STS C200, Week 1: Politics and Historiography

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1 The German Ideology / Karl Marx and Friedrich Engels [1]

In this essay, the authors present the materialistic method, compare their method to those of their opponents, and offer a brief analysis of (European, "recent") history through the materialistic lens.

Part A ("Idealism and Materialism") introduces the key assertion that there exists a connection between ideas and the reality in which they were conceived. This is in stark contrast to the Young Hegelians, which treat most everything as a religious conception and criticize using theological tools. In particular, Young Hegelian analysis is based solely on ideas or "phrases", and does not consider their "material surroundings".

Next (in Part A), the authors describe the premises of the materialist method. The initial premise for the existence of history is that living individuals exist. Humans produce their means of subsistence, procreate, and increase their population. This, in turn, increases interaction among humans (in a manner determined by production of the means). Labor is divided and the population is separated: industrial against commercial, agriculture against town against country. Ownership of property then occurs in various forms: from tribal, through State and feudal, and ultimately modern capital. The authors stress a key aspect in their methodology, which is that their premises "can be verified in a purely empirical way", again in stark contrast to their contemporaries; their contemporaries reason "from heaven to earth" (from ideas and ideologies to reality) whereas the authors "set out from real [...] men, and [from] their life-process [they] demonstrate the development of ideological reflexes..."

I found Part B ("The Illusion of the Epoch") hard to decipher. It is focused on polemics with thought-schools unfamiliar to me. That said, some of the arguments therein sharpened certain less-nuanced points. For example, the authors observe that the ruling class sets the agenda and defines ruling ideas (which plays a key role in [2]), and thus an analysis focused only on ideas is inherently lacking as it considers only the history of the ruling class.

Part C ("The Real Basis of Ideology") sees an instantiation of the materialistic framework to our "real world", with an analysis starting from the middle ages and ending in the modern era. Initially, guilds are the center of productive knowledge, with masters at their helms. Production and commerce separate, and so merchants and movable capital emerge. With these, trade connects markets in the world, marking the start of "world history"; the larger market motivates specialization, and so manufacture is motivated and created.[1] A final, concrete and crucial example is in the maritime dominance of England: it increased demand on English goods (textile), and with manufacture as the bottleneck, the industrial revolution follows and with it capital as we know it (private capital). Finally, a concluding section circles back to the development of property.

2 The Social and Economic Roots of Newton's *Principia* / Boris Hessen [2]

The main goal of this work is to present a materialistic analysis of Newton's *Principia*. Structurally, I view the essay as partitioned into three parts: the materialistic analysis of *Principia* itself, a discussion on (conservation of) energy through consideration of the steam engine, and a polemic on machine-wreckers.

[1] Of particular interest to us is the assertion that "natural science [was made] subservient to capital..."

The analysis of *Principia* starts with a political and religious profile of Newton, based on his parliamentary activities and his correspondences with Richard Bentley (respectively). From a general socio-economic perspective, Hessen (later) rules that Newton was a "child of his class".

The brunt of Hessen's work is in portraying how the contents of *Principia* arose from the technical tasks of its era, tasks that are chosen by the ruling (or rising) classes. Hessen gives a detailed description of the technical items on the agenda, namely maritime trade and transport, mining, and military goods. The reason behind the significance of these is explained as well, and echoes the history given in The German Ideology: the transition from a feudal artisan society to one governed by trade and manufacture.

In the second part of his work, Hessen considers the law of conservation of energy, or rather why this law is not present in Newton's work. Hessen distinguishes between different kinds of energy (mechanical, thermal, electromagnetic), and observes that Newton and his contemporaries were concerned only with conversions within each kind of energy, but not between different kinds. The appearance of the steam engine (during Newton's time) brought into the spotlight the benefits of connecting one form of energy (thermal) to another (mechanical), and the ensuing scientific interest in this phenomenon (due to its relevance to production, of course) yielded the corresponding law of conservation.

The final part argues about the nature of machine-wrecking in the industrial age. Hessen considers two Nature articles [3, 4] that, per Hessen, claim that machine-wreckers (e.g. Luddites) were expressing the (allegedly positive) desire of returning to more "elastic" forms of production characteristic of the pre-industrial era. Hessen rejects this view: Not only would such a desire be blantantly reactionary (thus, negative), but the Nature articles misunderstand the actions of the machine-wreckers. The wreckers were attacking not the means of production, but the fact that the latter are privately owned and the system of wage in general. The physical destruction of machines is explained as an example of commercial fetishins: the machines symbolize the underlying exploitative relations between workers and their employers.

Although the significance of Hessen's work is commonly attributed to its novel contents, I appreciated it for its pedagogical tone. Hessen is not merely presenting a materialistic analysis of *Principia*, but seems to patiently teach the reader about Marx and illuminate Marxist thought. The essay starts with a summary of dialectical materialism, takes the time to reveal a historiographic debate (on late 17th century English revolutions) Marx had with Hume and Macauly, and through various points explicitly tells the reader which components of materialism are demonstrated in which parts of the text. This is perhaps not surprising given the venue and historical circumstances in which the essay appeared (see [5]), and I personally appreciated this as a neophyte of materialistic (and, generally, historical) thought.

3 From the Closed World to the Infinite Universe / Alexandre Koyré [6]

Koyré's book surveys the understanding of the "size" (finiteness, volume, or definiability thereof) of the universe through notable European thinkers in the sixteenth and seventeenth centuries. In high-level, Koyré says that the scientific revolutions of the era led to a total change in the framework of thought, and that the universe transitioned from a finite and closed concept governed by a clear hierarchy, to an infinite (or unfathomably large) system bound together by fundamental laws. With this thesis in mind, I will next highlight some points on each thinker considered by Koyré, and then give some impressions on the work as a whole.

First, Koyré presents the writings of Nicholas of Cusa, who viewed the universe as an imperfect expression of god. A prominent motif in his work is that at infinity, maxima and minima coincide. This theme recurs through different examples, for example in the measurement of size or motion. Koyré interprets this as stressing the lack of precision and stability in our universe. Indeed, it seems that Nicholas points to the error inherent in certain physical measurements (perhaps an early and non-rigorous uncertainty principle [9]). Interestingly, Nicholas explicitly points to the non-existence of perfect spheres, which are famously used in certain classical physical models [7]. On a tangential and anachronistic note, I cannot help but think that Nicholas would have greatly benefitted from infinitesimal calculus: while I can empathize with his confusion regarding the infinitely large, calculus gives us an elegant framework to reason about the infinitely small.

Next, Koyré considers Bruno and Copernicus. Copernicus's universe is not infinite but "immeasurable".[2] Bruno's universe is entirely infinite, an essentially unprecedented statement that he bases on the principle of plenitude. It's worth noting that while Digges made a similar assertion before Bruno, Koyré argues that Bruno deserves the credit for passionately advocating for this idea. Still, Koyré rules that Bruno was a "very poor" mathematician, philosopher and cosmologist, and he doubts whether Bruno influenced his contemporaries at all. This conclusion confused me: Koyré's criterion for crediting Bruno and not Digges was based not on the work itself but on its communication to others, yet he acknowledges that Bruno may not have influenced his contemporaries at all. Is science a shouting competition, where the loudest are rewarded regardless of content or effective communication?

Koyré then considers Kepler, who rejected the infinite universe for metaphysical and scientific reasons. Koyré focuses on two of Kepler's arguments. One relies on the principle of sufficient reason: if the universe is infinite and uniform, so must be the distribution of stars (and I add: a uniform distribution cannot be supported on an infinite object). The second is that an astronomical theory is scientific (I add: and therefore must be falsifiable); astronomy measures things by "seeing" them, and one cannot see infinitely far. It could be that my clarifications are misguided, but I find Kepler's logic in both arguments to be flawed: First, why must an infinite universe be uniform (and why must there be infinite stars)? For the second, it is precisely because we cannot see infinitely far that the infinite universe theory is falsifiable—if it is false, one should be able to see the edge of the universe.

Finally (in our scope), we have Galileo and Descartes. Both share Nicholas's view of an "interminate" or "indefinite" (but not "infinite") universe. Galileo suggests that the universe has no center in which the sun and earth can be placed. Descartes reasons using his extension, which, to my understanding, is simply multidimensionality (of a system, or an object within a system).

Koyré's work is glaringly non-materialistic (even idealistic), especially in comparison to Marx and Engels and Hessen. In his analysis, Koyré almost exclusively considers "great thinkers" and the discourse between them; reading the book, it appears as though science of that era was a closed world consisting of a few dozen people. Not all books need to have an extensive analysis of social and economic circumstances. But, for example, while Koyré does mention a remark of Christina of Sweden, who notes that an infinite universe seems to contradict man's god-given central position, he neglects to mention that Bruno was executed for voicing his ("infinite universe") views. This is despite the fact that the latter precedent surely has deterred his successors from stating similar views.

I was also surprised to find not one single mention of modern mathematics's understanding of the infinity, particularly Cantor's foundational work on infinity through the lens of set theory (see, e.g., [10]). Of course, this foundation was laid several centuries after the works studied by Koyré, but it could have helped clarify (or at least contrast) the liberal and vague uses of infinity used by the scholars this book studies.

4 Questions and topics for discussions

- Hessen describes "ruling ideas", set forth by a ruling class as an eternal truth. Is science itself a ruling idea? While specific theories are not eternal truths, the validity of the scientific itself is not falsifiable. Which class is responsible for science's dominance?

- An additional argument against the reactionary views presented in [3, 4]: Hessen provides a detailed (materialistic) analysis of why the industrial revolution arose precisely from the circumstances that preceded it. Therefore, it is futile to artificially "roll back" the wheels of history.

- A fun thought experiment: Could Cantor have saved Bruno? Bruno says that God is a "simple infinite" and that the (also infinite) universe is but a point compared to God. I do not know if "simple" had the inferior connotation it has today, but history tells us that Bruno's argument did not convince the inquisition. Cantor, on the other hand, could have explained that the universe is *transfinite* where God

[2] Again I cannot help but note that in modern mathematics, any non-measurable set is actually infinite (with respect to the Lebesgue measure, commonly associated with the "real world". See, e.g. [8]).

is of *absolute infinity*, and so God retains their supremacy. (That said, I do not know if Cantor could have exonerated Bruno from the additional charges of "magics and divination".)

References

[1] Karl Marx and Friedrich Engels, The German Ideology [1845-46]. Part A, B, and C.

[2] Boris Hessen, The Social and Economic Roots of Newton's *Principia* [1931]. Reprinted in The Social and Economic Roots of the Scientific Revolution: texts by Boris Hessen and Henryk Grossmann. Edited by Gideon Freudenthal and Peter McLaughlin, Dordrecht: Springer, 2009, 41-101.

[3] W.G. Linn Cass, Unemployment and Hope [1930]. Nature 125, 346.

[4] Science and Society [1930]. Nature 126, 497–499.

[5] Gerardo Ienna and Giulia Rispoli, Boris Hessen at the Crossroads of Science and Ideology [2019]. Society and Politics. 13 (No.1 (25) April 2019).

[6] Alexandre Koyré, From the Closed World to the Infinite Universe [1957]. Baltimore: John Hopkins University Press.

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[10] Azriel Lévy, Basic Set Theory [2002]. New York: Dover Publications.