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What Is at Stake in the Formalization of a Chronostratigraphic Unit? A Case Study on the Anthropocene

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Abstract

The prospective formalization of the Anthropocene as a chronostratigraphic unit by the International Commission on Stratigraphy has been intensely debated. This paper explores and assesses the stakes of this process from a philosophical perspective. I distinguish two senses of formalization—the descriptive and the evaluative—and argue that: 1) there are descriptive and evaluative formalizations of the Anthropocene beyond the confines of the ICS; 2) incoherencies between Anthropocene proposals and the ICS's current tenets are not a decisive reason for deferring descriptive formalization; and 3) the prospective evaluative formalization of the Anthropocene by the ICS would be impactful.

1. Introduction

In 2000, Paul Crutzen and Eugene Stoermer proposed to use the term “Anthropocene” for the current geological epoch, to acknowledge the ongoing impact of human activities on the Earth (Crutzen and Stoermer 2000). This impact has been well-documented in a vast number of scientific publications. However, most impact is reported on the atmosphere, hydrosphere, biosphere, cryosphere, pedosphere, and at their interfaces. There is less compelling evidence about the impact of humans on the lithosphere. This is the predicament: It is in the lithospheric domain that geological epochs have been traditionally formalized, based on stratigraphic evidence.

The International Commission on Stratigraphy (ICS) is generally recognized as the official international arbiter for definitions of units of geological time or “geochronological” units. Their approach is to identify bodies of rock—known as chronostratigraphic units—established between specific stratigraphic horizons, which represent specified intervals of time. Thus, each chronostratigraphic unit has a corresponding geochronological unit. Chronostratigraphic units are established through the Global Boundary Stratotype Section and Point (GSSP) approach, which establishes the lower boundary of a chronostratigraphic unit, according to a biotic or physical stratigraphic signal with global scope (Murphy and Salvador 1999, 269).

In order to be formalized by the ICS, the Anthropocene should go through the same process of being defined by a lower boundary based on a stratigraphic signal. The body in charge of collecting evidence for this purpose is the Anthropocene Working Group (AWG). On its website, the AWG declares its official stance: 1) the Anthropocene should be treated as a formal chronostratigraphic unit; and 2) its base should be established based on a stratigraphic signal around the mid-twentieth century. Formalization of the Anthropocene by the ICS is still pending, and rejection remains a realistic scenario.

In his persuasive 2019 paper, Carlos Santana argues that formal recognition of the Anthropocene by the ICS should be indefinitely deferred by challenging two arguments in favor of its formalization (Santana 2019). The first one is referred to as the “future geologist perspective” argument. According to it, formalizing the Anthropocene is justified based on what future geologists will recognize as significant markers in the stratigraphy to establish the lower boundary of the Anthropocene roughly in our present time. Santana challenges this argument by pointing out that “extant geological changes don’t reach the thresholds necessary to define [the Anthropocene as] a new epoch, and predictions about the future are impossible given human capability to slow and reverse anthropogenic effects” (1077).

The second argument is referred to as the “synchronic perspective” argument. According to it, formalizing the Anthropocene is justified based on the synchronic consequences of its formalization, above all its political effects. In particular, formalizing the Anthropocene may convince climate change skeptics about the human impact on the environment, which would significantly reconfigure the political space. Nonetheless, Santana argues that formalizing the Anthropocene does not warrant these expectations and it could even backfire (*ibid.*).

In this paper, I explore and assess some of the stakes of the formalization of the Anthropocene, using Santana’s argument as a foil to structure my own. I proceed in four steps. In section 2, I distinguish and explicate two senses of “formalization,” namely the descriptive and the evaluative. In section 3, I submit that there is a plurality of formalizations of the Anthropocene, both descriptive and evaluative, beyond the confines of the ICS. In sections 4 and 5, I address the predicaments for formalizing the Anthropocene in the context of the ICS, as schematized by Santana. I submit that Santana’s argument can be restated as: 1) an argument for “the lack of descriptive formality” of proposals for formalizing the Anthropocene that assume the future geologist perspective; and 2) as an argument for “the incompetence of evaluative formalization” of the Anthropocene, leading him to reject the “synchronic perspective” argument. I counterargue both of Santana’s appraisals in sections 4 and 5, respectively. Finally, in section 6, I deliver concluding remarks.

2. Descriptive and evaluative formalizations

There are two senses in which the term “formalization” is used: the descriptive and the evaluative. Consider the Merriam-Webster Dictionary, which defines “formalize” as: 1) to give a certain or *definite form* to; 2a) to make formal; and 2b) to give formal status or *approval* to (Merriam-Webster, *n.d.*; my emphasis). These two distinct senses can be referred to as the “descriptive” and “evaluative” senses of formalization, the

descriptive capturing the idea of *definite form*, and the evaluative capturing the idea of *approval*. As a caveat, the objects of formalizations in science can be varied, such as concepts, methods, and theories. For the purposes of this paper, I focus on the formalization of the Anthropocene as a concept.

In the descriptive sense, formalization amounts to providing an *explicit and rigorous articulation*. Articulations give definite form to concepts through language. This language may be mathematical, as in formalizations in the exact or quantitative sciences. However, formalizations may also be achieved by means of natural or technical (but not necessarily mathematical) languages. In particular, this is how descriptive formalization of the Anthropocene as a concept should be understood: as an explicit definition and/or classification rigorously based on a principled scheme. In practice, this means stating its date of beginning (explicitness) based on empirical evidence (rigorosity).

In the descriptive sense, formalization is a means for clarity (cf. Suppes 1968, 653). This aim may be construed as a non-epistemic desideratum (e.g., aesthetical). However, its main import in science is epistemic: Formalization is a strategy to avoid ambiguities and errors in communication, and thus promote efficient and precise scientific research. Having said this, there is no single, objective metric to measure the clarity of an articulation. Because of this, formalizations could be achieved by alternative articulations, making the choice a contextual matter.

In the evaluative sense, formalizing a concept means providing it with *institutional approval and endorsement*. This makes evaluative formalization a contextual matter, given that different institutions may have different standings on concepts. Evaluative formalization of the Anthropocene amounts to deeming the general, if vague, notion of a present human-driven time worth of approval. In practice, this means admitting and/or promoting the use of the term in peer-reviewed publications, official documents and reports, names of institutions, etc.

In the evaluative sense, formalization leads to standardization (cf. Suppes 1968, 654). That is, the institutional endorsement of concepts affords common terminology and related practices for the endorsing institutions. Standardization may be motivated by non-epistemic aims (e.g., instrumental, aesthetical, ethical, or political). However, it is its epistemic import that plays a major role in justifying it in the context of science. Standardization improves communication among scientists by means of affording common terminology and related practices, making scientific research more efficient and precise. Still, it is worth mentioning that standardization may at times function as an impediment for innovation and adaptation. In this sense, scientists should also be cautious about procedures of standardization and remain vigilant of the established standards.

These two senses of formalization are conceptually distinct and, in principle, independent. That is, institutional endorsement of X does not imply that X has an explicit and rigorous articulation, and X having an explicit and rigorous articulation does not imply its endorsement by specific institutions. Nonetheless, these two senses of formalization tend to cooccur, often causally so. On the one hand, explicit and rigorous articulations tend to motivate institutional approval and endorsement, due to the valuable opportunities for efficient sharing and reusing of content. On the other hand, institutional endorsements may come first, for standardization purposes, and motivate elucidatory efforts later.

In particular, descriptive and evaluative considerations cooccur in the AWG vote for the formalization of the Anthropocene. The first vote asked “Should the Anthropocene be treated as a formal chrono-stratigraphic unit defined by a GSSP?,” which is an evaluative consideration. The second vote asked “Should the primary guide for the base of the Anthropocene be one of the stratigraphic signals around the mid-twentieth century of the Common Era?,” which is a descriptive consideration. It is interesting to note that both questions received the same number of votes in favor: twenty-nine out of thirty-three votes (see AWG’s website). This reflects how entwined descriptive and evaluative considerations are in spite of their in-principle orthogonality. With the descriptive/evaluative distinction well established, I proceed to assess the status of the Anthropocene.

3. A brief commentary on the status of the Anthropocene beyond the ICS

“Anthropocene” has become a widely used term among working scientists from different disciplines, such as climate studies, ecology, oceanography, economy, and anthropology, to name a few. A search in Google Scholar returns about 265,000 entries with the term Anthropocene, with a substantial component of peer-reviewed articles (Google Scholar, [n.d.](#)). In fact, two of the most prestigious scientific journals—*Nature* and *Science*—have published articles endorsing it (e.g., Lewis and Maslin 2015; Waters et al. 2016). And there are journals and research centers exclusively dedicated to studying the Anthropocene and named after it (e.g., Elsevier’s “Anthropocene” or the Vienna Anthropocene Network). With this evidence, it becomes difficult to make a case for the lack of institutional endorsement *tout court* of the term “Anthropocene.” Thus, in the evaluative sense, the Anthropocene is a formal notion in several domains.

To be clear, what is deemed acceptable is not a single, explicit, and rigorous articulation of the Anthropocene. Rather, what is being endorsed is a general notion, common to all employments of the term, rooted in its etymology. The shared notion is that the present time is “human-driven,” i.e., human activities are affecting the dynamics and constitution of the planet in an unprecedented fashion. This general notion is not controversial (e.g., “[i]t is unequivocal that human influence has warmed the atmosphere, ocean and land”; IPCC 2021, SPM-5). The controversial part is how to formalize the Anthropocene descriptively, i.e., how to articulate this general notion explicitly and rigorously. Conceding that the general notion of the Anthropocene is formal, in the evaluative sense, in multiple contexts, I proceed to focus on the issue of its descriptive formality.

As a matter of fact, there have been several attempts to explicitly and rigorously articulate the Anthropocene. Each attempt states a date of beginning of the Anthropocene (i.e., explicitness) based on empirical evidence (i.e., rigorosity). For example, Lewis and Maslin (2015) compile nine potential start dates for a formal Anthropocene (175). These proposals range widely in date of beginning based on different events, e.g., 5,020 yr before present (beginning of rice production), 1610 (new-old world collision), and 1964 (great acceleration). They also range in the evidence on which they are based, e.g., CH₄ inflection in glacier ice, low point of CO₂ in glacier ice, and radionuclides (¹⁴C) in tree-rings.

It is not my intention to discuss the particular merits of these and other proposals. My point here is to show that descriptive formality is compatible with a plurality of

articulations. That is, a same concept may be explicitly and rigorously articulated in multiple ways, each one satisfying the epistemic aim of clarity through definite form. This is the case with the Anthropocene: There are several descriptive formalizations of the Anthropocene conceptualized as a human-driven epoch, each one establishing a distinct date of beginning based on specific empirical evidence. The fact that there is no agreement on the endorsement of a particular articulation is a problem of standardization, i.e., a matter of evaluative formalization at the level of specific articulations. As a corollary, descriptive formalization is not necessarily a path toward standardization.

The latter is an important lesson, given that standardization is one of the main aims of the ICS. In its website, the ICS declares that the purposes of its stratigraphic guide are “to promote international agreement on principles of stratigraphic classification and to develop an internationally acceptable stratigraphic terminology and rules of stratigraphic procedure—all in the interest of improved accuracy and precision in international communication, coordination, and understanding.” These purposes are laudable goals that prompt efforts for formalization, including that of chronostratigraphic units and related geochronological ones. However, geochronological units are of interest to scientists beyond the international community of stratigraphers. Hence, it is crucial to elucidate the scope of standardization that would ensue from a potential formalization of the Anthropocene by the ICS.

The AWG has emphasized that its mandate should not be conceived as an attempt to force interdisciplinary standardization. In a recent report, this is stated clearly: The AWG’s first task is to identify and assess scientific evidence for the “geological” or “stratigraphic” Anthropocene, i.e., geological evidence that justifies the formalization of the Anthropocene in the stratigraphy (Zalasiewicz et al. 2019, 2; Vidas et al. 2019, 31). This leaves space for other disciplines to descriptively formalize the Anthropocene in other, nonstratigraphic ways. In particular, Zalasiewicz et al. (2019) concede that the social sciences, humanities, and arts may develop their own concepts of the Anthropocene (3). And Vidas et al. (2019) admit that other natural sciences may not be particularly interested in the descriptive formalization of the Anthropocene as a chronostratigraphic unit, e.g., archaeology and Earth System science (34–35).

At the same time, the AWG has a second task, namely “to explain the usefulness of formalisation of the Anthropocene for both geological and wider scientific communities, which in this case include those beyond the physical sciences” (Ibid., 32). There is a sense in which descriptive and evaluative formalization of the Anthropocene by the ICS would stabilize the concept. As Vidas et al. illustrate, this stabilization would likely benefit other disciplines and endeavors beyond stratigraphy and geology, bringing about some degree of interdisciplinary standardization. But here the rhetoric is crucial. Vidas et al. talk about stabilizing the term in a way that is “consistent” with the way it is understood in other domains (34). They talk about being “convincing” (as opposed to “conclusive”) and keeping “synergistic relations” with other disciplines (32, 35). In this sense, the AWG seems committed to contribute to interdisciplinary standardization but only up to some degree and with due process.

This makes an important difference. Standardization should emerge (if at all) from the free interactions, democratic procedures, and collective negotiations and exchanges in which scientists engage. In other words, the problem is not standardization simpliciter but “centralized” standardization, conducted in a reductionistic and

monolithic fashion. The patent interdisciplinarity of the debates concerning the Anthropocene calls for due process in deciding standards. In this sense, the AWG seem to play a mediating role, sensitive to the diversity of commitments across disciplines. It is to be expected that this attitude permeates and reaches most scientists working in these endeavors, especially those peers in stratigraphy and geology. In the next sections, I focus on the internalist problem of formalizing the Anthropocene within the context of the ICS.

4. Descriptive formalization and the problem of incoherence

As stated above, Santana challenges two arguments that provide support for the formalization of the Anthropocene in the context of the ICS. The first one is the “future geologist perspective” argument, which submits that formalizing the Anthropocene is justified based on what a future geologist will recognize as significant markers in the stratigraphy to establish the lower boundary of the Anthropocene roughly in our present time. Santana argues that this perspective—and the proposals based on it—fall into one of three problems. The future geologist may see evidence of human activity in the stratigraphy, but: 1) it may be relatively insignificant (merely a brief anomaly) because humans may be able to mitigate their impact; 2) even if humans are not able to mitigate their impact, the signal in the stratigraphy may end up being better regarded as a series of local catastrophes rather than geological events of global reach and long-term impact (making it not epoch-defining); and 3) the stratigraphic evidence may be there in the future but it may be better regarded as a continuation of processes that started already in the Holocene.

I suggest that these problems, which are rightly pointed out by Santana, are construed as problems of descriptive formalization. On the one hand, the future geologist perspective does not afford *rigorous* empirical evidence to descriptively formalize the Anthropocene as a geological epoch. This is because it relies on predictive criteria that may end up being wrong or otherwise provide insufficient evidence, i.e., not epoch-defining (problems 1 and 2). On the other hand, there is a problem concerning the lack of an *explicit* definition of the Anthropocene, due to a seeming continuation with processes that started in the Holocene (problem 3). Thus, Santana’s counterargument to the future geologist perspective can be expressed as an argument for the “lack of descriptive formality” in the proposals for the formalization of the Anthropocene.

I submit that these problems emerge from issues of incoherence among proposals based on the future geologist perspective and those tenets currently held by the ICS. First, there is an incoherence of methods between the predictive approach implicit in the future geologist perspective and the traditional empirical (GSSP) approach of the ICS. Second, if the evidence for the Anthropocene is not epoch-defining, then the features of an eventually formal Anthropocene epoch would be incoherent with those of other formalized geological epochs, particularly in terms of their duration and global reach. Third, an eventually formal Anthropocene would be incoherent with the current formalization of the Holocene, given that proposed markers for the beginning of the Anthropocene seem to blend with processes that commenced during the Holocene.

Thus, I interpret Santana’s challenge to the future geologist perspective argument as an attempt to safeguard the coherence achieved between the ICS’s guidelines and currently formal chronostratigraphic units. If this interpretation is correct, it must be

admitted that it reflects a reasonable goal: In most scientific endeavors, coherence across a constellation of scientific commitments is a central value. However, I articulate two responses that keep the formalization of the Anthropocene as a viable option in spite of its putative incoherent import.

First, the centrality of coherence as a value is compatible with the acceptance of immediate incoherence as a path toward prospective coherence. I illustrate this in the context of an argument by Oreskes (2019). She argues that epistemic strength is gained through diversity in scientific practice and representation. Opening scientific debates to a diversity of perspectives and communities of practice often has an immediate negative effect in the overall coherence of the endeavor at hand. But the thesis is that immediate incoherence pays off in the long term by enabling the exploration of unprecedented configurations and, through processes of reflective equilibrium, settling for more robust states of coherence.

Formalization of the Anthropocene may be seen under this light. In order to gain epistemic strength, the ICS may need to open the debate to the various proposals for formalization of the Anthropocene that do not cohere with its current guidelines and formal units. By broadening the scope of assessment, what used to be coherent within the narrow scope of the ICS would become incoherent in the context of the plethora of perspectives of the interdisciplinary community. But, as the thesis goes, this incoherence may only be temporary. The prospect is that all agents involved in the debate of the Anthropocene—including the ICS—may be able to find new configurations that are robustly coherent, even if this involves the readjustment of chronostratigraphic units and guidelines of the ICS.

The second response to the problem of incoherence is that the very centrality of the value of coherence may be questioned. In particular, geologists tend to navigate the overlaps and mismatches of schemes of classification without much anguish. Chronostratigraphy is not the exception. As Lucas (2018) points out, the ICS has been inconsistent in the past in its GSSP approach and overall schemes of classification. (“Inconsistency” and “incoherence” operate as synonymous in this argument.) For example, he reports that different subcommissions request exceptional ranks, such as “subsystems” for the Carboniferous and “subseries” for the Paleogene (9). Also, different subcommissions adopt different protocols for updating or retaining the names of chronostratigraphic units (Ibid.). Finally, there is inconsistent criteria among subcommissions in choosing the signals for defining GSSPs, switching from biotic, to physic, to hybrid criteria (Ibid., 9–10). As Lucas argues, these inconsistencies “reflect the differing philosophies, methods, priorities and available data of the different subcommissions. They also reflect a failure by the ICS to standardize both terminology and methodology. Thus, there has been no consistent method of GSSP definition [...]” (10). If Lucas is right, then the incoherent import of the Anthropocene as a chronostratigraphic unit could not be used as a sufficient reason for rejection.

In sum, I suggest that Santana’s criticism of the future geologist perspective argument rests upon the central value of coherence. But in a historical and inexact discipline such as stratigraphy, the value of coherence is susceptible to significant trade-offs, as reflected by practices of accommodation and transient incoherence in the GSSP approach. And even if the value of coherence reigns supreme, immediate incoherence may be accepted in the name of future coherence.

5. Evaluative formalization and its inherent political dimension

Santana challenges a second argument in support of the formalization of the Anthropocene: the “synchronic perspective” argument. This argument holds that formalization of the Anthropocene should be decided based on its synchronic consequences, in particular its political effects. Thus, the synchronic perspective argument embraces the political dimension of scientific endeavors, which include those of the ICS. After all, the fact that GSSPs are decided by vote makes the formalization of chronostratigraphic units inherently political. And this is especially so in the case of the Anthropocene, given that its formalization may change the relationship that humans have with the Earth.

Santana engages with the synchronic perspective argument by reacting to an editorial in *Nature* (2011): “Official recognition of the concept [i.e., Anthropocene] [...] would encourage a mindset that will be important not only to fully understand the transformation now occurring but to take action to control it” (254, my emphasis). Along similar lines, Vidas et al. (2019) discuss the utility that formalizing the Anthropocene might have in the contexts of international law and public health (36–9). I take these claims as a call for evaluative formalization of the Anthropocene due to its political impacts.

Santana departs from these views and denies that scientific recognition of the Anthropocene would help (2019, 1087). He focuses on what he considers to be the crux of the matter, namely the potential conversion of climate change skeptics due to the formalization of the Anthropocene. He argues that this expectation is unwarranted given that skeptics do not necessarily convert in light of scientific consensus (1089). Furthermore, Santana argues that scientific consensus may even work against conversion of the skeptics, polarizing the factions even more (ibid.). Thus, I suggest that Santana’s counterargument to the “synchronic perspective” argument can be cast as an argument for “the incompetence of evaluative formalization.”

I have two responses to Santana’s views. First, the potential political instrumentalization of the evaluative formalization of the Anthropocene goes well beyond the conversion of skeptics. If the skeptics are a lost cause (as Santana convincingly argues), the political space may still be reconfigured by the force of the undecided, the unmotivated, and the new generations. The formalization of the Anthropocene can be seen under this light: as a political signal that may be ignored by the skeptics, but one that may well attract the attention of those who need and often seek guidance. In this sense, I estimate that Santana takes too narrow a view of the potential benefits of the evaluative formalization of the Anthropocene.

A second response is that, beyond matters of political instrumentalization, the evaluative formalization of the Anthropocene signals a political stance. It may not be straightforward to instrumentalize this stance, given the complexity of relations in the political space and the longer-term (often unpredictable) effects. But this does not mean that the stance is impotent. Here, I am inspired by Latour’s views on political ecology (2004), according to which different political stances within the political space are to be “ecologically” managed through due process. The outcomes of these processes may not be straightforwardly predictable, but they are shaped by the presence of each stance in the political space. In this regard, it must not be forgotten that

the alternative—i.e., *not* formalizing the Anthropocene—would also have political implications (cf. Vidas et al. 2019, 40).

Ultimately, our political stances and related decisions should first and foremost stand for what we have reason to value, regardless of the concrete prospects of converting our rivals in the political arena. If you are, say, a left-winger, you should not stop proposing socialist policies just because the right-wingers are unpersuaded by your propositions. This would not be a sustainable strategy for the Left. The ensuing diversity of political views, even the rivalry among them, should not be regarded as intrinsically negative, to be surmounted with one being on the right side. There are opportunities for collective thriving in political conflict if the conflict is duly managed. It is through the tensions and subsequent dialogues between political stances that unexpected political paths may be discovered and eventually followed. But, in order to be representative, these processes require the signaling of stances in the first place.

Given these two responses, I consider that the competence of evaluative formalization of the Anthropocene cannot be reduced to the conversion of climate change skeptics. The first, non-instrumental, concern should be where the ICS stands in terms of the politics of the Anthropocene, orthogonally to the issue of its descriptive formalization. And the second, instrumental concern should be how the formalization of the Anthropocene can be exploited beyond the conversion of skeptics. The AWG has already signaled a clear stance with its vote for the evaluative formalization of the Anthropocene. It is up to the members of the ICS to decide whether they follow suit. Whatever they decide, they should not fear their signal not having political implications or even the potential to be instrumentalized in specific ways.

6. Conclusions

Before restating the main points of this paper, it is worth emphasizing what I have *not* attempted. I have *not* claimed that the ICS should formalize the Anthropocene. I also have *not* analyzed the merits of particular proposals for formalizing the Anthropocene in the context of the ICS. Rather, my only claims have been: 1) there is a plurality of formalizations of the Anthropocene, descriptive and evaluative, beyond the confines of the ICS; 2) the incoherence of “Anthropocene” proposals with the guidelines and formal units of the ICS is a weak reason for their rejection, given their potential for future coherence and the ICS’s record of inconsistencies; and 3) regardless of what the ICS does in terms of descriptive formalization, they could orthogonally decide a stance in terms of the evaluative formalization of the Anthropocene, which would have significant political consequences.

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