Physical Order vs. Divine Designer: Celestial Mechanics and Natural Theology Struggling for the System of the World

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Outline of the Argument

The concept of cultural hegemony is notoriously difficult. As it is presented in Gramsci's original writings, hegemony is a cluster of several ideas, insights, and suggestions (see Adamson, 1980; Bates, 1975; Howson & Smith, 2008; G. A. Williams, 1960). This is hardly surprising. One had to remind that the notion was developed to explain very specific historical processes in post-WWI Europe. Recently, however, the concept of hegemony has enjoyed an increasing popularity as an analytical tool to describe cultural phenomena in contemporary society beyond the historical and theoretical strictures of the Marxist framework (Holub, 1992). My goal in this paper is to explore the possibility of using the concept of hegemony to illuminate the clash between scientific and philosophical theories.

Hegemony has to do with a central problem: how ideas influence human social and political life at large. It has thus to do with the effect of systems of thought on our life, but also with the process through which these systems come about (Jackson Lears, 1985). In Gramsci's work, this phenomenon is interlinked with three main factors. The first factor is the role of intellectuals in the genesis, elaboration, and dissemination of a hegemonic system of thought in society (Q12; Gramsci, 1929-1935, pp. III, 1513-1551). The second factor is the function of education as the site where the struggle between competing hegemonic systems takes place (Entwistle, 1978). Gramsci is very explicit in acknowledging that hegemony manifests itself prominently in pedagogical processes (Q10; Gramsci, 1929-1935, pp. II, 1331):

> The educational relation should not be restricted to the field of the strict "scholastic" relationships by means of which the new generation comes into contact with the old and absorbs its experiences and its historically necessary values and "matures" and develops a personality of its own which is historically and culturally superior. This form of relationship exists throughout society as a whole and for every individual relative to other individuals. It exists between intellectual and non-intellectual sections of the population, between the rulers and the ruled elites and their followed, leaders and led, the vanguard and the body of the army. *Every relationship of "hegemony" is necessarily an educational relationship*. (English translation in Adamson, 1980, p. 142, emphasis added).

Finally, the third factor is the *common sense* as the complex cultural element for the shaping of which hegemonic forces struggle. As Raymond Williams has noticed, hegemony "is not limited to matters of political control but seeks to describe a more general predominance which includes, as one of its key features, a particular way of seeing the world and human nature and relationships" (R. Williams, 1976, p. 146). This predominance takes a social and political meaning when it reconfigures the popular philosophy which Gramsci calls common sense, whose "fundamental character is that it's a fragmentary, inconsistent, inconsequent worldview, congruous with the character of the people of whom it is the philosophy" (Q8; Gramsci, 1929-1935, pp. II, 1045). Science plays an important role in shaping common sense: "common sense is not something rigid and motionless, but it ceaselessly transforms itself by enriching itself with scientific notions and philosophical opinions turned into established wisdom" (Q24; Gramsci, 1929-1935, pp. III, 2271). As I show in the following sections, intellectual elites, educational concerns and common sense feature prominently in my narrative.

The dynamics of the hegemonic struggle, though, is more complicate. Although Gramsci insists on the epistemological impact of hegemony (Q10; Gramsci, 1929-1935, pp. II, 1249-1250), he does not provide a full-fledged account of how the forces competing for establishing a new system of thought or for defending an old one, carry out their battle. A general idea underwriting the hegemonic struggle seems to be the following. The complex of human cultural productions and practices contains divergent potentialities, which can lead to opposite views of man and society. The hegemonic groups tease out the suitable potentialities and make them the bases of their own specific system of thought (see Agazzi, 1959).

Recently, this idea has been taken up in the context of political analysis of ideology (for a survey see Norval, 2000). In particular, Ernesto Laclau (Laclau, 1992; Laclau & Mouffe, 1985) and Michael Freeden (Freeden, 1996) have argued that the construction of ideological (or hegemonic) systems of thought requires the selections of particular concepts and their elevation to the status of a *decontested totality*. This account allows us to analyze the struggle for cultural hegemony in terms of the political functions of the concepts, the arguments employed to construct the systems of thought, and the discoursive practices used to defend them. This is the strategy I intend to pursue here.

In the following sections I show how some important results of celestial mechanics, in particular the stability of the solar system and the nebular hypothesis, led, in late XVIII century France, to a new view of the universe and the place of man in nature and society. When these ideas crossed the Channel, in the late 1820s, they inspired reformist and evolutionary thinkers such as John P. Nichol and paved to way to the Darwinian revolution. At the same time, however, they triggered the vehement reaction of conservative Victorian scientists. A particularly important case is William Whewell's attempt to conciliate the classical argument from design with the findings of French mathematicians. What was at stake in the debate between Whewell's Natural Theology and Nichol's science of progress was the cultural hegemony on Victorian society. I argue that the selection of concepts and the argumentative strategies in this debate show the character of an hegemonic struggle.

Celestial Mechanics: The Political Meaning of Mathematics

The eighteenth century was the century of celestial mechanics or, as it was also called, physical astronomy. The work of great mathematicians such as Clairault, Euler, D'Alembert, Lagrange, and Laplace pushed Newtonian theory to its limits. The descriptions of heavenly orbits, the passages of comets, the behavior of the moon reached levels of details and precisions hardly foreseeable by Newton himself. Astronomy rose quickly to the title of "queen of sciences" and acquired a huge cultural significance. It became a source of analogies, metaphors, and models for other aspects of human activity. Two achievements of celestial mechanics had a particularly strong impact on the late eighteenth century culture: the stability of the solar system and the nebular hypothesis (NH).

The first was not a single theorem, but a collection of results obtained especially by Lagrange and Laplace (Gillispie, 1997). Newtonian theory of gravitation provides the laws of evolution of the solar system, but do not guarantee that the planets will always stay together. It might happen that, at some point, two planets collide or one is ejected out of the system. Lagrange and Laplace managed to show, under some mathematical assumptions, that this is not the case. To be sure, the mathematical restrictions were pretty severe and the result was limited in scope. Nevertheless, it was immediately accepted as a mathematical proof of the eternal stability of the world (see for instance Playfair, 1807). This result had two opposite cultural bearings: it could be read as a proof of the autonomy of the world-machine or as a proof of an intelligent design. We will see in the next sections how the debate on these options unfolded in Victorian Britain.

The second achievement came to be called, after William Whewell, the NH. Introduced by Laplace in the second volume of his *System of the World* (Laplace, 1809), it was meant to be an explanation of the origin of the solar system. Laplace argued that some natural facts (small eccentricity and inclination of the planetary orbits, same directions of revolution and rotation) suggested that the solar system originated from an rotating nebula which progressively contracted leaving behind planets and satellites. From a philosophical perspective, the NH pointed at a world as an autonomous system, without any need of the transcendental foundation of God (Numbers, 1977).

In Revolutionary France these results became part of a reformist project that started from a new view of the world and of man and targeted a restructuring of society and education. Among the intellectuals, nobody did more for this project than Auguste Comte. His positivistic philosophy advocated a new taxonomy of sciences as an integrated epistemological, political and pedagogical program. Among the effects of positivistic philosophy, he explicitly mentions "to regenerate education" and the "social re-organization" (Comte, 1893, pp. 11-12). In particular, Comte's elaboration on the NH became one of the inspiration source of English reformism (Schweber, 1991).

Science in Victorian Culture

The developments of French astronomy provoked mixed reactions in Great Britain. On the one hand, the scientific community felt deeply embarrassed for losing the lead to the Continent. Playfair lamented loudly that Newton's legacy had been taken up by Lagrange and Laplace, whereas the British mathematicians lagged miserably behind (Playfair, 1807). In particular, he urged his countrymen to become familiar with the new analytical methods used in France. It was the beginning of a process which would lead to the establishment of the Mathematical Tripos in Cambridge (Warwick, 2003).

On the other hand, the philosophical and political project associated with new astronomy seemed to undermine the traditional alliance between science and religion. As Cannon has famously argued, in Victorian culture science and religion represent a *truth-complex* aiming to unfold the relations between the moral and the physical world (S. F. Cannon, 1978). Ever since Boyle and Newton, science was viewed as cooperating with religion to understand world as a rational unity of which God is the efficient cause (Brooke, 1991; W. F. Cannon, 1960). Comte's scientific positivism and the NH posed serious problems to this tradition. The message from the other side of the Channel was that the physical world is an *autonomous system*, evolving according to its own laws and for which God is, at best, a *formal* cause, a possible hypothesis—which Laplace scornfully dismissed (Brooke, 1979; Peterfreund, 2012). The alliance between astronomy and geology was to be decisive for the establishment of an evolutionary way of thinking (Gillispie, 1996).

The challenge was also political, though. For the rational unity of the world is entrenched with the common sense and thus the place of man in society. Humphry Davy was stressing this crucial connection when he claimed that "science is in fact nothing more than the refinement of common sense making use of facts already known to acquire new facts" (Davy, 1839, p. 355). Challenging the relation between science and religion meant a reconfiguration of the common sense in terms of a much larger autonomy of the physical picture from its possible moral and social interpretations. Moreover, there were important bearings on the education policy. The rising in importance of science was related to the democratization of English political life and the increasing demand for more public education (Foote, 1954). The separation between science and religion, combined with Playfair's plea for more science in British education threatened to drastically reduce the role of theology in the production of the new intellectual elites. Cardinal John Newman had this problem firmly in mind when he argued that "religious doctrine is knowledge in as full a sense as Newton's doctrine is knowledge. University Teaching without Theology is simply unphilosophical. Theology has at least as good a right to claim a place there as Astronomy" (Newman, 1852, p. 42).

William Whewell and the Argument from Design

The burden to react to French astronomy and to Comtean positivism was bestowed upon the authors of the so-called Bridgewater Treatises. Upon his death in 1829, Francis Henry Egerton, eighth and last Earl of Bridgewater, left a considerable amount of money for the publications of a series of treatises "on the Power, Wisdom and Goodness of God as manifested in the Creation" (Topham, 1998). In 1833, William Whewell, fellow and tutor at Trinity College Cambridge, was asked to write the treatise on astronomy (on Whewell's Natural Theology see Brooke, 1977; Yeo, 1993). In this section I make two essential points for my argument. First, Whewell's answer to philosophical and political positivism consists in a reconfiguration of the discursive practices of Natural Theology by *selecting and adapting* some of the results and argumentative techniques of astronomy. In so doing, Whewell tries to appropriate those conservative potentials implicit in astronomy and, at the same time, to debunk its progressive potentials. This strategy defines a program for cultural hegemony. Second, the debate between Natural Theology and the upholders of the so-called science of progress (Schaffer, 1989) displays a very liberal attitude towards the rules of logic and scientific methodology. I consider this a sign that the debate was loaded with important extra-academic meanings.

My discussion of Whewell's book focuses upon the relation between the argument from design (AD), the stability of the solar system, and the NH. The AD has a very long story (Bowler, 1977; Dupré, 1974; Harrison, 2005; Pearl, 1970; Peterfreund, 2012; Temple, 1992). A very popular version, developed by William Paley, was based on the analogy between human contrivances and human organs: as the former, also the latter reveal the presence of a designer (Gillespie, 1990). The distinctive trait of Whewell's version is the use of probability. Throughout his book, he argues that the universe as it stands cannot be the effect of pure chance, *ergo* there must be a designer. The authority of this specific argument comes from the fact that Laplace himself had used probability calculus to establish the cause of the configuration of the solar system (Gillispie, 1997). The improbability of the universe concerns two aspects: the remarkable adaptation between the existing physical laws and the inhabitants of the universe and the specific values of some physical parameters (Whewell, 1833, p. 9). The first aspect leads to what is now called an *anthropic argument*, whereas the second points at the so-called *fine-tuning argument*.

The main contrast between the AD and evolutionism is that, for evolutionism there is no *mutual* adaptation between physical laws and biological beings: the former work as selectors of the latter. The observed harmony is the result of a historical process due to secondary causes. Whewell's strategy to counter this story consists in pushing the reason of the harmony back to the *origin* of physical laws and parameters: "the machine will move of itself, we may grant: but who constructed the machine, so that its movements might answer the purposes of life?" (Whewell, 1833, pp. 171-172). The initial setting and the determinism of the natural laws originate the observed universe (Whewell, 1833, p. 30). It's the extreme specificity of the setting that, according to Whewell, leads us to conclude the existence of a benevolent designer.

A favorite example is the stability of the solar system. Laplace showed that stability depends on some astronomical circumstances, whose random occurrence is highly improbable. This suggests a provident arrangement. However, the example displays the main feature of Whewell's AD, that is the fact that it's beset with logical fallacies (Ruse, 1977). What Laplace really stated was, at best, that, given those conditions, stability is *mathematical provable*. For Whewell's argument to work, one has to assume that those are the only *physical* conditions ensuring stability. This is only one example of fallacy. Another typical Whewell's statement is that special circumstances, which turn out to be suitable for human life, are very improbable and therefore designed. There are two difficulties with this claim. First, at times the circumstances are simply not so special. For example, the small eccentricity of the planetary orbits favors regular seasons. The orbits, though, are not *exactly* circular, which would be exceptional, but *almost* circular. This leads to John Stuart Mill's famous consideration that the AD selects some nice coincidences but cannot match many small imperfections with the idea of a supremely intelligent designer. Second, Whewell argues that the fine-tuned values of certain parameters is highly improbable. But, the values are not so exactly fine-tuned, to begin with, which brings us back to Mill's observation. Further, while it is true that a single value is much more improbable than the set of its alternative, any *single value* is as probable as any other. Thus, Whewell's argument depends on the question he asks.

This short discussion shows that Whewell's argument was not meant as part of a purely philosophical conversation. The goal of his program was much broader. By carefully selecting and arranging specific bits of the astronomical body of knowledge, he intended to provide a picture of the universe as shaped by a superior moral principle. This connection completely redefines the use of the physical world as a metaphor for social reform. Also the latter must come from above in terms of traditional values. This goal becomes clear in the third part of the book, where Whewell links the physical and the moral world. But it is probably even clearer in his discussion of the NH. Whewell admits that the hypothesis yields a plausible story about how the system evolved from a nebulous state, but he insists that there's still no explanation of the *origin* of the process. Whewell's strategy is to carve for Natural Theology a more foundational role and to relegate physical sciences to a purely instrumental function in order to debunk their social and political potentialities (Whewell, 1833, pp. 179-180).

This project challenged head-on the attempts by John Nichol and Herbert Spencer, among others, to start a season of reforms upon the notion of science of progress (Nichol, 1836, 1837; Spencer, 1857). Adopting a Comtean view, Nichol saw in the NH the model of a physical world starting from contingent initial conditions and evolving according to natural laws. This model could easily be exported to a program of social reforms promoting a new system of education and political economy. It is important to notice, however, that also the upholders of the science of progress took a very liberal attitude towards the construction of their arguments. As Simon Schaffer has noticed, the physical evidence in favor or against the NH were taken in a very flexible manner (Schaffer, 1989). When the Orion nebula was resolved into a system of stars in 1846, Nichol, who had heavily relied on that case, changed his argument to make the Orion observations irrelevant. As Schaffer suggests, this is the sign that something more important than an academic debate was at stake. The disseminated analogy between Ricardian political economy and mechanics and especially the evolutionary view of nature were the real target of this program. "[T]he nebular hypothesis was part of the science of progress, which showed how advance in the natural world would gradually change the social order;" ultimately, this program bore on the common sense because "teaching truths such as the nebular hypothesis would aid and illustrate educational and economic reforms" (Schaffer, 1989, p. 151).

Conclusions

To sum up, the debate between Natural Theology and science of progress in the early Victorian age shows some of the traits of a struggle for cultural hegemony I have outlined in the introduction. They presented alternative stories about the natural world by selecting and centralizing the body of scientific knowledge under competing principles. Their discoursive practices prove that what was at stake in this debate was a novel view of society, education, and economy.

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