

Una scienza modesta al centro della scienza moderna. La riflessione di un educatore*

*A modest science at the heart of modern science.
The Reflection of an educator*

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L'articolo, a partire da motivazioni pedagogiche, presenta una riflessione sull'idea di scienza moderna ed introduce il concetto di scienza modesta. Prendendo ispirazione da un saggio del sinologo Nathan Sivin, l'autore discute la possibilità che l'attributo 'modesto', da Sivin associato all'universalità dell'aspetto strettamente tecnico della conoscenza scientifica, possa rivelarsi appropriato a mettere in luce le limitazioni deliberatamente normative di quel nuovo modo di studiare la natura introdotto, tra il XVI ed il XVII secolo, da un gruppo di scienziati dei quali Galilei e Newton sono i rappresentanti più noti. Ciò permette di distinguere, all'interno della scienza moderna, un nucleo con modeste ambizioni cognitive – ma di notevole impatto concettuale e morale – dai suoi tanti altri aspetti epistemici e socioculturali. L'autore mostra come l'esistenza stessa di tale nucleo sia non solo non-banale ma significativa, in quanto richiede la scelta di una specifica gerarchia di valori riguardo alla conoscenza della natura avente la verità empirica e quella logica al vertice. Viene inoltre discussa la rilevanza del concetto di scienza modesta per sbrogliare problemi complessi come, ad esempio, quelli derivanti da questioni socio-scientifiche o di rapporto tra scienza e religione.

The article presents a pedagogically motivated reflection on the idea of modern science and it introduces the concept of modest science. Inspired by an essay by sinologist Nathan Sivin, the author discusses whether the adjective 'modest', which Sivin disparagingly applies to the universality of the strictly technical realm of scientific knowledge, could be appropriate to highlight the deliberate normative limitations of that new way of studying nature introduced by a group of 16th and 17th century scientists, of whom Galilei and Newton are the most famous representatives, and thus to distinguish a cognitively non-ambitious, but highly consequential, core of modern science from its many other epistemic and socio-cultural aspects. The author

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shows how the existence of such a modest core is not only non-trivial but significant, because it requires the choice of a specific hierarchy of values for the acquisition of knowledge of nature, with empirical and logical truth at the top. Finally, the relevance of the concept of modest science for disentangling complex problems as, for example, socio-scientific problems and science-religion issues is discussed.

Keywords: Scienza, Valori, Filosofia della Scienza, Scienza e Società.

Introduction

By teaching I learn more than my students. In the course I teach, students are required to read and reflect on excerpts from texts that address, deeply and critically, fundamental issues in all aspects of human life. By analysing, reflecting on, and discussing such texts, we hope that each student will form or re-form their own better justified, more coherent, or more articulated views on those issues. As teachers we go through the same process.

The first few times that I read the influential essay by N. Sivin, *Why the Scientific Revolution Did Not Take Place in China - or Didn't It?*, I dismissed as an unintelligent hyperbole the author's statement that, if universality or internationality of modern science refers only to «the narrow, rigorous technical realm of scientific cognition alone, they [i.e. universality and internationality - Ed.] constitute a modest claim» (Sivin, 9). It not only seemed to go against historical evidence, but to also contradict various other considerations in the same essay. Compelled to reflect further on the text, if only to better present it to students and to more effectively aid their learning process, I recently reconsidered my impulsive judgement towards Sivin's statement, I recognized the arguments that make it sensible and, unexpectedly, I gained a new insight on a subset of science that I now like to call modest science.

On the concept of modern science

Since the beginning of my university studies in physics, I have been continuously asking myself: what is the essence of the work of a modern scientist? What is its fundamental purpose? Is it self-satisfaction? (Poincaré, 22; Rabi, 1218-1222) And, if so, is it more an aesthetic one (Poincaré, 22; Chandrasekhar) or more the satisfaction that comes from an increased ability to manipulate the world around us (Poincaré, 23)? Is it practical usefulness for the individual and for the community? Such questions were not purely academic. As a person committed to lead a moral life, I wanted

to understand what role my love for science played for my morality. Pure personal satisfaction, no matter whether of the aesthetic type or due to the increased sense of power that comes from greater knowledge, did not seem enough to fulfil my aspirations. Utility, on the other hand, particularly for other fellow human beings, did not appear to easily justify much of the work carried out in theoretical physics, then my main field of work, given its often distant relation with applications.

I gradually started to realise that, though personal satisfaction and utility are legitimate aspects of the scientific endeavour, what is foundational of the modern scientific practice is the fact that scientists submit their hypotheses, theories, or results to the test of empirical observations which can, in principle, be performed by anyone with enough will and resources. No matter how clever, elegant, enlightened, a scientific idea appears, if it clashes with what is observed by us and by others, an intellectually honest scientist must recognise its fallacy¹ (Gellner, 109; Preti, 186). My realisation may appear trivial. Nevertheless it led me to a first glimpse of a moral aspect intrinsic to modern science: the choice of valuing what others observe as much as what we ourselves observe, and the acceptance of empirical truth even against personal wishes or preferences.

Throughout the years and through further studies, I learned that the change from previous forms of science to modern science can be understood as a change in the hierarchy of values related to our study of nature: from the primacy of the established authority, e.g. the tradition, the opinion of the majority, etc., to the primacy of empirical and logical truth (Preti, 170-173).

In this regard, Galilei wrote: «I think that in discussions of physical problems we ought to begin not from the authority of scriptural passages but from sense experiences and necessary demonstrations» (Letter to the Grand Duchess). Such a new hierarchy of values can also be found implicit in Newton's famous words:

For whatever is not deduced from the phenomena must be called a hypothesis; and hypotheses, whether metaphysical or physical, or based on occult qualities, or mechanical, have no place in experimental philosophy (Newton, 506-507).

Aside from Newton's peculiar position with regard to physical hypotheses², he is clearly implying that, in experimental philosophy, empirical observation has the highest importance. Sivin himself, citing Ernest Gellner, recognises the crucial role of such a shift in epistemic values:

[...] the European Scientific Revolution is more than a leap to a new form of knowing. It is natural to assume that in science the crucial test has always been “is it true?” But earlier that was only one of several equally important questions: Is it beautiful? Is it conventional? Is it morally improving? Does it lead to perception of the Good? Does it conform to certain esthetic patterns that all truth must, as astronomers up to Kepler believed that celestial orbits must be compounded of perfect circular motions? In science the test of truth has displaced most of these and redefined the others. This demand for truth above all was an appeal to fact-fact that was in principle public, verifiable, morally neutral, that did not change with the social circumstances of the observer, that was immune from interference by magician, or god, or human need (Sivin, 16).

And also:

But the new science did more than appeal to facts. It created facts of that kind for the first time, knowledge that had no value except truth value. That is an awesomely original creation. It took place in Europe between the time of Copernicus and Laplace and has spread across the world since. The same leap was not taken in seventeenth-century China. People there considered the idea of objective knowledge without wisdom, without moral or esthetic significance, grotesque (Sivin, 16).

Given the above, how – I wondered – can the same author consider the universality or internationality of «the narrow, rigorous technical realm of scientific cognition alone» a modest claim with regard to modern science? (Sivin, 9). I could only understand his statement as an inappropriate hyperbole aimed at a greater rhetorical impact.

At any relevant occasion – seminars, conferences, teachers’ meetings, lessons – I had regularly objected to the ambiguous use of the term ‘modern science’ as referring sometimes to contemporary scientific practices (Engelmann, 3-15), sometimes to the whole set of scientific attitudes and developments associated to the broad concept of modernity (Snyder), and sometimes to the body of theories and empirical knowledge developed through experimental investigations (Stichweh). I had also frequently objected to those arguments that stress the great variety of styles and ideas present throughout the history of modern science without mentioning its fundamental normative aspect, namely the requirement of testable hypotheses, which allows scientists to be influenced by their personal sensibilities without compromising the objectivity of the scientific results³ (Díez). And I still take particular issue with the weird idea that Popper’s falsificationist

account (2002) of modern science is too reductive because Kuhn (2012) has shown the importance of paradigm change in the history of science, as if the two arguments were alternative (Radnitzky).

Through further reflection, stimulated also by my students' essays on related topics, I realised that, perhaps, it was exactly my too narrow falsificationist conception of modern science that was preventing me from understanding the reasons of Sivin's statement. My understanding of what constitutes the novelty of that new way of studying nature brought about by the works, reflections, and proposals of F. Bacon, Galilei, Newton, and various other thinkers between the 16th and 18th centuries, was not wrong. But I had arbitrarily decided that the term 'modern science' should *only* refer to *that* new way of studying nature defined by the requirement of testable hypotheses and, consequently, by the distinction between physics and metaphysics. As a matter of fact, the term 'modern' has a broad semantic field (Snyder; Baudrillard; Toulmin) and it is thus legitimate for Sivin, as well as for anyone else, to use 'modern science' with reference to a much wider and more loosely defined cultural phenomenon. If the focus of the discussion is universality or internationality of that cultural phenomenon, then, I understand, it is not unreasonable to evaluate as a "modest claim" the assertion that anyone, in principle, can test the empirical validity of a modern science hypothesis. After all, even though, in principle, anyone can do it, there are many cultural groups⁴ and a large part of the world population who reject or simply neglect the requirements of «the rigorous technical realm of scientific cognition» (Sivin, 9).

At the same time, I also realised that the adjective 'modest' might be exactly fitting to describe that more specific type of science, defined by the requirement of testable hypotheses and the related distinction of physical theories from metaphysical ones, to which I attach special importance. When presenting my conception of the new way of studying nature I shall now avoid the term 'modern science' and I shall, instead, speak of *modest science*.

Modest science

What I call modest science is modest because its deliberate prescriptive limitations prevent it from claiming any absolute truth about nature⁵, and from indicating the things that we should consider important in life. It is a science that has "no value except truth value" (Sivin, 16). Moreover, the truth that it provides is mostly a negative truth: the falsity of a specific general hypotheses.

Defining aspects of modest science

On the above premises, I am able to formulate the following defining aspects of modest science:

- it implicitly assumes the existence of some basic regularity in nature;
 - such an assumption is necessary not only to justify the use of the term ‘science’, in contrast with a pure record of observations (Poincaré, 17), but, more importantly, to justify the foundational assumption that it is possible, for different observers, to find some recurring correspondence between what is observed by one and what is observed by another. Assuming that such a correspondence exists is not an arbitrary belief, but the consequence of a choice of value: the preference for a shared, inter-subjective, knowledge, instead of the acceptance of an irreducibly private knowledge;
 - the use of induction to generalise from observations is not only allowed, but it is considered the most rational choice among the available options⁶;
- it addresses only empirically testable hypotheses;
 - it only aims at recording and analysing what has been observed so far;
 - its body of knowledge consists only of observational records and of propositions that can be deduced from those records. Examples of such propositions are:
 - “Hypothesis A, with its related assumptions, is not logically incompatible with the current body of observations”;
 - “Hypothesis B, with its related assumptions, is logically incompatible with the current body of observations”;
 - general hypotheses can be part of modest science, as long as they are empirically testable.

Implications

Though modest, such a science is neither trivial nor insignificant. It is non-trivial because, as Sivin himself pointed out, its adoption or even tolerance by individuals or groups cannot be taken for granted: «People there considered the idea of objective knowledge without wisdom, without moral or esthetic significance, grotesque» (Sivin, 16). Such a rejection was also common in Europe, at least until the 18th century, and most Renaissance scientists were no exception in this regard (Butterfield, 34-36, 79). Presently too, many people do not see a value in modest science, compared to forms of seemingly more enlightened knowledge represented by any theory that directly includes ontological or axiological accounts of the world. It is not insignificant because identifying and distinguishing modest scien-

ce out of the broader concept of modern science (1) sheds light on the inter-subjective aspects and the choice of values at the foundations of modern science, (2) can reduce controversies in scientific debates by rendering explicit their hidden metaphysical assumptions and by distinguishing them from the *modest* pieces of logical and empirical knowledge, (3) can help to analyse and better address science-society issues, as a consequence of the previous point, and (4) can help to develop a more rational and thus sensible interaction between scientific knowledge and our value judgements and choices.

I have already pointed out the reasons for the inter-subjectivity and the hierarchy of values at the basis of modest science, which, in turn, is at the core of modern science, regardless of whether it completely defines it or it only constitutes one of its defining aspects.

The way it can reduce controversies in certain scientific debates is by reminding scientists that metaphysical assumptions, or otherwise non-falsifiable statements, are not part of modest science, even though some may argue that they are part of a broader scientific pursuit of truth. This is why Sivin can state that «science and religion have long since learned to co-exist» (Sivin, 8): whether a physical system can be conscious or not (Block; Chalmers; Melloni), as well as the question of whether we have real free will (Libet), can perhaps be considered legitimate scientific questions, but they do not belong to modest science; the existence of an infinite number of parallel universes (Everett), that seems to provide a more elegant interpretation of quantum mechanics, is not a modest science assumption; whether there is a purpose in evolutionary processes (Walsh) or not is not a modest science question.

For the same reason, modest science allows for alternative views of the world, and of the human being, no matter whether dualistic, or monistic, or of a more sophisticated type (Naturalistic Dualism). And Sivin's suggestion that modern science should get rid of European peculiarities (Sivin, 8), such as the distinction between mind and body, appears unwarranted. What need is there for modern science to get rid of something that is allowed by modest science? Old and new ideas, traditional Chinese theories of nature, *European patterns of thought* – using Sivin's own terminology – are equally legitimate in modern science as long as they do not clash with modest science.

Recognising the presence of modest science at the core of modern science helps us to examine and remove the mystery out of certain fascinating suggestions, such as that «science cannot take on consciousness without a significant change in methodology, a change that would enable scientists to identify and analyze the elements of subjective experience» (Kandel, 132).

Modest science requires empirical observations, while consciousness is not empirically observable. Could that *significant change in methodology* get rid of empirical observations? In that case, it would be an additional type of *non-experimental philosophy*⁷ and, thus, probably not *inter-subjective*⁸ knowledge. If, instead, empirical observations were to remain a requirement, then we would still not know how to test the hypothesized elements of subjective experience (Kandel, 132).

At the same time, the coexistence of modest science with any religious belief or any culture is not automatic and not always possible because the primacy of logical reasoning and empirical truth in «discussions of physical problems» (Letter to the Grand Duchess) may, and sometimes does, clash with certain hierarchies of values. This happens not only when empirically derived knowledge clashes with beliefs based on the authority of tradition, religious or otherwise, but also when it would imply a change of values. Though, as is well known, factual knowledge alone cannot directly imply normative statements, once fundamental values or aims have been established, then empirical knowledge and logic can imply the means, i.e. the derived values, that should be adopted to reach those aims or uphold those fundamental values. The values derived through the application of modest science may clash with some of the values of the tradition, the community, or the authority in general.

Conclusion

In my pedagogical effort to help students to identify the defining aspects of modern science out of a relatively foggy picture, I had perhaps sacrificed too much some important aspects of such a complex cultural and historical phenomenon. I had originally dismissed as unreasonable Sivin's judgment that the universality of «the rigorous technical realm of scientific cognition alone» (16) is a modest claim. From a socio-historical perspective he may well be right. At the same time, his words invited me to ask whether “modest” could be a suitable attribute for that «rigorous technical realm of cognition» itself, not only for the universality claim. And I realized that not only it is indeed fitting to describe the deliberately limited scope of the empirically falsifiable science, but also that the provocative term “modest science” could have a pedagogical usefulness. Rather than insisting on a specific definition of modern science, I now think it is more useful to ask students to reflect on the role of *modest science* both within the broader modern science and in their personal and social life.

It may seem simply a play with words, but my hope is that giving a fitting and memorable name to the subset of modern science defined by the requirements of logical consistency and empirical testability allows me and the students to freely reflect on the many social, historical and cultural aspects of what we now commonly call “science” without the risk of missing the essential reflection on its modest but highly consequential foundations.

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¹ The way Galilei presents such a position can hardly be more emphatic: «We must also take heed, in handling the doctrine of Moses, that we altogether avoid saying positively and confidently anything which contradicts manifest experiences and the reasoning of philosophy or the other sciences. For since every truth is in agreement with all other truth, the truth of Holy Writ cannot be contrary to the solid reasons and experiences of human knowledge» (Letter to the Grand Duchess).

² Newton seems to be so concerned about some of his contemporaries habit of considering purely speculative hypotheses as respectable as those that are supported by a large amount of empirical observations as not realizing that his own propositions «rendered general by induction» (Newton, 507) are technically hypotheses.

³ See, for example, Poincaré's discussion on the role and legitimacy of the subjective sense of beauty as well as usefulness in the process of scientific discovery and the fact that, ultimately, even the hypotheses that arise from special inspirations need to be tested against logic and empirical observation (15-24).

⁴ As Sivin himself suggests (16-17), it is enough to think of cultural groups for which esthetic criteria, moral principles, social conventions, authority are not subordinate to logic and empirical observation in matters of truth.

⁵ This is explicitly stated by Galilei: «Either we want to penetrate the true and intrinsic essence of natural substances through speculation, or we want to content ourselves with some general knowledge of their effects. Trying for the essence is, according to me, not less impossible and – as far as our effort is concerned – not less vain when it is directed towards the elemental substances as for those which are most remote and celestial» (Lettera a Marco Velseri).

⁶ A very enlightening justification of induction is provided by Reichenbach (348-404). His basic insight is that «Hume believed that a justification of induction could not be given because *we do not know whether we shall have success* [in predicting future events - Ed.]; the correct formulation, instead, would read that a justification of induction cannot be given if *we knew that we should have no success*. We are not in the latter situation but in the former; the question of success is for us indeterminate, and we may therefore at least dare a wager» (362).

⁷ *Experimental philosophy* is one of the terms used by Newton (506-507) to refer to the subset of natural philosophy that is limited by empirical testability.

⁸ Preti insightfully considers empirical truth as inter-subjective because it refers to facts that are outside and between the subjects (168).