BORNH **Bulletin of Regional Natural History**

Formerly **Bollettino della Societá dei Naturalisti in Napoli**

Husserl and Galileo Notes on '*The Crisis of European Sciences*'

Daniele Piomelli

DOI https://doi.org/10.6093/2724-4393/12912

***Correspondence:**
piomelli@hs.uci.edu
https://orcid.org/0000-0002-2983-774X

Affiliation:
Departments of Anatomy and Neurobiology, Biological Chemistry, and Pharmaceutical Sciences
University of California, Irvine
California 92675

Competing interests: The Author declares that he has no competing interests for this work.

Financial Disclosure Statement: the Author declares that no specific funding was received for this work.

Submitted: 1 Sept 2025
Revised: 19 Nov 2025
Accepted: 22 Nov 2025
Published: 5 Dec 2025

Associate Editor:
Antonino Pollio

Abstract

Edmund Husserl's *The Crisis of the European Sciences* (1934–1938) diagnoses modern science as estranged from the concrete world of human experience—the *Lebenswelt*. He identifies Galileo Galilei as the "discovering and concealing genius" whose mathematization of nature produced a science methodologically powerful yet existentially hollow, abstracting from lived experience to deal in idealities. Husserl offers phenomenology as a corrective, restoring subjectivity to the foundations of knowledge. His challenge remains pressing in fields such as neuropsychopharmacology, where subjective states are central but resist quantification. Scientific instruments capture correlates yet miss the lived essence, sometimes distorting method by equating nonpathological drug states with psychosis—a category mistake that treats experience as reducible to measurement. In this essay, I argue that Husserl mischaracterizes Galileo. The basis of modern science lies not in mathematization but rather in Galileo's invention of the experiment as a cycle of imaginative framing, controlled intervention, and theoretical revision. Mathematics reifies, linearizes, and quantifies thoughts that would otherwise remain intuitive and confused. Galileo's pragmatic view of causality—as manipulable conditions rather than metaphysical essences—grounds modern experimental logic. Giambattista Vico later reformulated this idea as *verum esse ipsum factum*: the true is what is made (done). Galileo thus unified imagination, mathematics, and lived practice, even as Husserl's concern about science's neglect of subjectivity endures.

Keywords: G. Galilei, G.B. Vico, epistemology, phenomenology

Riassunto

La Crisi delle scienze europee (1934–1938) di Edmund Husserl diagnostica nella scienza moderna un distacco dal mondo concreto dell'esperienza umana, la *Lebenswelt*. Husserl vede in Galileo Galilei un "genio rivelatore e occultatore": con la matematizzazione della natura avrebbe inaugurato una scienza metodologicamente trionfante ma esistenzialmente vuota, astratta dall'esperienza vissuta. Come rimedio, Husserl propone la fenomenologia, che riporta la soggettività al fondamento della conoscenza. La questione è evidente in campi come la neuropsicofarmacologia, dove gli stati soggettivi sono centrali ma sfuggono all'oggettivazione e alla quantificazione: gli strumenti tecnici colgono correlati, non l'essenza vissuta, talora producendo distorsioni interpretative. In quest'articolo, sostengo che Husserl travisa Galileo. Il fondamento della scienza moderna non è la matematizzazione, bensì l'invenzione dell'esperimento come ciclo assieme immaginativo e pratico: dalla formulazione concettuale all'intervento controllato e ritorno alla teoria, con la matematica usata per reificare, linearizzare, a quantificare l'immaginazione. La concezione galileiana di causalità—cause come condizioni manipolabili piuttosto che essenze metafisiche—disegna per prima la logica sperimentale moderna. Giambattista Vico riprese tale intuizione col motto *verum esse ipsum factum*: il vero è ciò che è fatto. Galileo unì dunque immaginazione, matematica e prassi vissuta, anche se la preoccupazione husserliana sulla rimozione della soggettività rimane attuale.

Parole chiave: G. Galilei, G.B. Vico, epistemologia, fenomenologia

Introduction

Edmund Husserl's *The Crisis of the European Sciences* (1934-1938), published posthumous and unfinished in 1954, is a deeply ambitious and often frustrating text. Part historical diagnosis, part philosophical intervention, it proposes that European science—and, by extension, all modern science—has lost its way by detaching itself from the concrete world of human experience, what Husserl calls the lifeworld [*Lebenswelt*]. The culprit, in his view, is Galileo Galilei, "at once a discovering and concealing genius" (Husserl, 1954/1970, p. 52) whose project of mathematizing nature established a mode of science that abstracts from the lived world of our experience to deal only in idealized geometrical entities. For Husserl, this marks both the triumph and the failure of modern science: a triumph of method, a failure of meaning.

The foundational move Husserl describes—the replacement of intuitive, perceptual givenness with mathematical idealities—is, in his eyes, the source of the present crisis. Science becomes progressively more technical and precise, but also more alienated from the world it seeks to explain. Phenomenology, Husserl argues, must restore the broken link. It must show how all objective knowledge, including science, arises from intentional acts of consciousness. The subject, not the object, must be placed back at the center, but in a manner more rigorous than Descartes was able to achieve with his *cogito*.

Husserl's insight

There is undeniable value in this critique. It is true that modern science conceals—or rather forgets—its origins in lived inquiry, that the data scientists collect are detached from experience. The study of psychoactive drugs, particularly psychedelics, offers an interesting case in point. These agents produce mental experiences that defy description and quantification but are nonetheless central to their actions. Neuroimaging data, behavioral tests, and molecular techniques allow us to identify correlates, but do not capture the core of the phenomenon: the altered consciousness itself. Even the most perceptive of psychological analyses fails to achieve this goal. Discussing mystical experiences, including those induced chemically, William James wrote in 1902: "Although so similar to states of feeling, mystical states seem to those who experience them to be also states of knowledge. They are states of insight into depths of truth unplumbed by the discursive intellect. They are illuminations, revelations, full of significance and importance, all inarticulate though they remain; and as a rule they carry with them a curious sense of authority for aftertime" (James, 1902/1982). Anyone who has had an experience of this kind—James called them *noetic*—can attest to the uncanny accuracy of this statement. Yet, no one can go beyond the paradox that what feels most real eludes empirical validation, as none of our models or measurements captures this reality as it is lived.

This split between empirical data and lived experience exemplifies what Husserl diagnosed as a crisis: the disconnection of scientific inquiry from the *Lebenswelt*, the lifeworld of direct, embodied experience. This is evident throughout the field of neuropsychopharmacology, where the boundary between the 'objective' and the 'subjective' is inherently porous. Yet conventional scientific frameworks demand a clean separation between them, periodically leading researchers into conceptual cul-de-sacs. This point is illustrated vividly by investigations on Δ^9-tetrahydrocannabinol (THC), the psychotropic constituent of *Cannabis sativa* (L.). Under certain conditions, THC can elicit experiences that closely resemble those produced by classical psychedelics, like psilocybin or LSD.[1] However, to quantify and categorize these effects, researchers often rely on psychosis rating scales—tools designed to detect pathological conditions such as schizophrenia rather than intentionally sought experiences. This methodological choice equates the cannabis-induced state with a psychotic episode, unnecessarily pathologizing it.

Such framing is, borrowing Gilbert Ryle's term, a *category mistake*—the logical error of assigning something to the wrong conceptual category (Ryle, 1949/2002). Like other such mistakes, it not only misrepresents the phenomenon itself but also forecloses the possibility of understanding it on its own terms. This problem extends to most classes of drugs that directly or indirectly modify brain activity, a fact exploited in pharmacology through the *drug discrimination test*. Developed by Paul Janssen and collaborators in the 1960s and '70s (Colpaert et al., 1976) this behavioral paradigm leverages an animal's ability to recognize and respond to the interoceptive cues produced by specific classes of drugs—or even different doses of the same drug. Its remarkable sensitivity demonstrates that animals can identify these interventions by the *way they feel*—their subjective signature. Disciplines as diverse as neuropsychopharmacology and animal cognition, pain research and consciousness studies all face this problem: how to account for phenomena that are accessible only through subjective experience, yet fundamental to the effects being investigated. What should an empirical scientist do when experience itself becomes the datum? The task here is not to devise better descriptive or measuring tools—the scientist's default course of action—nor to note that something ontologically subjective can still be epistemologically objective—as John Searle would correctly point out (Searle, 1995). Rather, it is to reconsider critically the place of subjectivity within the scientific enterprise.

[1] The profound psychedelic effects of cannabis preparations containing high concentrations of THC are described by early European users—most famously, members of the Parisian *Club des Hachichins*— who consumed it in a fat-rich medium and on an empty stomach—both likely to increase the drug's absorption.

This is not a new concern[2] and is not one that we can take on here, beyond acknowledging its importance. It is time for us to turn to what I consider the key flaw in Husserl's analysis.

Galileo and the grounding of modern science

It is not Galileo's mathematization of nature that grounds the modern scientific enterprise, but rather his invention of the modern experiment. This distinction is critical. The Galilean experiment is a structured practical activity in which a possible portion of the world is first imagined and then physically constructed in a controlled setting[3]. Before becoming a formal method, it's an attitude toward the world. An attitude that we see unfold across Galileo's entire life work. Between 1582 and 1583, while still in his late teens, he noticed that a swinging lamp in the cathedral of Pisa took the same amount of time for each oscillation, regardless of the arc's amplitude. He measured it using his own pulse as a chronometer, recognizing what is now called *isochronism*—the approximate equality of swing periods for small-angle pendulum oscillation. Just a few years later, in 1586, he designed and built a hydrostatic balance to measure the specific weight of different bodies, describing it in a short treatise that circulated only in manuscript form. These anecdotes frame Galileo's lifelong conviction that practice—not abstract logical or mathematical principles—is foundational to scientific knowledge. This same conviction would lead him to perfect the telescope and aim it at the heavens rather than at enemy armies or ships at sea, as its Dutch inventors had done, discovering in 1610 Jupiter's satellites, the Moon spots, and the phases of Venus.

For Galileo, the scientist's task is to imagine a theoretical scenario, create controlled physical conditions under which it might (or might not) be realized, and then interpret its outcome. Mathematics is critical during both the ideation and the interpretation of the experiment but, he held, when theory and observation conflict, empirical evidence must prevail: "Did he not assert," asks Salviati in the *Dialogue Concerning the Two Chief World Systems* (1632) "that what experience and the senses show us must be placed before any reasoning, even though that reasoning might seem very well founded?" (Galilei, 1632/1970) Salviati's words mirror Galileo's own views and stands in stark contrast to those Husserl attributed to him: "For [Galileo]," the philosopher wrote, "a physics was immediately almost as certain as the previous pure and applied mathematics." (Husserl, 1954/1970, p. 39). More critically, never in *The Crisis* does Husserl mention Galileo's insistence on the importance of experimentation and science's grounding in lived practice.

Yet, the Galilean experiment—and, by extension, all modern experimental science—is irreducibly practical and active. It proceeds neither solely from experience toward abstraction, nor from abstraction toward experience. It is better described as a cycle: from thought to practical intervention, back to thought. The language of mathematics plays a special role in this process, enabling the reification, linearization, and quantification of thoughts that words alone would convey only intuitively and confusedly. Since a young age, Galileo had shown a deep love for mathematics and—likely influenced by the Platonic views of many of his Florentine contemporaries—believed that Nature itself was imbued with it: "Philosophy—he writes in an oft-cited passage—is written in this grand book, I mean the

[2] Thomas Nagel and others have long argued that subjective experience—what it is like to be a bat, or a human on LSD—is irreducible to objective description (Nagel, 1974).

[3] The laboratory experiment is one instance of the modern experiment. I use the term to encompass all scientific activities that require empirical verification—from molecular biology to paleontology and including theoretical sciences insofar as their conclusions remain hypothetical until verified.

universe, which is continually open in front of our eyes. But the book cannot be understood unless one first learns to comprehend the language and read the letters in which it is composed. It is written in the language of mathematics, and its characters are triangles, circles, and other geometrical figures, without which it is humanly impossible to understand a single word of it; without these, one wanders about in a dark labyrinth." (Galilei, 1623/1977)

Nevertheless, even when an experiment begins as a mathematically framed question and ends with a mathematical interpretation of the results, it would not be scientific without the intermediate step of empirical verification. As Galileo has Salviati say in the *Dialogue Concerning the Two Chief World Systems*: "This [experimentation] is the custom, and properly so, in those sciences where mathematical demonstrations are applied to natural phenomena, … where the principles, once established by well-chosen experiments, become the foundations of the entire superstructure" (Galilei, 1632/1970).

Galileo's notion of causality further underscores his epistemic stance. Aristotle had insisted that all knowledge is knowledge of causes: "We do not have knowledge of a thing—he wrote in the second book of *Physics*—until we have grasped its why [διὰ τί]—that is, its cause [αἴτιον]" (Aristotle, 1934). But whereas Aristotle regarded causes as metaphysical essences, Galileo took a radically different view. In the *Discourses and Mathematical Demonstrations Concerning Two New Sciences* (1638), Salviati explains: "The present does not seem to be the proper time to investigate the cause of the acceleration of natural motion concerning which various opinions have been expressed by various philosophers, some explaining it by attraction to the center, others to repulsion between the very small parts of the body, while still others attribute it to a certain stress in the surrounding medium. It is sufficient for our Author that we understand him to mean by uniformly accelerated motion one in which the velocity increases by equal amounts in equal times. If therefore we find that the properties which he deduces correspond to those which are observed in nature, we may conclude that his assumption was correct" (Galilei, 1638/2003). Speaking for Galileo, Salviati thus declines to pursue the cause of acceleration in Aristotle's sense, attending instead to the measurable properties of naturally accelerated motion. Galileo's position on causality is articulated even more clearly in the earlier anti-Aristotelian *Discourse on Floating Bodies* (1612): "Cause is that which, when present, brings about the effect; and when removed, takes the effect away" (Galilei, 1612/1968)—a formulation whose pragmatic clarity foreshadows both interventionist accounts of causality and the logic of contemporary biology, where the functions of genes and proteins are investigated through loss- and gain-of-function approaches that either disrupt or enhance their activity.

Galileo was not interested in philosophical disputes and did not leave a formal description of his experimental method. Modern interpretations are often unsatisfactory. Eugenio Garin described Galileo reasoning as "analysis and resolution, which proceeds from experimental data to reach the mathematical structure that constitutes the backbone of reality," (Garin, 1978) undervaluing—in my reading—the epistemic role of practice. More recently, Gregory Dawes observed that Galileo's method "resembles speculative natural philosophy insofar as its probative force depends upon a priori, mathematical reasoning, but it also resembles experimental natural philosophy insofar as the principles of such reasoning are tested against experience" (Dawes, 2016). Though historically grounded, the juxtaposition between speculative and experimental natural philosophy fails to capture the full consequences of integrating the language of mathematics and the practice of experiment. This integration harnesses the narrative drive of the human mind—our innate impulse to make sense of the world using language-based accounts, including mathematics—to imagine possible realities and guide exact physical experimentation that tests their factual validity. In the words of Ludovico Geymonat: "To understand Galileo's method one must understand how he combined [experiment and mathematics], transforming them in a single process that is both rational and empirical" (Geymonat, 1970). For us—who are born and live in a world permeated by numbers, science and technology—appreciating the significance of this epistemic leap requires a considerable effort of imagination.

The Catholic Church, however, immediately recognized its revolutionary impact. The publication of Nicolaus Copernicus's *De revolutionibus orbium coelestium* (1543) had left the ecclesiastic authorities largely unfazed. In the words of cardinal Roberto Bellarmino, who played a pivotal role in defining the Church's stance on heliocentrism: "To suppose that the Earth moves and the Sun remains stationary preserves all the appearances better than introducing eccentrics and epicycles; this is very well said and poses no danger, and it is sufficient for the mathematician. But to assert that the Sun truly occupies the center of the world, rotating only on its own axis without moving from east to west, and that the Earth occupies the third sphere and spins rapidly around the Sun, is a very dangerous claim…" (Bellarmino, 1615/1989). Copernicus' elegant calculations posed no threat to the established world order. Galileo's unprecedented use of mathematics, by contrast, carried profound implications: it leveraged the reifying, linearizing, and quantifying power wielded by this language to transform thought into symbol and number, both into practice, and practice into secure knowledge, opening entirely new cognoscitive horizons.

The true is what is made

The extraordinary success of Cartesian epistemology, with its improbable grounding of certainty in clear and distinct ideas, all but buried Galileo's insight that true knowledge is fully achieved only in an act of making. That insight, however, resurfaced less than a century later in Giambattista Vico's first major philosophical work: *On the most ancient wisdom of the Italians* (1710) (Vico, 1710/1988a). The treatise opens with an abrupt and explicitly anti-Cartesian assertion: *verum esse ipsum factum*, the true is precisely what is made (or done). The intellectual origin of this maxim, which Vico traces to the Latin usage of *verum* and *factum* as synonyms, remains debated. What is clear, however, is that the maxim shifted the dominant model of knowledge: from viewing the knower as a passive contemplator of fixed ideas or internal impressions to understanding them as an active creator of truth. As Vico clarifies: "… hypotheses about the natural order are considered most illuminating and are accepted with the fullest consent of everyone, if we can base experiments on them, *in which we make something similar to nature* [emphasis mine]" (Vico, 1710/1988, p. 52). Truth for him arises—through the process of metaphorical thinking—within the products of imitative human activity. It is not guaranteed by God, as Descartes maintained, but by our own cognoscitive powers. Vico carried this principle into the *New Science* (1744), with his attention now firmly turned toward human history: "But, in such a dense night of thick darkness that covers antiquity—Vico writes opening the book's third section (*On principles*)—that light which can lead us out of so great an obscurity must be taken as a principle: namely, that this world of civil society has certainly been made by men, and therefore its principles must be found within the modifications of our own human mind." (Vico, 1744/1942, p.117).

From Jules Michelet onward, most interpreters have justifiably focused on the anthropological and historical aspect of Vico's thought (Michelet, 1837). But Vico, like other members of the contemporary Neapolitan *Academy of the Investigators*, also nurtured a vivid interest in the natural sciences. Three years before publishing *On the Most Ancient Wisdom of the Italians*, he composed a short essay—*On the Balance of the Living Body*—concerned with mechanics and physiology. Possibly influenced by the works of fellow citizens Giovanni Alfonso Borelli (1608-1679) and Leonardo di Capua (1617-1695), the treatise is now lost, leaving us only to speculate about its contents and significance. Yet the principles Vico articulates in his later work make his position clear: we cannot fully know Nature itself, since we are not its makers. What we can and do know—*ex intus,* as it were—is the incessant human labor of modifying Nature and creatively imitating it, including through the practice of the modern scientific experiment. Like the products of our activity, science is accessible (knowable) to us because it is of our own making—its empirical truth borne out in the unending generative power of its constructs. That these constructs reshape material, intellectual, and social life attests to their reality.

Conclusions

Let us return to Husserl. I have argued that his critique of Galileo as "at once a discovering and concealing genius" is unfounded: Galileo did not mathematize the world in abstraction from the intentional human experience of the *Lebenswelt*; on the contrary, he bound them together through the intentional practice of the experiment, driven by the immense combined forces of imagination and mathematics. Vico intuited the significance of this advance and recast it in the philosophical language of his time, turning Descartes' logic on its head.

Yet Husserl's judgment of post-Galilean science as a triumph of method and a failure of meaning still stands. This failure manifests not only in science's inability to acknowledge subjectivity as a datum, as I noted earlier, but even more so in a growing chasm— between science and the public, between scientific and humanistic disciplines, and between scientists, increasingly reduced to "highly brilliant technicians of method" (Husserl, 1954/1970, p. 56), and the meaning and goals of their own work. In this light, Husserl's project remains unfinished, and perhaps more urgent than ever.

References

Aristotle (1934). *Physics*, Book II, 194b23. Trans. W. D. Ross. Harvard University Press, Cambridge, MA, 1934, p. 107.

Bellarmino R. (1615/1989). Letter to Father Paolo Antonio Foscarini, April 12, 1615. *Interdisciplinary Encyclopedia of Religion and Science*. https://inters.org/Bellarmino-Letter-Foscarini.

Colpaert F.C., Niemegeers C. J., JanssenP. A. (1976). Theoretical and methodological considerations on drug discrimination learning. *Psychopharmacologia*, **46**, 169-177.

Dawes G. W. (2016). Experiment, speculation, and Galileo's scientific reasoning. *Perspectives on Science*, **24**, 343–360.

Galilei G. (1612/1968). *Discorso intorno alle cose che stanno in su l'acqua o che in quella si muovono*. Favaro A. (a cura di). Giunti Barbera, Firenze, 1968 (reprint of the 1890 edition), p. 131.

Galilei G. (1623/1977) *il saggiatore*. Flora F. (a cura di). Einaudi, Torino, 1977, p. 55.

Galilei G. (1632/1970) *Dialogo sopra i due massimi sistemi del mondo.* Sosio L. (a cura di). Einaudi, Torino, 1970, p. 70.

Galilei G. (1638/2003). *Discourses and Mathematical Demonstrations Concerning Two New Sciences. Day Three*. Transl. H. Crew and A. de Salvio. Macmillan, New York, 1914 (reprinted Cambridge: University Press, 2003), p. 60.

Garin E. (1978). *Storia della filosofia italiana*, vol. II, Einaudi, Torino, 1978, p. 846.

Geymonat L. (1970). *Storia del pensiero filosofico e scientifico*, vol. II, Garzanti, Milano, p. 171.

Husserl E. (1954/1970). *The crisis of*

European sciences and transcendental phenomenology. An introduction to transcendental philosophy. (D. Carr, Transl.) Northwestern University Press, Evanston, 1970, p. 405

James W (1902/1982). *The Varieties of Religious Experience: A Study in Human Nature*. Penguin Books, London, 1982, p. 380.

Michelet J. (1837). *Mémoires de Vico écrits par lui-même*. Bruxelles, Societé Belge de Librairie, pp. 1-44.

Nagel T. (1974). What is it like to be a bat? *The Philosophical Review*, **83**, 435–450.

Ryle G. (1949/2002). *The concept of mind*. The University of Chicago Press, Chicago, 2002.

Searle J.R. (1995). *The Construction of Social Reality*. Free Press, New York, 1995, pp. 8–9.

Vico G.B. (1710/1988). *On the most ancient wisdom of the Italians unearthed from the origins of the Italian language*. Transl. with an introduction and note by L.M. Palmer, Cornell University Press, Ithaca and London, 1988.

Vico G.B. (1744/1942.) La Scienza nuova seconda. Nicolini F. (a cura di). Laterza, bari, 1942, p. 117.

Bulletin of Regional Natural History (BORNH) ISSN 2724-4393.