RESEARCH ARTICLE

From Mathematics to Physics: A Genealogy of the Foundation of the Scientific Method in the Social Sciences

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Abstract

The eighteenth century was an era dominated by a critical philosophy that challenged all previous systems of thought. It rejected theology and dismantled the sacred status once conferred by the Church upon feudal institutions. It promoted the spirit of tolerance, freedom of thought, scientific inquiry, and the elevation of reason. Thinkers of the time opposed outdated conceptions of the world and introduced a new worldview grounded in positivist science. The rationalists of the eighteenth century subjected all forms of knowledge to criticism: religion, society, and political institutions. These figures were prominent in the history of European thought and played a major role in the liberation of minds and the enlightenment of reason. A wave of intellectual emancipation spread, championed and defended by these thinkers. Significant works emerged, such as David Hume's attempt to apply the experimental method to the human sciences for the first time, alongside the rise of Cartesian rationalism. Among the most notable figures of the eighteenth century were Condorcet and Auguste Comte, who sought to apply the scientific principles of mathematics and physics to the methodology of study in the social and human sciences.

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Introduction

The Enlightenment era marked both a renaissance and a revolution against the dominant paradigms of the Middle Ages particularly the control exercised by the Church over European thought, and the reverence for saints and ancient sages. Enlightenment philosophers demonstrated that historical progress is achievable only through civilizational advancement, which in turn depends on the progress of reason. Although many Enlightenment thinkers were believers, they regarded religion as limited strictly to worship and moral values, and asserted it should not interfere in matters of the state or politics. The prevailing motto of the time was the rejection of superstition, metaphysics, and mythology, in favor of opening the path to reason.

This motto was carried forward by a number of philosophers and thinkers such as Copernicus, Bacon, Descartes, Newton, Voltaire, d'Alembert, Diderot, and Condillac, among others. These thinkers pursued different methods to realize the practical embodiment of that motto. Notably, David Hume attempted for the first time to apply the experimental method to the human and moral sciences, while Pascal sought to replace old judgments with experience, challenging Aristotelian wisdom—for instance, the claim that "nature abhors a vacuum."

Equally influential was Condorcet, a pioneering progressive mathematical philosopher, who worked on applying statistics and probability theory to elections, institutions, and social phenomena in general. His aim was to base decisions on scientific grounds and thus achieve human happiness. He famously declared: *"the infinite perfectibility of mankind."* For him, this progress was rooted in reason, which transforms the scientific method into a practical and methodological tool to advance social development—just as it facilitates mathematical progress.

Following in his footsteps, Auguste Comte undertook the task of applying the physical (scientific) method to the social sciences, establishing himself as a positivist and empirical philosopher. Based on this intellectual lineage, our choice of topic focuses on "social mathematics" or the mathematization of sociology during the Enlightenment—beginning with Condorcet and extending to his fellow citizen Auguste Comte, who attempted to apply the methods of physics to sociology, thus giving rise to social physics.

Central Questions:

- What were the philosophical and methodological visions of Condorcet and Auguste Comte?
- What scientific goals did they pursue by applying a formless science to the construction of sociology?
- Did their project succeed?

The idea of natural law and the natural human dominated eighteenth-century thought, characterized by the ascendancy of the concept of law in both the natural and social sciences. It was Montesquieu who first pointed out in Europe that social life is governed by specific laws, much like the natural world. He believed that laws represent necessary relationships derived from the nature of things.[1]

The philosophy of the Enlightenment was founded on the principles of Cartesian rationalism. René Descartes' book *Discourse on the Method* played an active role in systematizing scientific thought and regulating it within a framework of rational concepts, deviation from which was considered a departure from science. The eighteenth century recognized Descartes' merit, particularly through his disciples Locke, Berkeley, Condillac, Newton, and others—who all worked under the banner of his ideas and rationalism to combat entrenched and preconceived beliefs, without concern for the consequences they might face from the government and religious authorities.

Philosophy had been rejected due to its critical perspectives and its attempts to establish freedom of thought, which leads to a diversity of viewpoints and differences of opinion. Voltaire, for instance, considered philosophy to be the torch that ought to illuminate the path for humanity, and that this torch was never used to burn thinkers, as was done by the courts of the Inquisition.

As for the second domain physics it was represented by classical physics, which, under the leadership of Newton, upheld the principle of mechanism believed to govern everything in the universe. The philosophers and thinkers of this century were profoundly influenced by philosophy, especially in France, where figures such as Clairaut, d'Alembert, Lagrange, and Laplace explained and disseminated Newton's doctrine of the world system, applied modern calculus to the sciences of mechanics and astronomy, and established the science of celestial mechanics.[2]

Moreover, the eighteenth century adopted both rationalist and empirical scientific ideas that had prevailed in the seventeenth century, fusing them together within a framework of strong belief in unlimited progress progress that humanity continuously achieves through a single, exclusive path: the path of reason and science. In this context, the philosophers of the century employed a concept that dominated modern thinking namely, the concept of **determinism** (déterminisme), which Newtonian physics had imposed on modern classical science.[3]

As Yumna Tareef Al-Khouli says, the spirit of science liberates the mind from metaphysical delusions just as it frees it from lurking idols and errors. Thus, the pioneer Francis Bacon taught us that the spirit of science is based on two pillars: **experiment** and **the rejection of metaphysics**.[4]

This marked the rise of a scientific renaissance, and scientific progress became a model for advancement in various other fields social, economic, political, and moral. The scientific method became a practical tool that facilitated the path to progress, and scientists worked to generalize it across all fields of human knowledge. The best evidence of this is David Hume's attempt to apply the experimental method for the first time to human and moral studies.

Up to the seventeenth century, the idea of human progress occurred spontaneously, without planning, collective effort, or conscious attempts aimed at advancement or the realization of a better world—a world of perfection. However, following the scientific discoveries of the seventeenth century, confidence in the future grew, and mankind began to see itself as superior to the past. The theory of progress was not merely a set of opinions repeated by thinkers; rather, it was a conviction deeply rooted in the people of that era. They subjected everything to criticism and examination, which helped free history from many errors.

Thus, **continuous progress led by human reason** became the starting point for moral standards, civilizational efforts, and political goals. This idea of sustained human advancement was clearly articulated in Turgot's essays (1750) and in *History of Humanity* (1764) by Isaak Iselin. [5]

Ever since Newton discovered the law of gravity in the universe, rationalist philosophers were driven to advocate for including the human being within the realm of natural enti-

ties, and thus subjecting him to the same laws. From there, the deteriorating social situation—caused partly by people's attachment to old values began to shift. For Newton, upon discovering gravity, the universe became a grand mechanism, and this notion inspired Renaissance philosophers. Thus, the discovery of the laws of governance, social life, and societal dynamics was seen as the appropriate alternative for building a new society.[6]

The Concept of Progress:

Since the 18th century, the term "progress" has become synonymous with "rationalization." The movement of progress in time became equivalent to the movement of human reason through time, toward a specific state of knowledge and freedom. Progress came to represent a scale of values that begins with superstition and ends with reason in terms of knowledge, and starts with primitiveness and ends with civilization.

Condorcet considered progress to be the greatest law of human development. In his theory, he turned to history to demonstrate the work of reason and to enumerate its role in social efforts. His book *Historical Sketch* served as a historical introduction to a larger work on the history of science and its impact on society. He built his entire social thought on the idea that the progress of knowledge leads to the progress of the human race, making the former the foundation of the latter. The advancement of science, thought, and knowledge results in the advancement of society.

Turgot justified this principle by establishing a coherence among the various forms of social activity. Thus, Condorcet based his vision on the duality of the progress of reason and science on one hand, and social, moral, and political development on the other affirming the inseparable unity between intellectual progress, freedom, virtue, respect for natural rights, and the influence of science in eliminating fanaticism.

He noted that all political and moral errors originated from false beliefs, which were closely linked to errors in physics and ignorance of the laws of nature.[7] His ambitious project aimed to clarify the successive transformations in human society and the influence each moment has on the next. Through these successive changes, the progress of the human race toward truth or happiness is achieved.

Condorcet relied on two fundamental principles to develop his vision of the link between the advancement of reason and that of society at the same time:

1. His conviction that the obstacles that had hindered the progress of the human mind such as autocratic rule, elitist governance, and the widespread dominance of preconceived ideas were demolished through political, social, and scientific revolutions.

2. His belief that the discoveries of the empirical school had made progress possible and affirmed the capacity of the human mind to reformulate natural laws in its favor and thus control them [8].

Social Mathematics:

From the ten stages he defined for the development of the human mind, he emphasized in the final stage the spirit of the era to which he belonged, attempting to demonstrate the hypothesis of the mind's ability to predict the future by comparing human phenomena to natural phenomena. He regarded the human being as part of a whole, and according to Aristotelian logic, what applies to the whole applies to the part.

This applies to the sciences as well: human sciences are a branch of knowledge just like the natural sciences, and what is true for the latter can also be true for the human sciences especially in the matter of integrating mathematics. Condorcet confirmed the possibility of applying mathematics to human matters, social physics, and the physiology of every feeling, tendency, or inclination with the same precision and usefulness as found in natural sciences. He believed metaphysicians had succumbed to illusion and deception, since there is nothing in nature that is teleological; everything is subject to measurement and quantification [9].

Thus, Condorcet linked human sciences with experimental sciences and called for scientific progress that would result in moral progress. As "Yvon" stated: "If we accept this conception, then the resulting conclusion is that there is no limit to progress, because the number of combinations and permutations increases with the number of elements. And as long as the matter remains linked to humanity as a whole, the lines of intellectual progress and moral advancement increase just as a player's chances grow the more they engage in the game with greater and more numerous attempts" [10].

The Marquis de Condorcet emphasized the importance of quantity in the advancement of science, particularly the role of probability calculus, given its essential function in the anticipated progress of all sciences, if applied in their research. It would grant these sciences the same precision and clarity enjoyed by mathematical sciences.

In this context, he referred specifically to the human sciences and in particular to sociology or what he called "the social art." He sought to interpret the social art with a spirit imbued with a mathematical orientation, one based on combinatorial probability, which later became known as **social mathematics**, where the human being becomes a gambler navigating conflicting probabilities and their outcomes. In doing so, he frees himself from the domination of instincts and emotions over his decisions and subjects them instead to the rule of reason and mathematical science [11].

The application of probability calculus would lead to significant progress in the field of knowledge, improvement of language, and political principles of the state built upon re-

spect for weak nations, equality between societies and individuals, and thereby the creation of moral values among peoples. Morality too, as a social phenomenon, was not exempt from this rational framework [12].

Social Physics:

The shift toward experimental science began in the early 19th century, when the scientific and philosophical groundwork had been laid for the spread of positivist philosophy. The first to use the term *positif* (positive) was the utopian thinker and proponent of the scientific study of man and society, **Saint-Simon**, who sought to make science the law, lexicon, and new religion of humanity, considering it the true path to salvation. He stated: "At present, the best use we can make to strengthen our intellectual capacities is to grant the human sciences the status of positive science" [13].

In this, he was influenced by the model of the natural sciences, especially Newtonian physics. His aim was to produce an epistemological break with theological philosophical thought, and thus achieve scientific and social recognition and credibility [14]. In this regard, he followed in the footsteps of Condorcet, who attempted to discover the law of progress though, according to Saint-Simon, he remained at the level of hypothesis. It was his successors who sought to elevate this hypothesis to the rank of scientific theory by discovering a law for society as valid as the physical law of gravity.

Saint-Simon proposed the physiological law of the human race, which consists of the alternation of two epochs: the *organic age* and the *critical age*. In the organic age, people are aware of a common goal and coordinate all their efforts to achieve it. In the critical age, however, they are unaware of any goal, and thus their efforts are scattered and fragmented [15].

Saint-Simon adopted his teacher Condorcet's vision of the evolution of the human mind and the progress of knowledge, establishing stages of intellectual development patterned on the evolution of the human race or human society. For example, an organic age appeared in Greece before the era of Socrates, followed by a critical age that lasted until the barbarian invasions. Then came another organic age in the homogeneous societies of Europe, from the time of Charlemagne to the end of the 15th century. Then *Luther* initiated a new critical age, which still persists. Now, according to Saint-Simon, the time has come to prepare for the emergence of a new organic age, which humanity must necessarily move toward [16].

Saint-Simon believed that man is not unique and does not require special treatment, contrary to Condorcet's view. Instead, he is a resident of the kingdoms of animals and plants, subject to the same general laws, and once these laws are discovered, they will lead us to happiness and harmony [17].

Comte's call was directed at establishing a positive science under the name of social physics. He stated: "We already have celestial physics, terrestrial physics, mechanics, botanical physics, animal physics and we still need one more and final kind of physics: social physics. This is the science that takes social phenomena as its subject of study, regarding them as having the same essence as astronomical, physical, chemical, and physiological phenomena, inasmuch as they are subject to the fixed laws of nature" [18].

The meaning of establishing social physics is to study society using the methodology of modern science, limiting itself to explaining phenomena based on the fixed relationships between them, due to their similarity and sequence. It is the positivist method, not the theological or metaphysical one. It is the method of the modern positivist age. Social physics studies social phenomena just as other sciences study astronomical phenomena.

However, after some 18th-century thinkers especially Condorcet tried to subject social phenomena to quantitative mathematical estimations by applying probabilities and statistics in order to give them the precision and certainty of mathematics, Comte ultimately rejected the term *social physics*, arguing that human phenomena are too complex and that mathematics can never reach precise and deterministic laws in this domain. He replaced it with the term sociology, saying:
"Down with the prestige and language of mathematics, no matter how noble they seem! No mathematics, no physics what matters is a science that is deterministic in any way. Let's call it sociology. Yes, down with everything called scientific determinism, with its assumptions of fixed realities, for only through generalization of method just as we move from arithmetic to algebra, from regular number calculation to irrational number calculation can progress become unlimited. This is what we witness in the boundless advancement of sciences in general, and moral sciences in particular" [19].

Auguste Comte rejected the idea that other sciences could study the laws of human society. For example, biology studies man as an animal, but it does not take into account the complex systems and traditions developed by humans. Human society is an accumulation of systems, knowledge, skills, traditions, and values... and biology or any other science cannot study them. That is why sociology was created specifically to deal with such phenomena [20].

What we understand from Auguste Comte's position is that the human phenomenon is unique in its kind, which invalidates Condorcet's assumption that the social phenomenon can be subjected to the mathematical method, or that probability and statistics can be applied to it. Even though Comte was influenced by Condorcet's methodological framework, he reexamined his predecessor's approach with a critical and analytical eye. Claiming the possibility of introducing probability and statistics into a science

fundamentally based on determinism undermines the very foundations of this discipline.

Comte followed Claude Bernard in his view that *"probability and statistics pose a threat to the principle of determinism."* For this reason, he rejected the work of the Belgian astronomer and social theorist Adolphe Quetelet, particularly his 1869 book *Social Physics*, in which social phenomena were treated with mathematical and statistical precision [21].

As for the idea of progress, Comte believed that scientific development does not occur independently within the three stages of human thought, but rather through their interdependence. Each science relies on the one that preceded it and paves the way for the one that follows it, taking into account the degree of generality and complexity. Therefore, he permitted the classification of sciences in the following order: mathematics, astronomy, chemistry, physics, biology, and sociology.

Conclusion

From what has been presented in this chapter, we can summarize the following points:

1. Since natural phenomena can be predicted by knowing the causes of their occurrence, the same condition is sufficient for human phenomena. Prediction will therefore be possible, and what applies to natural phenomena can also be applied to human phenomena, since the latter are part of nature.

2. The scientific regulation of human phenomena in general and social phenomena in particular requires the adoption of quantitative methods, or in other words, the introduction of numerical language to make them more precise.

3. Condorcet's attempt to turn the "social art" into a highly precise positivist science relied in particular on probability theory.

4. Condorcet introduced probability into matters such as elections, justice, and commerce considered social phenomena with the aim of demonstrating that the opinion of the majority is not always correct.

5. The scientific study according to Condorcet gave rise to what came to be known as social mathematics, which in turn laid the groundwork for what would later be called social physics.

6. The movement of scientific progress and the linkage between experimental and human sciences resulted in what came to be known as scientific rationalism.

Footnotes

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