

Science and technology, whose is the primacy for?

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World Journal of Advanced Research and Reviews, 2023, 17(01), 189–195

Publication history: Received on 24 November 2022; revised on 05 January 2023; accepted on 07 January 2023

Article DOI: <https://doi.org/10.30574/wjarr.2023.17.1.1476>

Abstract

The many years of epistemological discussion involving scientific culture, in the search for the primary role to be assigned to technology or science, has not yet reached a definitive synthesis.

In the present technological era, marked by the continuous flourishing and converging of knowledge from one discipline into the other, this distinction has little meaning, if anything, it is a matter of assigning to both the fundamental role that together can and must fulfill for the man who is, or should be, both the creator and the sole beneficiary.

In this article we briefly are going to review the prerogatives assigned by scientists and philosophers to the two activities over the centuries, finally arriving at the proposal to transfer the achievements of science and technology from utilitarian use to the exclusive benefit of industry, social use for the fundamental benefit of man.

Keywords: Science; Technology; War industry; Technoscience

1. Introduction

In this article we are going to try to define science and technology and to assign them the role they must play in social development.

Science is the complex of theoretical knowledge acquired through speculation and reasoning layered and handed down over centuries by the human tradition, and assume value and perform the task of producing progress when confirmed by experimental evidence.

Technology is the complex of tools to produce, measure, experiment, diagnose and validate the theories that science proposes and discovers.

Without the experimental confirmation provided by technology, science is deprived of its value and remains a set of postulates that cannot be used for progress.

In any case, what gives value to science and technology and assigns them the role of stimulus to the progress of civilization are the results obtained and the benefits it produces.

Technology produces material benefits and benefits, if used ethically for the well-being of man or to increase information.

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Science produces only theoretical information that translates into benefits through technology.

Technology is the aspect that more than any other qualifies today's society, which is therefore defined as a technologically advanced society and pervades all aspects of social life.

Never before have we been literally submerged by tools with a high technological content, such as mobile phones, computers, televisions, video games, and so on, which have become the viaticum that transversely fills the daily life of all walks of life and of all ages.

In particular, industrial technology is so invasive that it has obscured science, to which it is closely connected and is the other important activity of today's society.

In fact today's science has a predominantly technological connotation, and finds expression in the tools and devices that we use daily, even if we ignore their scientific content that the various researches have made so familiar, so much so that we have become completely addicted and dependent on them.

Science and technology are so intimately interwoven that it is difficult to understand and define their boundaries in different fields of application.

There is no scientific sector in which the use of technological tools is not made and the computer has become the indispensable aid for every research activity.

In the past historical periods the two activities, scientific and technical, were clearly separated and distinct between the different production areas and especially in the skills.

The tools and tools were used in daily activities, to procure food by hunting or for defending and for the transformation of raw materials.

The makers of such instruments did not have particular scientific knowledge, but they were ordinary people who by skill and experience improved the artifacts to facilitate their survival.

While scientists and philosophers of antiquity did not have particular requirements for tools in their speculative activity.

Science began to evolve and progress as the great geniuses of the past Galileo, Leonardo da Vinci, Newton, etc. have become artisans and have invented the tools necessary for their research while assuming the role of technicians and scientists.

This historical epistemological observation should resolve the current debate between scientists and philosophers, whether science or technology is more important for human progress.

To raise the question of the primacy between the two areas of human knowledge, were the physicists that with the revolution of quantum mechanics and modern physics intend to claim the paternity of technology as a daughter and direct derivation of their theories.

In this work we are supporting a different conception, according to which there would be no quantum physics and other sciences without the contribution made to them by technology.

At the same time we raise some criticisms of the alleged cultural dominance of modern physics over other sciences.

2. Who is responsible for the primary role of science and technology?

What we call technique is the set of activities of building tools and means to perform specific functions. The technique is the result of a joint commitment between empirical practice and creative invention, and does not exclude in its baggage "theoretical" knowledge.

However, technology differs from science in that its product is always material and the ultimate goal is always practical and applicative. The distinction between science and technology therefore arises in terms of method and purpose, and is not directly related to knowledge as such.

We define with the term technology the "scientific technique", that is the technique that does not make use of the only empirical practice in the use of devices and tools, but studies and takes advantage of the theoretical insights acquired to invent new solutions and new applications.

In recent decades, science and technology are becoming more and more inextricably linked, and mutually connected to each other as tools and means to progress, so we prefer to talk about "technoscience".

The separation of one from the other, is purely academic, as only on the level of the operating method we are able to make a theoretical distinction.

Historically the technique was born before science, as it uses skills separated from scientific knowledge, and based on empirical acquisitions, therefore it is free to "experiment" alternative technical solutions, providing advantages in the production and processing of raw materials.

There are countless examples of technical achievements in human history, from prehistory to recent times.

Science is born from socio-economic needs or from commercial or military needs, and both in ancient history and in recent times it is mainly applied to industry, and has taken on the characteristics of the consumer society, like any other production system [1].

It therefore follows the logic of the market that generates new fictitious needs to be met, instead of providing answers to real existing needs, presents problems of overproduction, tends to evolve conservatively and not progressively, and is directly dependent on the military industry.

As such, today's science is not a purely cognitive undertaking detached from the rest; Science, technology and technology are so deeply intertwined with each other and with politics and economics that every discourse around them concerns implications of economic interest and dominance over the market.

In the past centuries and even more recently technology has driven by strategic and military needs, and commits resources of organizations and equipment for billions of dollars, for the sole purpose of supremacy on the international scene.

A substantial part of the GDP of different nations is invested in military spending and in the technological modernization of the offensive armamentarium Figure 1.

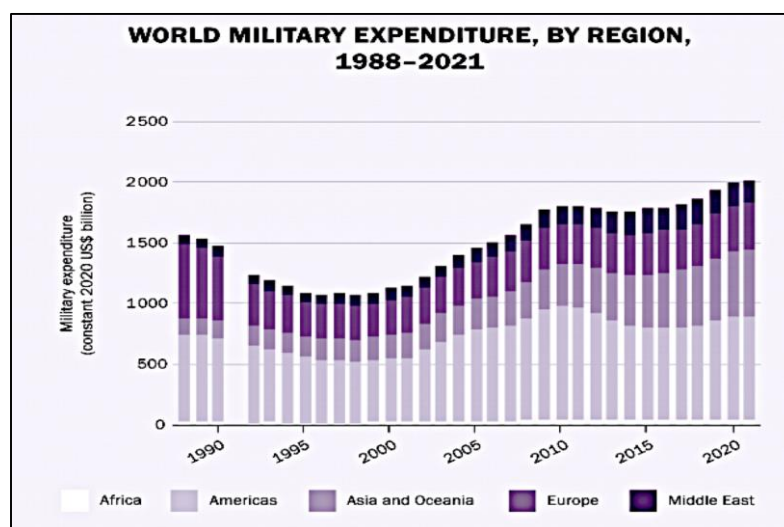


Figure 1 (Stockholm, 25 April 2022) Total global military expenditure increased by 0.7 per cent in real terms in 2021, to reach \$2113 billion. The five largest spenders in 2021 were the United States, China, India, the United Kingdom and Russia, together accounting for 62 per cent of expenditure, according to new data on global military spending published today by the Stockholm International Peace Research Institute (SIPRI)

Such a massive economic commitment is justified demagogically by claiming that the progress made by research in the war industry is directly applied in civil technology.

In order to settle the relative debate between the two activities we examine the relationship between scientist and technical apparatus. The latter responds to the need to expand the scientist's senses allowing him to reveal aspects of reality otherwise imperceptible.

Since ancient Greece there has been debate about the difference between the two concepts, more particularly between *tekhné* and *epistémé* (Aristotle), assigning to the former the meaning of ability and to the latter the meaning of knowledge.

The term technology has assumed in recent times, an intrinsic semantic content of scientific value, because it expresses the technical ability vitalized and enriched by the knowledge acquired through research.

While in past centuries the two concepts were separate and it made sense to give priority to one or the other, nowadays term technology has merged and merged them.

However, a field of science still exists and resists, quantum mechanics, which instead claims the priority of its theoretical bases as the parents of the most advanced technological applications.

In their presumption of scientific supremacy, physicists attribute to quantum mechanics, the role of true and unique science, which incorporates and swallows up all the knowledge of the universe, within their conceptions and abstract mathematical formulas, including achievements that belong to other disciplines, such as biology, chemistry, medicine, and so on.

In this paper we are going to try to bring the terms of the controversy into epistemic logic starting from quantum mechanics.

3. Science and technology through the epistemological approach

The recall of the concepts and theories of quantum mechanics is motivated by the fact that this science affirms in a dogmatic way, and it is the only one among the sciences to assert it, that the most advanced technology, (laser, cellular, magnetic resonance, etc.) is the daughter of its laws. Obviously you cannot claim the same paternity for the previous technology!

The Cultural Revolution produced by quantum physics has dematerialized the real world, reduced it to a complex of mathematical equations and formulas, and transfigured reality into an event only statistically knowable.

According to this science we are immersed in impalpable electromagnetic waves, we are bodies and substance recognizable and definable only quantistically.

The theoretical/animistic spectrum that has permeated this science has carried it in an evanescent empyrean regulated by formulas, matrices and vectors, so that the real world no longer exists if it cannot be represented by equations and diagrams.

According to physics there are two separate dimensions in the conception of the universe, a macroscopic dimension that obeys the laws of classical physics (by Newton) and a microscopic one that follows the rules of quantum mechanics (by Max Planck, Bohr, Maxwell, Einstein, Schrodinger, Heisenberg, etc.) that have not yet reached a unitary synthesis.

And the lack of conceptual unity between the two levels represents the greatest limit of this science, which leaves unresolved the dichotomy between the microscopic and the macroscopic world, without a unifying theoretical synthesis. When we have to interpret with the scientific rigor of physics real-world events, we don't know which of the two dimensions to refer to.

This has led to disconcerting claims by leading quantum physics theorists:

"The more successful the theory is, the more it sounds like nonsense" Albert Einstein [2];

"I think I can say that nobody understands quantum mechanics," Richard Phillips Feynman.

The impossibility of grasping and describing the properties of universal matter by means of our limited perceptual instruments and the inability to reify it in substance palpable and knowable, has led us to sublimate it with signs, symbols and ideograms, which are the only sizes we can handle at will.

This push towards the abstract transposition and transfiguration physically reproducible of the real world, in the concreteness of graphic signs and numerical formulas, is the only means we possess to know it, and despite its limits, is subjected to the irrepressible drive to know him. The origin of science, as a complex of intelligible and communicable rules, is enclosed in this typically human activity.

Science as an activity of human thought is shared, justifiable, unavoidable, but when it assumes the connotations of the most abstract transcendence, must be criticized and subjected to the method of verification and falsifiability of Popperian memory.

Speaking of science more generally, scientific speculation was born with man, it was born at the moment when men took awareness of their being, of the subjective self, as an entity different from the external universe and have begun to question themselves on the meaning of their being, of their existence and of the real world.

If we remove the "cogito ergo sum" from man, what remains of science? The absolute void.

It is incredible to observe what has been told and written by men, scientists and philosophers, on the essence of the real world, on its destiny and on ours, on the why of our existence and that of the universe.

From the origins of philosophical and scientific thought, until men began to observe the real world, infinite theories have succeeded in trying to answer the questions about our origin and that of the universe and the final goal that unites us.

All the answers we have given ourselves are nothing more than the projection of ourselves, of our mental abstractions on the real world, are nothing more than the transcendental reification of our thoughts.

The transfer of our imagination has taken shape and substance in science and philosophy, or rather, in the infinite forms and substances that the history of epistemology and philosophy have told us.

Actually the material universe transcends our human dimension, and it is something completely different from our subjective relativism.

That is why there are as many truths and theories as there are scientists and philosophers who tell them, and if with them they seem to take objective form and substance, in reality they are only phantasmagoric mental elaborations, so that if we abstain from the scientists and philosophers who shaped them, what remains? A corpus of graphic and verbal signs, so many *relata rēfero*, (Herodotus 484 BC- 425 BC, thus illustrates his duties as a historian: «I have the obligation to say what is said, *λέγειν τὰ λεγόμενα* but I have no obligation to believe it»), which have no relevance, with the real world.

The material universe is so immeasurable and complex that we will never know its essence, as we are the imperfect, and still unfinished, evolutionary expression of an infinitesimal amount of its matter.

That said, with regard to science and in particular quantum physics, let us now examine technology and its role in the evolution of science.

4. Role of technology in scientific evolution

The scientific knowledge of nature, obeys the method of the dual level of information acquisition, which provides in the investigation procedure, two alternatives, a primordial, which takes place through the direct approach through the sensory organs that we have, and a second one that uses an indirect approach and involves the use of technological tools.

Ultimately, scientific research and knowledge is focused exclusively on the relationship between man and the rest of the surrounding world, mediated or not by suitable instrumental apparatus.

The reflected response to the sensory stimuli we receive from the environment is aimed at pure survival and adaptation to the environment itself, or it transcends the simple primary response of a conservative type, and tends to explore the sense of our sensory experience and our relationship with the world in the search for the origin and meaning of the events we perceive.

Over the centuries, scientists have been developing tools that amplify the stimuli coming from the surrounding world, and consequently improve the knowledge of nature.

These technological tools are devices interposed between the external world and our senses, which ultimately collect and transmit the information of these apparatuses. In this sense, technology represents the second most complete level of the cognitive process, while our receptor systems allow us a more superficial and immediate level of knowledge.

The epistemological conception of quantum physics, which would subject technology to a subordinate role compared to scientific research, presents an unrealistic approach to the process between observation and knowledge that leads to the acquisition of the real world.

The history of scientific knowledge goes hand in hand, with technological advances, and although technological apparatuses ultimately derive from brilliant intuitions, or from random observations of researchers, however without such tools we would not have been able to acquire and develop new knowledge of the natural world and the universe.

Thus, for example, the researches of Antoni Van Leeuwenhoek, optician and naturalist, led to the invention of the microscope, Galileo with the invention of the telescope opened the way to new cosmological conceptions, while Volta with his battery gave rise to electrical instruments, and so on.

Thanks to the microscope we discovered cells and bacteria, as well as the telescope was fundamental to discover the stars and planets of the universe.

Therefore technology is the indispensable means for scientific progress.

In the interactive circular relationship between science and technology, man occupies a fundamental central position, Figure 2, and is able to give form and substance in transferring the observation of nature from simple empiricism to knowledge encoded in the most advanced know-how.

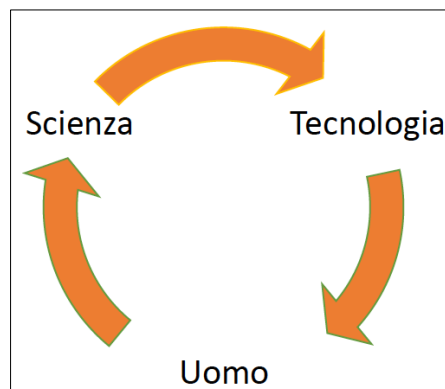


Figure 2 Role of the central man in science and technology

Technological progress comes from man-made instruments and proceeds through continuous testing and verification of the efficiency of the results obtained with them in performing a particular task or overcoming the difficulties of examining the outside world.

Each stage reached by technology enriches progress in the knowledge of the universe.

There are countless examples in all scientific fields of the fundamental contribution of technology to scientific progress.

Despite the important role that technology plays in speculative activity, our knowledge is ultimately the result of the irreplaceable conceptual interpretation and elaboration that we are able to give to the results that technology reveals to us.

Therefore, in examining the interdisciplinary interaction between science and technical achievements, we must not lose sight of the central role of man, because in the end it is man who elaborates and establishes knowledge with his own representation of the material world.

Space engineering, cybernetics, robotics, nanotechnologies, have evolved gradually, empirically, adding step by step, the small innovations that experience and intuitions offered.

While scientific theories and formulas from astronomy to quantum mechanics have remained almost the same since the Copenhagen school to this day.

Then if it were true that technology depends on science, as physicists claim, with the revolution produced by quantum mechanics, we would have had to obtain more advanced technologies since its inception, but it was not so.

5. Conclusion

It is certainly true that technology is born from ingenuity, and that this does not need mathematical formulas and theorems to express themselves, observes, test, learn and modify according to experience, the results it gets in a process of continuous evolution.

And it is equally clear that without technology, science would not have made progress, particularly in recent decades, which was not by chance the technological age.

Although it is true that the search for new technologies responds to the need to look for new research tools under the pressure of theoretical speculation, it is equally true that the results obtainable with technologies are completely unpredictable, and only when they produce new knowledge, then they offer acquisitions and interpretations useful for progress. In this sense, technology is an indispensable tool for scientific investigations, is in effect the necessary intermediate stage to close the circle of scientific progress.

An example for all, Madame Curie, after examining tons of pitchblende, (German name of uraninite ore for its black color and for the appearance and luster of pitch) discovered radioactivity and X-rays, July 1898, providing scientists with a formidable research tool for the examination of molecular and organic structures.

Watson and Crick would never have discovered the structure of DNA, in 1953, without the aid of X-rays, nor would Max Perutz have obtained the structure of Hemoglobin in 1959.

Ultimately, if scientific knowledge exists it is because there is the man who builds it in his image and likeness on the basis of the experiences acquired with or without technology.

Then the age-old question of whether the role of science or technology is more important for human knowledge is resolved by overcoming the artificial theoretical conflict that divides them, and recomposing the close link of the virtuous circle between the two activities, of which man is the sole creator and at the same time beneficiary.

Compliance with ethical standards

Disclosure of conflict of interest

The authors report no conflicts of interest in this work.

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