the world of science.

But this seems not to be the case: the topical gap between science and the other approaches to reality denounced by Snow remains active, wide and deep. Amid serious problems of unimaginable magnitude not many years ago — overpopulation, environmental degradation and global warming, oppression and injustice, marginalization and poverty, new diseases and hunger,... — and totally conflicting interests, two confronted bands discuss heatedly in front of a population devoid of references that does not know what to think . They are, on the one hand, the radical detractors of the rationality and the search of scientific solutions and, on the other side, their enthusiastic defenders — the new dionisians

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and the new apollonians, as they were called by the historian of science Gerald Holton².

It is not difficult to trace how we managed to reach this situation. We live now among mixed feelings ranging from enthusiasm for science to its rejection, from the admiration for its spectacular results to its condemnation as a closed caste with a cryptic and incommunicable language. Science gives enormous power and has great prestige. But at the same time, it inspires fear because it seems difficult or even incomprehensible and because of its connection with the arms race or the environmental degradation. The public opinion feels perplex and confuse in the midst of so much power, prestige and fear.

Since several decades ago and with increasing intensity, an intellectual process is putting in question the Modernity, the historical time generated in the eighteenth century during the Enlightenment. A new way of thinking emerged then across Europe, a different attitude driven by the second wave of the Scientific Revolution and the first one of the Industrial Revolution, which led to an exaltation of the human reason when people understood how powerful a tool is it to understand the world. Many, specially sociologists and philosophers, believe now that its historical time is finished because, as is heard everywhere, the reason has already given everything it could and we must find something else to put in its place.

What exactly is said to be in crisis? Simplifying the abundant analysis of philosophers, historians and sociologists, it can be stated that the Modernity is an attitude defined by two elements: the triumph of reason completely liberated and a unitary conception of history.

In the Enlightenment, the thought felt free from any tie, thanks to the success achieved in the study of nature by a new science that combined the experimental method with the mathematical analysis. On the other hand, the obsession with a unitary history, understood in the occidental way, left outside a multitude of cultures, what served to justify colonialism and racism, or at least led to a Eurocentric attitude. But the Modernity brought more than an intellectual change. Quite on the contrary, it affected deeply the economic and social life. The applications of science stimulated new types of businesses, improved the communications and fostered the commerce. The new concern for hygiene and the medical discoveries provoked a marked increase of the population. The economy developed intensely with the emergence of new kinds of industrialists and traders that fostered an emerging optimism. The conviction that the inevitable liberation of all the citizens was near imposed a secularized hope in a new man in a one-dimensional history, with no possible return, understood as something purely human.

Everything seemed to justify this simple vision in the nineteenth century. Advances in chemistry allowed to increase the production of food and those in

medicine overcame or mitigated diseases. This opened the way for the liberation of other slaveries. Indeed, the rejection of the argument of authority *a priori* would not have been possible before the Scientific Revolution, which gave birth to the new idea that any statement needs to be proved because it is possible to detect possible errors, a conviction established as a direct consequence of the experimental method of Galileo and Boyle who gave birth to modern science. It was not by chance, therefore, that human rights were born in Europe. They could not have originated in a culture which had not undermined previously the primitive idea that the value of an argument depends on wealth and power of those who proclaim it. Not surprisingly, this generated the myth of progress based on science, from which only good things can be expected. A euphoric vision of history established thus in the European culture.

But in the twentieth century this optimism began to be shaken by the terrible consequences of the application of military technology during the First World War, and was later shattered in the explosions of Hiroshima and Nagasaki and in the horrors of the Holocaust. Since then, the arguments for pessimism accumulate: mankind has the ability to self-destruct — not once but several times —, the planet deteriorates, the megacities generate horrible bags of marginalization, the gap between rich and poor widens. Moreover, the reductionist obsession by some scientists to explain absolutely everything in terms of corpuscles and movement, without any space for other approximations to reality, leads to a world view that many consider cold and inhuman.

The dual use of science and technology

It became clear then that the thinkers of Enlightenment had not understood well that science can cure but also can kill. This is expressed sometimes by saying that science is of dual use. It all depends on the ethical values on which any action is based, an issue that had not received enough attention during the 21st Century. A very expressive example of this ambivalence is given by the case of the great German chemist Fritz Haber, a Jew who had collaborated frequently with his country's army as a means to be socially accepted. Haber discovered a cheap method for synthesizing ammonia from air, what was very important because it allowed the manufacture at low cost of nitrogenous fertilizers to improve the crop yields, so that it became easier to feed the populations. But he was also the inventor of the first chemical weapons, in the form of canisters or containers full of chlorine that released the gas, like siphon bottles, when opened windward from the enemy soldiers³. Many allied combatants and civilians were burned and even dead. For the former discovery he received the Nobel Prize in Chemistry 1918, as a benefactor of mankind. For the latter he was put on trial a few months later and condemned as an enemy of mankind by a tribunal formed to judge morally war actions. The ambivalence of science is here clearly exposed. It must be underscored that his two discoveries were based on the same science, chemistry, applied in a case to nitrogen, in the other to chlorine.

This story had a most unfortunate lateral consequence. Haber's wife, who had known the invention before its use and asked him in vain not to use it,

committed suicide upon learning that her husband's chlorine cylinders had caused a large number of victims. The story is told in a book written by Fritz Haber's son by his second wife, a historical study of chemical weapons in which he tries to exonerate his father, partially at least³.

This ambivalence of science and technology has indeed a very negative impact on its relations with the humanities and other approaches to reality. It is like a high barrier that separates them. The only way to overcome it passes through a deep reflection on the ethical values underlying the technical applications.

On the breach between science and humanities

All this has caused a deep divide in society. Today's planetary society is well far away from the 19th Century's optimism, when it was believed that mankind was following an ascendant path that would lead, thanks to science, to a perfect world where men would be prosperous, happy and wise. It is worth examining some views on science. Let us first see some negative criticism⁴.

a) Uninteresting criticisms to science

— By creationists or fundamentalists. I will not discuss them.

— By postmodernists, the apostles of weak thought or the so called War of Sciences (of nature and of society), most frequently sociologists and philosophers.

The members of these groups are characterized by a marked distrust of science and a disavowal of scientific objectivity⁵. They claim that scientific knowledge is nothing more than a congenial agreement between colleagues, just a cultural construct that should abandon any claim of objectivity. Science would be just a communal system of beliefs with much less empirical basis than what is usually assumed. A champion of this idea is Andrew Pickering, who wrote a book on elementary particle physicists whose provocative title "Constructing quarks" explains well his view that the accepted theory of the constituents of matter is merely a product of cultural agreements among colleagues without empirical basis⁶. More specifically he states "In order to form a vision of the world, nobody has any obligation to take into account what 20th Century science says" and also "Given their extensive training in sophisticated mathematical techniques, the preponderance of mathematics in particle physicists' accounts of reality is no more hard to explain than the fondness of ethnic groups for their native language." Many scientists respond angrily, convinced that science seeks and finds truths that are objective because they can be checked at any time by other researchers by means of reproducible experiments, which are subjected to all sorts of criticism and controls. Many scientists admit that science can not explain everything, but they are convinced that it offers deep truths, if partial, on the behaviour of the world. Although it will never enunciate something that could be called the truth of the universe — that is the final and definitive theory that could explain everything —, the amount of things that we know objectively about matter, life or man is continually increasing. These are truths that remain already established in an objective manner. Can anyone doubt that Newton's laws describe, at least with

good approximation, the actual behaviour of the planets or that the chromosomes contain the DNA molecule of the biological heredity?

It is true that science is a human enterprise, imperfect and fallible, and even that it has sometimes pathological aspects, as any human undertake. But what is ignored by those who see it as a mere cultural construct is that the scientific method imposes a collective system of control that detects and eliminates errors or unfounded conventions. As a result, the community of scientists becomes much more objective and reliable than each one of its members. Note specially that the system includes the repetition of the experiments and theoretical analysis by researchers from rival, even enemy, schools. This explains the high agreement that is reached about the laws of nature, even among those who had departed from very different intellectual positions. This is sometimes called confluentism.

b) Criticisms to science worthy of consideration

As examples of criticisms to science to be considered with attention, let us take two examples of two great humanists: the German philosopher Edmund Husserl and the Czech novelist Milan Kundera.

The first gave a famous lecture in 1935 in Vienna on the crisis in the European world⁷. For him, Europe was the spiritual sphere that emerged in ancient Greece by a new attitude which he describes this way: "*men were then seized by the passion for the knowledge of the world, outside of any practical interest.*" Husserl tries to understand the causes of the crisis manifest in the First World War and in the glimmers of the Second. He attributes it to a "*rationalism that got lost after the Enlightenment*" and the "*fatal mistake of believing that science is what makes men wise*". He reacts against what he sees as a unilateral and exclusive character of modern science and against "*the scientific dominance of the sphere of the spirit*" that leads without remedy to the "*oblivion of the subject.*"

Kundera discusses the role of literature in today's world, contrasting the figures of Cervantes and Descartes as co-founders of the Modern Age⁸. He claims the legacy of the former, not that of the latter, declaring that "*in this age of degradation and progress*", we must vindicate the non-scientific knowledge whose existence is poorly known because of the preponderance of science. There are things that a novel can discover, since "*the knowledge is the only raison d'être of the novel, always emerged from a question on the human society*" that can only be answered "*understanding the world as ambiguity*". He speaks of the "*terminal paradox*": "*the Modern Age destroyed all the values inherited from the Middle Age but, after the final triumph of reason, it is the irrational that seizes the world, since there is no system of values to avoid it*".

c) Scientific opinions

As an example we can mention the chapter VII, "*Against philosophy*" of the book "*Dreams of a Final Theory*" by the 1979 Nobel Prize for Physics Steven Weinberg⁹. In that work, this famous physicist explains his conviction that we are already very close of the complete knowledge of all the laws of nature, so that we would reach soon the total wisdom. We could then answer all the questions. That would be achieved thanks to the reductionism of which Weinberg is a great

defender. In Chapter VII he explains his reasons to believe that philosophy not only will not have helped to achieve this goal, but in fact has been an obstacle along the history of science. It should be noted that not all the scientists agree with Weinberg on this point. For instance, Philip Anderson, another Nobel laureate in physics, this one in 1977, has an opinion contrary to reductionism, about what the two have maintained a controversy of great interest^{10,4}.

It may be interesting to consider another radical example. The renowned Oxford physical chemist Peter Atkins is a decided supporter of scientism and the omnicompetence of science, which means according to him that it is the only true knowledge and that it can answer any question, if not now, certainly in the future. In the development of his views he makes disdainful comments on humanities like the following one.

“That science can illuminate moral and spiritual questions should be a source of joy ... That it will do so by cleansing moral questions of the lies of the religious will not bring pleasure to the priests. That it will do so by elevating the ‘spiritual’ to a property of the complex circuits of the brain will not bring pleasure to the poets ... But it brings the deepest joy to those who value knowledge... Happily, science will continue despite the cantankerous efforts of philosophers to thwart its progress... scientists can stand aloof from the chattering bickerings of the fearful. They are busy explaining everything and bringing the Renaissance to its climax”^{11,4}.

These are only several of many examples showing the wide and deep breach between the two cultures. But, how important is it?

Science, technology and the problems of mankind: the hunger in the third world.

Some 900 or 1.000 millions people are seriously undernourished (approximately 16% of the population). This is the number of those who fail to ingest the minimum necessary dose of about 2,500 or 2,000 calories for men and women respectively, and suffer consequently serious damage; the children in particular die soon, develop little or suffer bad sequels for his adult life. To increase the production of food is thus a pressing need. But a fatal law of biology opposes it; growth has its limits. A certain ecological niche cannot contain an arbitrarily high number of animals or plants of any kind. If a small population of living beings — bacteria in a culture medium, trees in a valley, fish in a pond ... — are placed in a favourable environment, it will grow until reaching the maximum capacity of the habitat. Then the population will stabilize or begin to fall sharply. The Earth had 2,500 million inhabitants in 1950, has now about 6,000 and will probably have about 8,000-9,000 in 2050. Which is its natural capacity? How many people can it maintain?

The English clergyman Thomas Malthus made a terrible prediction in

1798: as the population grows faster than food production, "it will exceed the power of the earth to feed it," what will lead to major famines, and possibly to the end of the human race. His forecast was based on solid arguments, but failed because it did not take into account that the Industrial Revolution would produce a dramatic increase in agricultural productivity. That is why the technology had already defused the demographic bomb, also called "Malthus bomb," when he had made his prediction. But it was soon realized that the same effect could occur for another reason: the injustice in the distribution of wealth, in which Karl Marx insisted so much. Therefore, this prediction is sometimes called the "Marx bomb." To solve the hunger problem, we must defuse these two bombs.

These are the two sides of the problem: to improve agricultural productivity — which is a scientific and technical issue — and to achieve a more just social structure — which is not.

Something similar could be said of many of the other major problems of humankind — pollution, global warming, ozone hole, major diseases, and so on. One major conclusion from these reflections is that, as I said before, *many of the most serious problems of mankind will be solved neither only with science nor without science*. It follows therefore that a solution to these problems requires as a previous requirement to achieve a better understanding or a certain harmony between the two cultures. Unfortunately, this seems to be very difficult if one considers the opinions previously explained.

The transit along the twenty-first century, the science and the humanities

The preceding arguments are certainly much more than an academic debate since they refer to the main practical problems of mankind and to the never ending reflection on ethics. In this moment, their importance is enhanced by some circumstances of the present day civilization.

The capacity for destruction — and self-destruction indeed — of humankind is terrible, although the public opinion does not perceive well the seriousness of the problem. Just one detail to underscore this fact: each one of the about fifty nuclear submarines that are now in service carries an explosive power that is higher than that of all the bombs used up to now in all the wars that took place in Earth, including del Second World War and the wars of Korea, Vietnam, the Gulf, Afghanistan and Irak. A second detail: if all the 13,000 megatons in the nuclear weapons in 1990 were uniformly distributed over all the countries, Spain would receive near 3,000 bombs as the one which destroyed Hiroshima. On top of that, we must consider the chemical and bacteriological weapons and the possibility of culpable negligences, innocent errors or nuclear and biological terrorism by organized groups, sometimes even with the help of some states.

This is a new situation, no more than forty years old, and increasingly dangerous. It is a manifestation of what the British cosmologist Martin Rees calls the "dark side of science" in a recent and most interesting book¹², in which he argues convincingly that a society that becomes *highly technological* and *planetary* becomes also *more vulnerable*. The technical advances may make it less secure, not more. Rees makes two statements: (i) that before 2025 a terrorist attack

with chemical or nuclear weapons or an imprudence, for instance the escape of a highly lethal engineered virus from a laboratory or a informatics virus that disrupt the communications in a region of the Earth, will cause a cataclysm with more than a million deaths; (ii) that the probability that our civilization will survive the Twenty-first Century is not higher than 50 %. The first one is not absurd in any way whatsoever. Indeed, its possibility has been confirmed by some real experiments, for instance by releasing some aerosols from small planes and studying the way in which they fall to Earth. If they were loaded with some virus the results would be horrendous. Neither the second statement is absurd. Our civilization could collapse, leaving many people alive, because of an informatics supervirus that would cause an economic breakdown in a wide region or a pandemia caused by a biological supervirus or a nuclear war in the middle of the century.

I believe that Rees' warning is worthy of consideration: the pass through this century will probably be a difficult proof for humankind. In that eventuality the previous arguments on the world problems and the two cultures would become important. The understanding that there are diverse modes of thought and the renounce to any form of superiority of any one of them is a pressing need. Science will be certainly necessary to handle many extremely difficult problems but we must reject the temptation to use it in an exclusive manner. This is not just an interesting academic subject to debate, not even something necessary to tackle some particular problem however important. It might be a question of survival. Because, as I said before,

many of the most serious problems of mankind will be solved neither without science nor only with science.

¹ C. P. Snow, *Las dos culturas*, Alianza, Madrid, 1987.

² G. Holton, "The thematic imagination in science", en *Science and culture*, editado por G. Holton, p 88, Beacon Press, Boston, 1967.

³ L. F. Haber, *The poisonous cloud*, Oxford University Press, 1986.

⁴ A. F. Rañada, *Los muchos rostros de la ciencia*, Ediciones Nobel, Oviedo, 1996, chapters 1 and 7; 2nd edition: Fondo de Cultura Económica, Mexico, 2003.

⁵ G. Vattimo *et al.*, *El fin de la modernidad*, Gedisa, Barcelona, 1986; A. Finkielkraut, *La derrota del pensamiento*, Anagrama, Barcelona, 1987; G. Vattimo *et al.*, *En torno a la posmodernidad*, Anthropos, Barcelona, 1990.

⁶ A. Pickering, *Constructing quarks. A sociological History of Particle Physicsts*, Chicago: University of Chicago Press, 1984.

⁷ E. Husserl, *Die Crisis der Europäischen Wissenschaften und die Transzendente Phänomenologie*, Martinus Nijhoff Publishers B. V., Den Haag, 1976.

⁸ M. Kundera, "La desacreditada herencia de Cervantes" (The discredited legacy of Cervantes), in the book *El arte de la novela*, Tusquets, Barcelona, 1987.

⁹ S. Weinberg, *Dreams of a final theory*, Random House, London, 1993; Spanish edition: Drakontos, Madrid 1995.

¹⁰ Ph Anderson, *More is different*, Science, **177**, 393, 1972.

¹¹ P. Atkins, *Will science ever fail?*, *New Scientist*, 8 august 1992, p. 32.

¹² M. Rees, *Our final Century. Will the human race survive the Twenty-first Century?*, William Heineman, London, 2003; Spanish edition. Drakontos, Madrid, 2004.