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SCIENCE: PERCEPTION AND INSTABILITY

CAN THERE BE A SINGLE DESCRIPTION?

PEDRO RUIZ-CASTELL

Science has become the main standard of truth for contemporary societies. But what exactly is scientific knowledge? This article tries to answer the question by critiquing towards the description of science as a single universal model based on a distinctive method of obtaining knowledge. The text addresses the impossibility of defending the existence of an alleged scientific method, highlighting the complexity of scientific activity and its relationship to time-bound social and cultural aspects. Thus, we consider the importance of understanding how scientific knowledge is constructed and legitimised with a number of connections and interactions of various elements that provide a historical form to what we understand by science.

Keywords: science, scientific method, scientific knowledge.

We have all made a distinction, at some point, between sciences and humanities. The idea that these two fields of knowledge are divorced is quite widespread in contemporary culture. According to tradition, the separation started to build up during the nineteenth century with the appearance of new fields and specialities, consolidated within laboratories and university departments. The process was accompanied by the transformation of research into a professional activity and the development of a new industry based on scientific knowledge and its application to economic activity. As a consequence, the progressive separation of science and humanities during the nineteenth century led to growing isolation and distance between both cultures with disastrous effects for contemporary culture (Snow, 1959).

Whether or not we share the perception that there are two distinct cultures, it is true that when we use the word *science* we usually refer to what we know as hard or natural sciences. Those are disciplines like physics, chemistry, mathematics or biology. Undoubtedly, in the collective imagination, a scientist is the professional of those sciences. Conversely, we call «humanists» those devoted to the study of history, philology, sociology or law. It goes without saying that most people think the latter are anything but scientists; in any case, they are often seen as scholars or intellectuals, a perception shared by many people working within humanities.

But to what point is this differentiation real and effective? And if it is, what characteristics define sciences and humanities? We can reformulate the question in the following way: can the knowledge provided by humanities be branded as scientific? Can we say that history, philology, sociology or law are sciences? In other words, does it make sense to talk about human and social sciences?

«WHEN WE USE THE WORD 'SCIENCE' WE USUALLY REFER TO WHAT WE KNOW AS HARD OR NATURAL SCIENCES»

THE WORD

To be able to answer these questions, we must first ask ourselves what we understand as science. Coming from the Latin form *scientia*, the Spanish word *ciencia* appeared at the beginning of the seventeenth century in the first Spanish monolingual dictionary and related to the ability to understand things given their causes or principles (Covarrubias, 1611). In this sense, in texts of the time it is not strange to read expressions such as *ciencias humanas* (human sciences, Fonseca, 1622), as they were framed in a philosophical tradition – or knowledge system – that would survive into

the Modern Era, mainly in universities. However, its meaning would change over the years.

In a wide sense, the term *ciencia* encompassed acquired knowledge or that which is able to create new knowledge. Nonetheless, there were many forms of knowledge. Which one could be safely believed? What characteristics must exist for a certain type of knowledge to be considered scientific and, therefore, real and truthful? Authors such as Francis Bacon (1561-1626), René Descartes (1596-1650) or Immanuel Kant (1724-1804) tried to offer, in different historical eras, a general characterisation of what science should be. We may understand this interest in building a logically articulated system of knowledge extraction, regulated by institutions and publications exerting an adequate control, as part of the quest for autonomy to which natural philosophers, who started being called scientists in the nineteenth century, aspire. In this way, legitimised by academic and university institutions, science was identified during the eighteen hundreds with pure knowledge created, independently from other powers, in separate and supposedly neutral intellectual spaces.

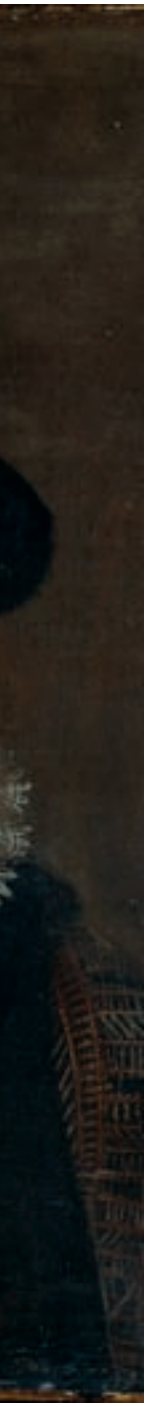
Those who produced that knowledge and were now given the name scientists, far from being held responsible for the misuse of their discoveries, were portrayed as selfless characters exclusively dedicated to cultivating their intellect and obtaining knowledge for the common good. It was, undoubtedly, a biased account the success of which must be understood within the framework of the social, economic and cultural transformation that this type of knowledge fostered and which allowed us, precisely, to understand the different connections that condition the development of scientific activity. Not without reason, science was destined to represent a central role in the development of modern societies and in the transformation of the world, serving the ideals and moral values of western civilisation (because they were able to separate myth from reality and fact from fiction, unlike the rest of cultures).

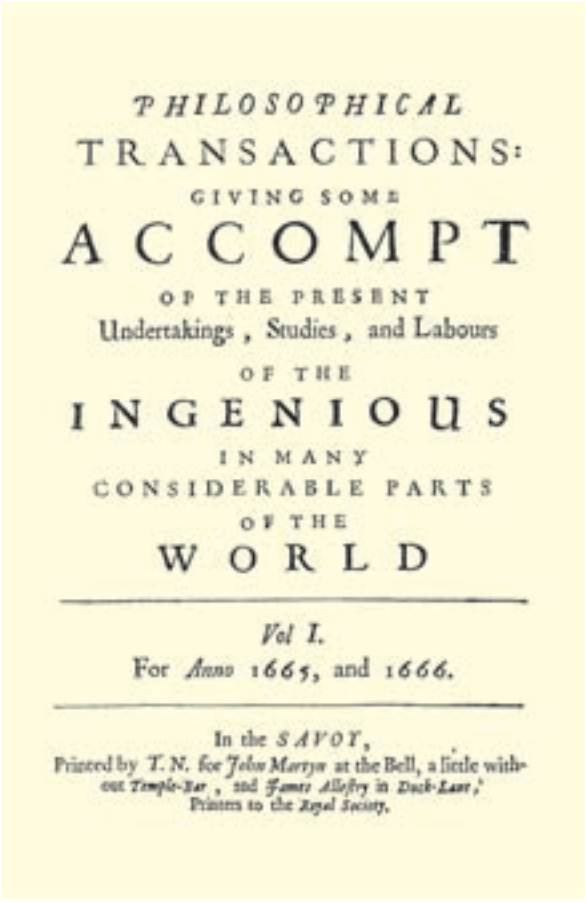
The interest in identifying scientific knowledge in order to distinguish it from other kinds of knowledge – like religious or metaphysical knowledge –, reached its peak in the 1920s and 1930s, with the defence of science by the logical positivists of the Vienna Circle. Science had to selflessly search for the truth and be responsible for the production of objective knowledge, verified by facts. Scientific knowledge had to be universal and independent from the context in which it was formulated. This could only be achieved through the application of a special and distinctive method named the *scientific method*.

Portrait Gallery of Dulwich, London

Authors such as Francis Bacon, René Descartes or Immanuel Kant tried to offer, in different historical moments, a general characterisation of what science should be. Above, portrait of Francis Bacon, circa 1622.

«SCIENCE IS NOT, CONTRARY TO THE COMMON BELIEF, CIRCUMSCRIBED AND STABLE OVER TIME»





PHILOSOPHICAL
TRANSACTIONS:
GIVING SOME
ACCOMPT
OF THE PRESENT
Undertakings, Studies, and Labours
OF THE
INGENIOUS
IN MANY
CONSIDERABLE PARTS
OF THE
WORLD

Vol I.
For Anno 1665, and 1666.

In the SAVOY,
Printed by T. N. for John Martyn at the Bell, a little without Temple-Bar, and James Allestry in Duck-Lane,
Printers to the Royal Society.

Royal Society

We may understand this interest in building a logically articulated system of knowledge extraction, regulated by institutions and publications, as part of the quest for autonomy to which natural philosophers, who started being called scientists in the nineteenth century, aspire. In the picture, cover of the first issue of the journal *Philosophical Transactions*, first edited by the Royal Society in London in 1665.

«THE ACCOUNT OF THE SINGLE AND UNIVERSAL SCIENTIFIC MODEL WAS GREATLY INFLUENCED BY THE SUCCESS OF CONTEMPORARY PHYSICS IN THE NINETEENTH AND TWENTIETH CENTURIES»

THE PROBLEM WITH METHOD

The astounding success of disciplines such as physics in the nineteenth and twentieth centuries made many fields of study want to be characterised as «scientific», in an attempt to get recognition for the strength of their methods and how fruitful their results were. Unsurprisingly, during the twentieth century science became the main standard for truth, capable of determining what is real and what is fiction. To this end, it was necessary for those fields to formulate and apply what was known as the scientific method. But, what was the method about?

As mentioned above, the common vision of science maintains that scientific knowledge directly stems from facts. Science – the positivists say – produces true knowledge from objective facts that are revealed to thorough and unprejudiced observers directly through their senses. There are two aspects we must take into account in connection to this, however: the nature of facts and how scientific knowledge stems from it.

It is true that facts alone do not mean much. What really constitutes a novelty and contributes to the development of science is the formulation of observational statements. But the formulation of such statements requires a conceptual framework that is conditioned by our education, our knowledge and our expectations. The perception of the same fact can change from one person to another depending on the conceptual frame and the theoretical background in which the experience must be necessarily situated. Without a doubt, it is easier to observe and discern something when we know what we are looking for and how to interpret it. In this sense, observation cannot be said to guarantee the extraction of immutable truth. Observational statements are verifiable and revisable, as the history of science shows. There are lots of examples showing how what was accepted for hundreds of years as observable facts sustained by evidence – like the Earth's immobility or Newton's mechanics –, has later been considered wrong (Chalmers, 1976).

There are some who defend that it is really the experiment – rather than mere observation – that is necessary in order to obtain relevant facts with which to get the reliable foundation with characterises scientific knowledge and, thus, correctly describe the processes of nature. But this demand does not solve the essential problem: establishing these experimental results can be wrong if the knowledge sustaining them – both theoretical and practical – is deficient or inadequate. Experimental results are also fallible and

revisable and their meaning can change depending on the function of the theoretical framework in which they are formulated. Certainly, the human mental abilities from which these results are obtained is closely adapted to the cultures in which they operate.

Therefore, we cannot say that the true knowledge that allegedly stems from science derives from fact to experience, despite the fact that they have been acquired through observation and experimentation. This «naïve inductivism», as some authors call it, shows important inconsistencies coming from the subjectivity of the observation and the possibility of obtaining false conclusions from inductive inference based on true premises, as some authors have highlighted (Russell, 1959). Even when we suppose that the scientific method may function starting with statements from speculative and provisional theories, verified through observation and experimentation, the truth is we can never conclusively claim that a theory is valid. In any case it will be the best available, that is, the most suitable for the tests to which it is subjected, because theories are fallible and can be improved or substituted (Popper, 1959).

Moreover, the history of science is full of examples that allow us to see how the process of reasoning, observation and experimentation evolves historically. We know that the methods used by researchers are subjected to transformations and that scientists have been able to change their own rules. In other words, the regulating principles of science have changed over time. And as much as we can identify historical rules in scientific practice that were only accepted in a particular moment, we cannot claim there is a universal scientific method.

In short, the verification that scientific theories cannot be proven conclusively denies the existence of a distinctive and characteristic method for science. This made some authors give up the idea that science is a special rational activity, different from those of other forms of obtaining knowledge, as some modern authors and sociologists indicate, inspired by what is known as epistemological anarchism (Feyerabend, 1975).

WHAT IS SCIENCE?

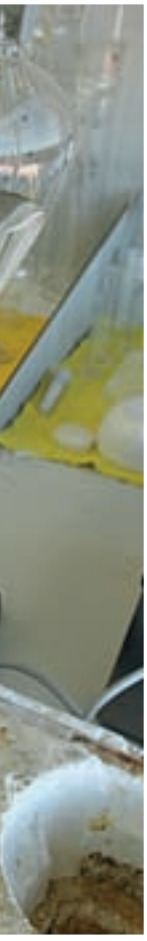
The account of the single and universal scientific model, founded on a distinctive method for obtaining knowledge, was greatly influenced by the success of contemporary physics in the nineteenth and twentieth centuries. However, as we have already seen, this paradigm of what science should be is not sustainable if we go deep into the functioning of some of the most established scientific disciplines.

Miguel Lorenzo

Scientific knowledge is not directly extracted or distilled from nature to be then applied to technical and social ends. It is rather «constructed» from observation and experimentation, turning the obtained information into something intelligible, interesting and useful. We can never, therefore, see scientific activity isolated from its context.

«THE PERCEPTION OF THE SAME FACT CAN CHANGE FROM ONE PERSON TO ANOTHER DEPENDING ON THE CONCEPTUAL FRAME AND THE THEORETICAL BACKGROUND IN WHICH THE EXPERIENCE MUST BE NECESSARILY SITUATED»

Anna Mateu



Scientists themselves know that the methods for the resolution of questions addressed by different fields of study are different in form and number. If we pay attention, for instance, to experiment reproducibility – an aspect understood by many as fundamental to establish scientific fact and obtain the consensus that provides stability to scientific knowledge –, we would realise that its role is not so decisive. Sure enough, there are scientific disciplines such as cosmology where this is of no importance. Similarly, people, societies and ecological systems are not inanimate objects and cannot be manipulated as physical objects are. Simply put, not all scientific disciplines work the same way. That is why some authors prefer referring to «sciences», instead of «science», when they speak about methodology and the production of trustworthy knowledge about the real world.

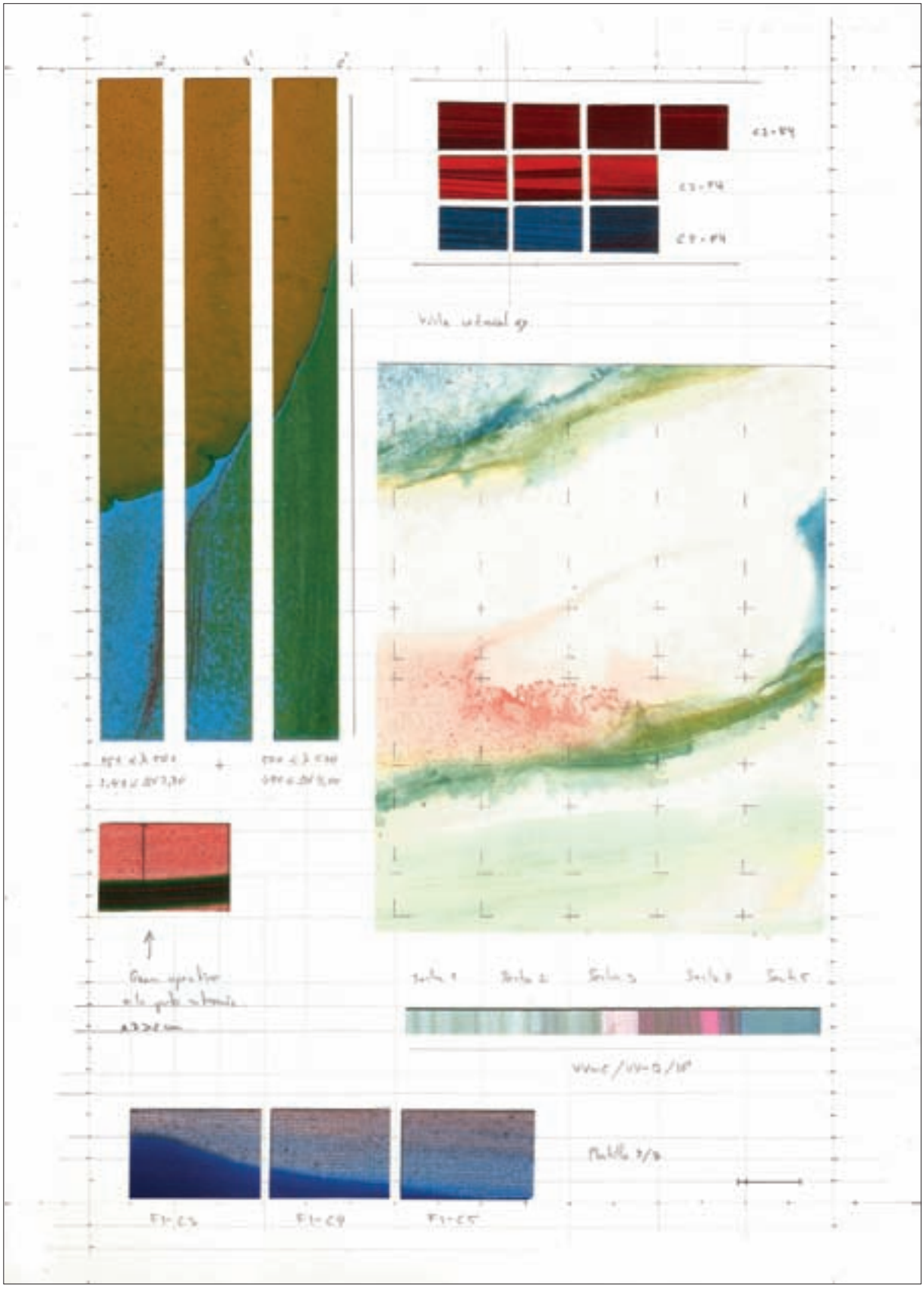
«SOME THINKERS AND SCIENTISTS BELIEVE THAT THE RELATIVISM AND THE SOCIOLOGICAL CONSTRUCTIVISM DEVELOPED IN THE LATE DECADES OF THE TWENTIETH CENTURY EXAGGERATE UNCERTAINTY WITHIN SCIENTIFIC ACTIVITY»

Some authors such as Dominique Pestre (in the picture) chose to use new categories to describe the complex process that is science. Hence the characterisation of the history of science as a string of «knowledge regimes» articulated on «social modes of existence» or certain ways of social commitment, production practices and political management.

Besides, as mentioned before, fact perception presents a marked social and cultural component, since it is conditioned by elements such as previous knowledge and expectations. Scientific knowledge is not directly extracted or distilled from nature to be then applied to technical and social ends. It is rather «invented» and «constructed» from observation and experimentation, turning the obtained information into something intelligible, interesting and useful. We can never, therefore, see scientific activity isolated from its context, since it includes not only intellectual and technical dimensions, but also cognitive, institutional, social, political and other dimensions. The results obtained by scientists can offer information both about nature and about culture. Therefore, scientific investigation must be conceived as a complex network of practical activities that act on the natural world and not as the mere formation of a group of theoretical propositions verified via the simple observation of the world.

The influence of social aspects in the development of scientific activity is also accepted by most authors, and is evidenced by studying the social organisation of science or the development of some scientific policy. There are also a lot of concepts and techniques with a social origin used in scientific disciplines, as proved in Thomas Malthus' work (1766-1834) on the development of the Darwinian idea of natural selection. Hence, we can claim that all scientific practice has a clear social nature. Consequently, science emerges from a series of connections that involve different aspects and are articulated differently in each historical era, including knowledge results, instrumental and discursive practices, values and rules, institutional and organisational realities, political and social mores, economic and legal scenarios, etc. Science is not, contrary to the common belief, circumscribed and stable over time.

In this sense, some authors chose to use new categories in order to describe this complex process. Hence the characterisation of the history of science as a string of «knowledge regimes» articulated on «social modes of existence» or certain ways of social commitment, production practices and political management (Pestre, 2005). In this way we would be able to consider both the interdependence of different



Nico Munuera. *Intuitive Colour Knowledge VI*, 2014. Collage in mixed technique on paper, 21×30 cm.

aspects that affect the development of «sciences», and the transformations that, over history, have allowed for the regulation and legitimation of what was considered at a particular moment good scientific practice – a fact revealing multiple logics with their own temporary nature.

From this perspective, scientific knowledge also covers elements that are often built in a routine way and at a local scale, without depending on particularly great or excessively rational methods. This vision provides a much richer, complex and suggestive perspective about scientific activity, highlighting the persuasion and credibility work of scientists in organised spaces where such knowledge is formalised and spread. That is why science historians are interested not only in the development of ideas and arguments and in the techniques and tools designed to research nature, but also in the ways of representing and communicating the results and the institutional strategies to promote science.

EPILOGUE

Not every author is completely convinced of the virtue in unmasking science's aura of objectivity and truth. Some thinkers and scientists believe that the relativism and the sociological constructivism developed in the late decades of the twentieth century exaggerate uncertainty within scientific activity, favouring radical scepticism towards science arising from a false and harmful stereotype. It is, perhaps, a rather extreme perception aimed at maintaining the epistemological status acquired by scientific knowledge during the last centuries.

However, it does not seem ridiculous to think that something exists that distinguishes sciences from other types of knowledge such as religious or mystical knowledge. The problem is that, despite the impossibility of accepting the existence of a universal scientific method and the difficulty in answering the question of what science is – as crudely evidenced when exploring in detail the way different scientific disciplines answer their questions –, we have no inconvenient in identifying, however ambiguously or imprecisely, the existence of something called «science» (Chalmers, 1976; Ziman, 2003).

Thus, what would best characterise the sciences is their attempt to establish generalisations or models to explain in a rational, agreed upon way what happens in nature in relation to human beings. Even though, regarding what has been discussed here, the demand for certainty is unrealistic, we can at least argue that scientific generalisations – that is, the formulation of laws and theories – allow us to expand and improve our knowledge, without being justified beforehand or imposed due to value judgements or individual criteria. For some authors, these statements are enough to fight the most extreme scepticism and relativism, providing a substitute for the universal method that would define science and we have rejected.

«SCIENTIFIC ACTIVITY INVOLVES A MULTITUDE OF METHODS AND TECHNIQUES. AND IN MOST CASES, BOTH LOGIC AND IMAGINATION ARE USUALLY COMBINED»

However, what is really interesting is the way this scientific knowledge is constructed and legitimised starting with a series of connections and interactions between different elements. Scientific activity involves a multitude of methods and techniques. And in most cases, both logic and imagination are usually combined in order to deduce processes from certain structures or behaviours. The «hard» sciences share this methodology with the «humanities», which are not alien to what has been explained here and which, therefore, are also capable of generating scientific knowledge. The key lies in understanding how, in any of these fields of representation of reality, imagination is limited and disciplined by a series of rules and values that can, no doubt, change over time, giving a historical context – i.e., variable over time – to everything we understand as science.

REFERENCES

Chalmers, A. F., 1976. *What Is This Thing Called Science?* University of Queensland Press. St. Lucia, Queensland.
Covarrubias, S., 1611. *El tesoro de la lengua castellana o española*. Luis Sánchez. Madrid.
Feyerabend, P., 1975. *Contra el método. Esquema de una teoría anarquista del conocimiento*. Ariel. Barcelona.
Fonseca, C., 1622. *Quarta parte de la Vida de Christo*. Luis Sanchez. Madrid.
Pestre, D., 2005. *Ciencia, dinero y política*. Nueva Visión. Buenos Aires.
Popper, K. R., 1959. *The Logic of Scientific Discovery*. Hutchinson. London.
Russell, B., 1959. *The Problems of Philosophy*. Oxford University Press. New York.
Snow, C. P., 1959. *The Two Cultures*. Cambridge University Press. London.
Ziman, J., 2003. *¿Qué es la ciencia?* Cambridge University Press. Madrid.

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