Essay

The Missing Foundation: Why Science Dissemination Fails Without a Scientific Culture

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The Missing Foundation: Why Science Dissemination Fails Without a Scientific Culture

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Abstract: This essay examines the structural crisis hindering effective science dissemination, particularly in contexts lacking a robust scientific ambiance and foundational education. Using Brazil—a major global economy with paradoxically low literacy and PISA scores—as a case study, the article argues that attempts to inculcate science often fail due to deep-seated formative deficiencies. It traces the historical shift from holistic, humanistic education towards a pragmatic, utilitarian model, leading to a conflation of science (theory) with technology (*techne*) and a decline in speculative inquiry and major breakthroughs. Factors such as knowledge fragmentation, the "reverse Flynn effect," and a contemporary scientific *modus operandi* driven by quantitativism and immediate results further exacerbate this issue. The paper warns against science detached from ethical and humanistic values, citing historical misuses. It concludes that meaningful science dissemination, capable of fostering critical discernment, requires a revitalized educational approach centered on integrated, humanistic knowledge. Only by cultivating such a foundational scientific culture can society genuinely engage with and benefit from scientific advancements, avoiding a descent into "digital neo-barbarianism."

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Education inculcates this new creed in the new generation without passing through the mental processes that led to it; and, therefore, without perceiving or understanding its foundation. Just as a belief transforms into a dogma when passively received, the foundations of a reasoned opinion disappear from the consciousness of those who hold it, even if they continue to mechanically repeat the words through which they justify it. (On Liberty, Chap. II, John Stuart Mill)

The word "ambiance" originates from the Greek term *ambire*, meaning "to surround." It refers to the set of characteristics and conditions of the environment that influence people's experience, perception, and behavior in a given space (Harper, 2023). The resulting effect is not a consequence of a single isolated factor but rather of a harmonious convergence of coordinated forces, each acting in a special way to achieve the desired qualities. In the context of this discussion, it concerns the creation of the foundations and general conditions necessary for the flourishing of an authentic scientific culture, capable of sustaining solid and progressive scientific development.

Although the argument may seem elementary, actions taken in this regard appear to follow a reverse order: there is an attempt to inculcate, and not infrequently, impose "science" upon a society with significant formative deficiencies. Taking Brazil as a striking example of this premise, a country that ranks 9th among the world's largest economies, yet only 12% of its individuals are considered fully literate, while 29% of the population is classified as functionally illiterate (INAF, 2022). Furthermore, the PISA educational performance index (OECD, 2022) reveals serious deficiencies among Brazilian students: 65th in mathematics, 61st in science, and 52nd in reading, often ranking below countries with lower investment per student. In higher education, our best university ranks 85th, and few Brazilian institutions feature among the top 500 globally (QS, 2024).

The restoration of the path of authentic *scientia* is entirely possible and must be resumed from the explanatory principles that underpin structured knowledge. This ideal served as the basis for a pedagogical model aimed at formation—in the sense of giving form—to an individual ordered in

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thought and action, a participant in a universe comprehensible through the light of reason. In this conception, the formative itinerary begins with the understanding of language and the development of logical clarity, fundamental elements for shaping an ordered and rigorous mind. This initial mastery paves the way for more advanced studies, where mathematical reasoning and the harmony of numerical relationships lead to the investigation of natural laws, revealing the profound structure and intrinsic order of the world, or *physis* (Koyré, 1957). Thus, the intellect is guided to transcend the limitations of the sensible world and approach the universals, where true knowledge resides (Jaeger, 1943). This holistic formation—conceptual, logical, metaphysical, aesthetic, and moral—provides the individual with the necessary foundations to understand things through their causes, the basis of authentic *philosophia naturalis* (Koyré, 1966).

It cannot be denied that human beings have a certain connaturality with this way of thinking, which, intuitively, seeks the "why" (*propter quid*) of things. However, being speculative in nature, the apprehension and understanding of natural phenomena through scientific activity develop through abstractions and the formulation of explanatory hypotheses, which attempt to elucidate these phenomena, albeit approximately (Artigas, 1998). These factors reveal that such an intellectual process is naturally potential but requires a combination of conditions that enable it to perform operations of greater abstractive complexity *in actu*. Due to this peculiarity, science has flourished and reinvented itself under special circumstances throughout human history, which is directly related to the environment in which it is embedded.

Considering, therefore, science as a product of its environment, it is no coincidence that great scientific advancements were preceded or accompanied by moments of intellectual and artistic effervescence. This occurred in Ancient Greece, as well as during the Scholastic, Renaissance, and Baroque periods, the era of the Scientific Revolution (Bronowski, 1973). The Victorian Era and the Belle Époque also provided an intense cultural environment, which catalyzed radical changes in all sciences, especially in Physics, Chemistry, and Biology, forging the contemporary scientific vision. These examples highlight the importance of ambiance in its diverse facets—artistic, philosophical, aesthetic, economic, and intellectual—as an essential starting point for scientific flourishing, and not as isolated events in time.

It is well known that, with the advance of the industrial age and the consolidation of market economies, the educational paradigm underwent a profound transformation. The ideal of integral human formation, which sought to promote knowledge for knowledge's sake and develop a holistic understanding of reality, was gradually replaced by a pragmatic and utilitarian model, focused on technical training and productive efficiency. This new model, although economically efficient, reduces the role of science to its ability to generate practical and measurable results, weakening the speculative and reflective dimension that sustained scientific development in previous eras (Readings, 1996).

Thus, enveloped by numerous technological advancements, especially since the 19th century, we have lost the elementary distinction between the competencies and characteristics proper to theory and technique (*techne*), such that the latter—a productive activity—becomes synonymous with the former—a speculative activity, even though *techne* can dictate its course while disconnected from science (Koyré, 1966). As a consequence, and contrary to the *communis opinio*, we have become a society based on technology and praxis, but not a truly scientific society.

This conception directs work towards a sequence of highly effective, yet repetitive, procedures and protocols, distant from their roots in explanatory causes and principles. Such an approach silently diminishes our speculative capacity, replacing intellectual inquiry with mere technical training. This phenomenon is corroborated by the gradual decline in the capacity for scientific innovation, or "breakthroughs," evident since the 1970s (Collison & Kalivoda, 2022). One of the reasons cited for this decrease is the growing difficulty of integrating and organizing unified knowledge, a striking feature of the fragmentation and overspecialization of knowledge.

This detachment from unified knowledge seems to be objectively reflected in broad trends, such as the gradual reduction of the intelligence quotient (IQ) in industrialized countries, reversing the growth of the last decades of the 20th century in a process known as the "reverse Flynn effect" (Flynn,

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2012). Among the suggested causes for this effect are the increasing dependence on technology and the decline in reading habits, which reduce cognitive challenges, a process expected to intensify with the gradual transfer of more noble competencies to artificial intelligence (AI).

Collectively, the factors above demonstrate that the construction of a vigorous scientific environment is never a completed task, even in advanced societies, but rather an ongoing effort that demands constant commitment and preservation—an even greater challenge amidst the generalized deterioration of high culture.

These adversities compound the very *modus operandi* of contemporary science, sustained by a quantitativist and immediatist logic, which increasingly compromises itself with issues of convenience, restricting its funding and interest to projects aligned with specific agendas (Bourdieu, 2001). Such a scenario rewards repetition and penalizes free inquiry, eliminating divergent viewpoints, which keeps the activity alive and inspiring.

Paradoxically, it is in this impoverished environment of ideas and values that science becomes hypertrophied, elevating itself from an efficient cause to its own *raison d'être* (Artigas, 2000). This science, stripped of a foundational culture, becomes myopic regarding its own explanatory limits, especially ethical ones, rapidly molding itself to opportunistic rhetoric, transforming from a common good into a mechanism of persuasion, availing itself of the divisive and simplistic perspective that has permeated all social discussions.

It is important to remember that scientific development is not intrinsically positive, especially when detached from its humanistic aspect. In the 19th century, for example, eugenic theories, based on distorted interpretations of biology and genetics, helped shape concepts of "pure race," later used to justify policies of exclusion, segregation, and genocide (Kevles, 1985). In the early decades of the 20th century, the Soviet scientist Trofim Lysenko rejected the principles of Mendelian genetics, promoting the persecution of scientists who defended classical genetics, accusing them of being "reactionaries" and committed to "bourgeois science" (Medvedev, 1969).

In the current scenario of intellectual impoverishment, science dissemination faces an insurmountable obstacle: without an educational foundation that allows individuals to understand and contextualize information, disseminated science loses much of its formative and enlightening value. Made accessible only superficially, science becomes a series of isolated pieces of information, disconnected from the principles that give it cohesion and meaning, promoting a fragmented and, at times, distorted understanding of scientific reality. This compromises the objective of dissemination as a means of broadening critical discernment and informed reflection, emptying it of its emancipatory potential. Instead of contributing to the development of a more conscious and enlightened society, science dissemination, in this context, risks being assimilated dogmatically (Feyerabend, 2010), strengthening only simplistic or even polarized impressions about science and its implications.

The premise that concludes this essay is founded on the importance of building knowledge that forms a society capable of evaluating and pondering the applications and implications of techno-scientific development in light of its values, not to their detriment. Such education must nurture the intellectual and emotional development of students, promoting creativity and the ability to apply knowledge practically, avoiding the risk of "inert knowledge" (Whitehead, 1929). Under such circumstances, science dissemination, in its various formats, becomes an enriching element for those already structured forms of knowledge, sharpening the intellect towards new possibilities.

It is from a truly humanistic knowledge, integrated with other areas of knowledge and enhanced by praxis—an element scarce to the ancients—that we can build the desired scientific culture. The result will be a more fecund and lucid science, capable of resolving the fundamental misconceptions of our time as a natural consequence of forming individuals more aware of the complexities and explanatory limitations inherent in scientific activity itself (Morin, 2001). This education, focused on mutual understanding and the recognition of uncertainties, strengthens the ethical and critical training necessary to face the challenges of the future. Without this reformulation of the foundations of knowledge, we risk definitively becoming digital neo-barbarians.

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