

Recovering Mathematics After Heidegger's Critique

Jared Woodard

Fordham University

jaredwoodard@gmail.com

Both Heidegger's critique of metaphysics in *Being and Time* and his later analysis of modern technology depend upon a more specialized argument against modern mathematical physics. In particular, Heidegger objects to the expansion by moderns like Descartes, Galileo, and Newton of the domain of epistemic certainty and to the projection of *a priori* ontological conditions upon entities. In this paper, I will: 1) recount Heidegger's critique of the mathematical by tracing the development of that critique across his career, 2) demonstrate the centrality of that critique to the larger goals of both his early and later projects, and 3) briefly evaluate whether the intuitionist and platonist positions in the philosophy of mathematics are suggestive of resources which can evade Heidegger's critique.

I.

If the available secondary literature is any guide, consideration of Heidegger's critique of mathematics must not be a very important topic.¹ Hopefully, this essay will provide some persuasive reasons why this silence in the literature represents an unfortunate lacuna: first, Heidegger cared greatly about mathematics throughout his career; second, his arguments against modern mathematics play central roles in his major projects; and finally, a consideration of the specifics of his critique suggests that, rather than privileging poetic reflection in the thinking of being, alternatives within mathematics itself may be ontologically viable. This final provocative conclusion can only be entertained on the basis of a thorough understanding of Heidegger's

¹ Of the handful of sources that treat mathematics at any length, most have broader scientific goals in play, and the two mathematics-specific essays (Elden 2004, Kisiel 1973), though insightful, are not comprehensive by any means.

critique of mathematics, so the bulk of the present essay will survey the relevant texts from Heidegger's corpus in order to summarize his critique in its most developed form.²

In 1911, just two years out of high school, Heidegger switched departments from theology to mathematics and natural sciences.³ For the next two years the bulk of his coursework was in mathematics, including analytic geometry, integral and differential calculus, and algebraic analysis. On July 27, 1915, along with his submitted dissertation on the theory of categories in Duns Scotus, Heidegger delivered a trial lecture to the Philosophy faculty at Freiburg on "The Concept of Time in the Science of History," which was published in a journal the following year.⁴

The two arguments that will be characteristic of Heidegger's approach to the mathematical throughout his life are already present in this early text. They are: first, that the mathematical projection of nature as exhibited in the sciences predetermines the ontology of beings encountered in experience, and second, that this projection is epistemologically overconfident insofar as it asserts certainty about its operations. In the introductory paragraph, we find Heidegger giving a qualified defense of the "tendency toward metaphysics" in the philosophy of that period, this tendency taken as an understandable response to the persistence of problems in epistemology and logic; what is most interesting is that both philosophy and the natural sciences are understood to be pursuing their solutions so as to establish grounded "claims to power" in order to "master our culture," though philosophy does not express a "[will] to power in the sense of the violent intellectual forces of the so-called 'worldview of natural

² The relevant texts listed by composition date are:

1. [1915] "The Concept of Time in the Science of History," *Supplements: From the Earliest Essays to Being and Time and Beyond*, ed. John van Buren (Albany: SUNY Press, 2002), pp. 49-60. Hereafter *CT*.
2. [1924-5] *Plato's Sophist*, trans. Richard Rojcewicz and André Schuwer (Bloomington: Indiana Univ. Press, 1997). Hereafter *PS*.
3. [1926] *Gesamtausgabe, Band 22: Die Grundbegriffe der antiken Philosophie* (Frankfurt am Main: Vittorio Klostermann, 1993). Hereafter *GAP*, translations mine.
4. [1926] *Being and Time*, trans. John Macquarrie and Edward Robinson (London: Blackwell, 1962). Hereafter *BT*.
5. [1935-6] *What is a Thing?* trans. W. B. Barton, Jr. and Vera Deutsch (Chicago: Henry Regnery, 1967). Hereafter *WT*.
6. [1949] "The Question Concerning Technology," *The Question Concerning Technology and Other Essays*, trans. William Lovitt (New York: Harper & Row, 1977). Hereafter *QT*.

³ For this and the following biographical data, I rely on John van Buren, "Chronological Overview: Education, Teaching, Research, and Publication," *Supplements*, pp. 17-33.

⁴ Although his career turned decisively towards philosophy from then on, throughout his life Heidegger continued to serve on examination committees for dissertations in mathematics. David Farrell Krell, "General Introduction: the Question of Being," *Basic Writings: from Being and Time to The Task of Thinking*, ed. David Farrell Krell (New York: Harper Collins, 1977), p. 12.

science.” (CT 50)⁵ Philosophy will not retain this relative innocence in Heidegger’s mind for very long.

Here, however, the primary target is Galileo. Whereas ancient and medieval investigations sought out “the metaphysical essence and hidden causes of the appearances that impose themselves on us in immediate reality.... Galileo’s science signifies something fundamentally new in its *method*. It seeks to gain mastery over the diversity of appearances by means of laws.” (CT 52) Both the ontological and epistemological assumptions of modern mathematics are evident in Galileo’s famous mathematization of nature (“the book of nature is written in the language of mathematics”). In the first place, Galileo’s new method posits measurable and comprehensible relationships between phenomena (epistemological claim), and second, admits only these knowable entities and their relationships to the plane of existence (ontological claim): “tracing all appearances back to the basic mathematically definable laws of a general dynamics.” (CT 53) Heidegger has already positioned himself against this modern method: his thesis in “The Concept of Time in the Science of History” is that there is a dimension of experience which does not submit to either of the modern mathematical claims, namely, the human historical experience of time as a qualitatively – rather than quantitatively – differentiated phenomenon.

Although in 1915 his resources for resisting Galilean mathematization were limited, by 1924 we find Heidegger applying the strategy with which he approached so many topics to mathematics in particular: by returning to ancient and medieval conceptions, he attempted to identify the point of divergence that marked the beginning of modern distortions. In the case of mathematics, he adopts and explains Aristotle’s understanding of the mathematical. The excursus on Aristotle and mathematics in Heidegger’s 1924-5 lecture course on Plato’s *Sophist* arises out of Heidegger’s attempt to understand *sophia* and the opposition between *sophia* and immediate everyday Dasein. (PS 65-69) According to Aristotle, *sophia* is distinctive as the “most rigorous” mode of inquiry because it “touches the foundations of beings in their Being.” (PS 68) Moreover, inquiries characteristic of *sophia* are determined from their outset by *archai*, first principles which “require the greatest acuity to be grasped...because they are the fewest” (PS 68). Only “because the *archai* are limited is a determination of beings in their Being

⁵ It is interesting that the anxious pessimism exhibited later in “The Question Concerning Technology” is already present here; perhaps this lends some additional sense of continuity to the early and later works.

possible” (PS 68) at all. The examples Aristotle gives of this “rigorous science” are the mathematical disciplines of arithmetic and geometry.

Mathematics is characterized as “that which shows itself by being withdrawn from something and specifically from what is immediately given. The *mathematika* are extracted from the *physika onta*, from what immediately shows itself.” (PS 69) It is important not to read Aristotle through Cartesian or Kantian lenses: for Aristotle, this withdrawal from the immediately given is not a givenness to a subject, but a withdrawal from the natural place of the object (“place belongs to beings themselves” [PS 69]⁶). The mathematical, however, does not have a place, a *topos*; this is what distinguishes it from natural reflection about objects. Whereas “the natural man sees a surface as *peras*, as the limit of a body,” the mathematician “considers the mathematical objects purely in themselves.” (PS 70) Because the mathematician is not recasting her objects as providing some different *peras* or some alternate motion, she is not in danger of distortion:

[T]his extracting changes nothing of the objective content of that which remains as the theme of the mathematician. It does not turn into something else; the ‘what’ of the *peras* is simply taken for itself, as it appears. It is simply taken as it presents itself.... If the mathematician simply adheres to his special theme, he is never in danger that that will present itself to him as something other than it is. It is indeed here nothing other than what has been extracted. Beings are not distorted for the mathematician through *chorizein* [the process of abstraction]; on the contrary, he moves in a field in which something determinate may be disclosed. (PS 70)

This conception of mathematics as abstracting entities so that they may be taken simply as they present themselves does not sound so far off, of course, from the maxim of phenomenology, “To the things themselves!” (BT 58) And Heidegger is careful to note Aristotle’s concession here to the philosophers, that “those who discuss the Ideas, and disclose them in *logos*, proceed this way as well: *chorizontes*, ‘they extract.’” (PS 70)

But within mathematics, the distinction between arithmetic and geometry will prove to be of crucial importance. Even in these otherwise non-polemical lectures, we can sense the urgency with which Heidegger distinguishes the mathematicians under Aristotle’s purview and physicists (chastised here as Platonists) as such. Whereas mathematical abstraction properly leaves behind the *topos* of its objects, including the *kinoumena* – or determinate relation to motion – which is the concern of natural observers, the Platonist does not recognize *topos* and therefore *kinesis* as natural aspects of the object in question which must then be left behind in the artificial (though

⁶ Summarizing *Metaphysics*, XIV, 5, 1092a.

not distorting) process of abstraction; this misrecognition in turn allows him to make “of these *archai* genuine beings, among which finally even *kinesis* itself becomes one.” (PS 71) Heidegger thus opposes the mathematician, for whom *kinesis* is not another *archai* but rather “the *topos* itself whereby Being and presence are determined” (PS 71) to the (Platonic) physicist, who is guilty of insufficient abstraction.

The distinction between geometry and arithmetic clarifies this opposition. *Monas*, unit, is the lonely element of arithmetic; the most basic concern of geometry, however, is *stigma*, the point, which is a *monas* with a *thesis* added to it. (PS 71) This *thesis* makes all the difference: while both *monas* and *stigma* “are *ousia*, something that is for itself” (PS 72), the *thesis* operative in geometry signifies that the object in question has been wholly divorced from its natural place, and has acquired “an autonomy over and against the physical body.” (PS 76) Heidegger invokes Aristotelian metaphysics proper, whereby place is a natural, integral part of a being: “the place is constitutive of the presence of the being” (PS 73) – rocks fall because the ground is their natural *topos*, fire naturally goes up, etc. (Heidegger’s insistence that “these assertions of Aristotle’s are self-evident” (PS 73) is potentially quite problematic, but we will follow his argument all the way through in order to discern how much so.) The difference between the kinds of abstraction taking place in geometry and arithmetic are exemplified in the ways each relates the basic units of its operation to one another: for Aristotle, neither number nor the line is merely a construction of ones or points. The first number is in fact two, and the line is comprised of more than its points: “number and geometrical figures are in themselves in each case a manifold. The ‘fold’ is the mode of connection of the manifold.” (PS 76) What Heidegger investigates here is the difference between geometrical and numerical relation.

While geometrical objects retain some similarity to those physical objects from which they are derived, for example the quality of continuous extension, Aristotle derives his understanding of continuity not from geometry itself but from his reflections on physics.⁷ Heidegger rehearses the seven phenomena of co-presence. (PS 77-79) They are: 1) the *hama*, that which is in one place; 2) the *choris*, that which is separate, in another place; 3) the *haptesthai*, the touching, or that whose ends are in the same place (*hama*); 4) the *metaksu*, the medium in which some changing thing operates (like the stream through which a boat moves); 5) the *ephekses*, the successive, for whom that which is in between them is not of their same

⁷ *Physics*, V, chapter 3.

ontological nature; 6) *ekhomenon*, the self-possessed, an *ephekses* determined by the *haptesthai*, i.e. whose ends are touching; 7) *synekhes*, *continuum*, a more originary *ekhomenon*, the members of which have ends that not only touch but are identical to one another.

The relation characteristic of geometry is *synekhes*, the continuum: “what is posited in this *thesis* is nothing else than the continuum itself. This basic phenomenon is the ontological condition for the possibility of something like extension, *megethos*.” (PS 81) The argument against Platonic theoretical construction – where a line would simply be the collection of its points – is that such a collection may still have something infinitely large or different between the points that would disrupt their succession. The addition of *thesis* typical of geometry ensures that, in positing the continuum, the quality of extension can be understood. In absence of a *thesis*, the relation characteristic of arithmetic is therefore *ephekses*: “for there is nothing between unity and twoness” (PS 80), i.e. the nothing between 1 and 2 is of a different ontological nature than the numbers that bound it. Because geometry must posit a supplement, a *prosthesis*, in order to constitute itself, whereas arithmetic requires no such *thesis*, Aristotle finds number to be ontologically prior: it characterizes being “free from an orientation toward beings” (PS 83) – which is why Plato’s radical ontological reflection starts with number. But although arithmetic is dependent on sufficiently few *archai*, Aristotle does not admit it as the science of beings because its genuine *arche*, *monas*, is itself no longer a number. (PS 83) With that Aristotle, and Heidegger, turn to *sophia* as the genuine candidate science of being.

We are now in a position to make sense of Heidegger’s scathing remarks about Descartes in *Being and Time*. In the development of Heidegger’s critique of mathematics, this text marks an important development because it is the first occasion on which Heidegger links his argument against the modern mathematical physics of Galileo, Newton, and Descartes with his separate critique of metaphysics since Plato. The centrality of the argument against Descartes in *Being and Time* suggests that the two critiques are intimately related, and subsequent texts we will examine will only confirm this connection.

In his introduction, one argument Heidegger makes for the priority of his ontological investigation of being is that none of the positive sciences have been able to think the ontological status of the entities with which they are concerned, and even less have they thought the meaning of being in general. (BT 30) Indeed, Heidegger finds the sciences to be in various states of foundational crisis, including: theology, the social sciences, biology, physics, and above all

mathematics (Heidegger's schooling coincided with the development of fierce controversies between intuitionist and formalist schools regarding the foundations of mathematics.). (BT 29-30)

Nor would the resolution of such crises likely yield any significant results. Having stipulated that only an existential analytic of Dasein will be sufficient to clarify the meaning of being in general, (BT 32-34) Heidegger then determines that of the three possible "ontological problematics" through which being can be approached, only one is possessed by Dasein. (BT 121) The first two, the being of entities proximally encountered – readiness-to-hand – and the being of entities encountered in their own right – presence-at-hand – are mere *categories* which, we will see, are in fact indicative of the kind of inauthentic attitude to which mathematical physics tempts us. The third ontological problematic, the worldhood of the world, is the "ontical condition which makes it possible for entities within-the-world to be discovered at all." (BT 121) Within this problematic, Heidegger admits, it might be possible to attempt a formalization of the system of relations that are constitutive of worldhood. But "the phenomenal content of these 'Relations' and 'Relata' ... is such that they resist any sort of mathematical functionalization." (BT 121-2) On the contrary, it is supposedly these relations (the in-order-to, for-the-sake-of, etc.) that enable the discovery of entities on the order of the first two ontological problematics at all.

Descartes is the figure guilty of attempting just such a formalization, and Heidegger claims that the phenomenological destruction of the *cogito sum* is in fact a necessary condition for the continued progress of his existential analytic. Both of Heidegger's arguments against modern mathematics are operative here. First, insofar as Descartes sees *extension* as "basically definitive ontologically for the world," (BT 122), he predetermines what kinds of beings will be encountered in or admitted to experience. The *res corporea* are characterized above all by extension – size, length, thickness, etc. – in space, and this is defined as the constitutive quality that enables things to express all of their other qualities. Heidegger's most salient objection to this understanding of being concerns Descartes's equivocation on the use of 'being' as a descriptive term. Noting that for Descartes 'being' may signify both finite (the world) and infinite (God) substances, Heidegger quotes Descartes on the topic and claims that he "evades

the question.” (BT 126)⁸ The response that “being is not a predicate” is likewise taken as unsatisfactory. (BT 127) In short, Heidegger is providing an example in which the phenomenal content of relations constitutive of the worldhood of the world resists formalization.

The second objection, that modern mathematics induces unjustified epistemological confidence in its practitioners, is also in play here. Pursuing him further in §21, Heidegger asserts that Descartes’s interpretation is not only “ontologically defective,” but that he has failed to “securely grasp” the entities he was after. Since the only ontologically admissible entities are *res extensa*, “the only genuine access to them lies in knowing [*Erkennen*], *intellectio*, in the sense of the kind of knowledge [*Erkenntnis*] we get in mathematics and physics....That which is accessible in an entity *through mathematics*, makes up its Being.” (BT 128) Heidegger’s objection to this understanding is that despite his claims, Descartes’s ontology “is not primarily determined by his leaning towards mathematics...but rather by his ontological orientation in principle towards Being as constant presence-at-hand, which mathematical knowledge is exceptionally well suited to grasp.” (BT 129) In other words, the mathematics half of the “mathematical physics” to which Descartes appeals is inessential. Heidegger’s counterexamples bear this out: they dispute the physical sense of Descartes’s claims rather than their mathematical validity. Against the famous example of the melting wax, Heidegger retorts that the continuation across time of the malleable substance tells us nothing ontologically interesting about it – thus being is either inaccessible as such (which neither party is prepared to accept) or extension itself does not reveal being. Likewise, in the example of a hard substance resisting pressure, Heidegger replies that in abandoning everything but the hardness or resistance-property of the entity under consideration, Descartes also abandons the possibility of distinguishing between the two entities in contact: the mere closeness of a thing “does not mean that touching and the hardness which makes itself known in touching consist ontologically in different velocities of two corporeal Things.” (BT 130) Only if a being has the kind of being which Dasein has will it be shown hardness or resistance. Note: the first example seeks to undermine the certain grasp of entities in the world; the second undermines the self-knowledge of the subject. The overall impact of Descartes’s orientation is that he has “made it impossible to lay bare any primordial ontological problematic of Dasein; this has inevitably obstructed his view of the phenomenon of

⁸ The quote in question is: “No signification of this name [‘substance’] which would be common to God and his creation can be distinctly understood.” (BT 491)

the world.” (BT 131) For a philosopher seriously concerned with “getting the world back,” these are not insubstantial shortcomings. As mentioned above, this is the first instance in which Heidegger’s long-standing skepticism towards modern mathematics is combined with his destruction of the history of philosophy.

Later in *Being and Time*, Heidegger resumes this combined critique of modern mathematics and philosophy and extends its scope well beyond the specifically Cartesian heritage. In §69b, he considers the way in which the normal circumspective concern of Dasein emerges as the theoretical attitude characteristic of modern science. In particular, in examining the genesis of this attitude Heidegger is interested to notice what “conditions implied in Dasein’s state of Being” (BT 408) are necessary for the theoretical attitude to emerge. Theory, he notes, is not a simple withdrawal from or absence of engaged physical *praxis*; rather, it has a kind of *praxis* all its own, (BT 409) whether highly specialized as in the preparation of archaeological experiments, or simplistic measurements of a hammer which seems too heavy. In fact, the simple assertion that “the hammer is heavy” already signifies a switch to the theoretical attitude, and this is not a minor variation but a modification in which “our understanding of Being is tantamount to a change-over.” (BT 413) Not only is the hammer’s readiness-to-hand as a tool abandoned, but an essential feature of its presence-at-hand, its place, is also overlooked. “[I]ts place becomes a spatio-temporal position, a ‘world-point,’ which is in no way distinguished from any other.” (BT 413) This sounds remarkably similar to Heidegger’s description of geometric *thesis* from the 1924-5 lectures, in which objects are no longer considered in their natural places but as points on a grid or as surfaces in space. The crucial historical example of the emergence of this theoretical attitude is in fact the prevalence of mathematical physics since Galileo, Newton, and Descartes:

What is decisive for its development does not lie in its rather high esteem for the observation of ‘facts,’ nor in its ‘application’ of mathematics in determining that character of natural processes; it lies rather in *the way in which Nature herself is mathematically projected.* (BT 413-4)

Only when nature has been predetermined and projected as knowable can entities be encountered as inert matter ready for experimentation and measurement. The crucial feature of mathematical physics is thus that it “discloses something that is *a priori*.... the entities which it takes as its theme are discovered in it in the only way in which entities can be discovered – by the prior projection of their state of Being.” (BT 414)

To understand the significance of this section, it is important to note here the relationship between the theoretical attitude and mathematical physics: the latter is an example of the former, not vice versa. The culprit, in other words, ultimately responsible for ostensibly inauthentic modes of theoretical Dasein is not mathematics as such, or even “the mathematical,”⁹ but a way of being which Dasein allows itself to adopt. Heidegger does not develop his analysis of mathematics further in *BT* – there are obviously more pressing concerns, like the search for the conditions for the possibility of authentic Dasein – but even so we can see that his critique of modern mathematical physics plays a vital role in his overall argument.

The long chapter on modern mathematical science in Heidegger’s 1935-6 lecture¹⁰ marks the most advanced statement of his critique of mathematics insofar as it brings together the analysis given in the 1924-5 course on Plato’s *Sophist* of Aristotle’s understanding of mathematics with the discussion in *Being and Time* of Cartesian ontological distortion and the expansion of the theoretical attitude under modern mathematical physics. Although much of the material is familiar, some key innovations in Heidegger’s argument deserve consideration.

The most important argumentative advance made here, the distinction between mathematics and “the mathematical,” arises out of the attempt to distinguish modern from ancient mathematics and physics. Heidegger notes three arguments that have commonly been deployed for this purpose: first, that moderns deal with facts, versus ancient concepts and principles; second, that moderns conduct well-defined experiments; and lastly, that modern mathematical physics operates via calculation and measurement. (*WT* 66-68) However, these characterizations all apparently fail insofar as ancient thought is also factual, experimental, and calculative. Rather, “this fundamental feature of modern science for which we are searching [is] that modern science is *mathematical*.” (*WT* 68) Although modern science certainly deals with points, lines, and numbers, what we know as the discipline of mathematics is in fact “only a

⁹ The distinction between mathematics as a bounded, formal discipline and “the mathematical” (the latter deriving from the Greek *ta mathemata*, “the learnable,” those entities which are pre-given as accessible to thought) has not yet been made in any of Heidegger’s texts, and there is reason to believe it is not operative in *Being and Time*. When we read, “In the mathematical projection of Nature, moreover, what is decisive is not primarily the mathematical as such; what is decisive is that this projection *discloses something that is a priori*,” (*BT* 414) “the mathematical” here must be read as referring to the discipline which includes arithmetic and geometry, not the generalized epistemic orientation which discloses beings’ knowability a priori, since the latter interpretation of the phrase would have Heidegger saying something like, “what is decisive is not primarily the mathematical; what is decisive is the mathematical.”

¹⁰ B.I.5 of *What is a Thing?*, reprinted as “Modern Science, Metaphysics, and Mathematics,” in Krell, *Basic Writings*, pp. 271-305.

particular formation of the mathematical.” (Ibid.) What Heidegger from now will call “the mathematical” is derived from the Greek expression *ta mathemata*, “which means what can be learned and thus, at the same time, what can be taught.” (WT 69)¹¹ “The mathematical” is distinguished from four other Greek approaches to entities:

1. *Ta physika* – things insofar as they come forth from themselves;
2. *Ta poioumena* – things insofar as they are produced by humans;
3. *Ta khremata* – *physika* or *poioumena* insofar as they are in use or are at our disposal;
4. *Ta pragmata* – things insofar as we have to do with them in any way, including *praxis* in the widest possible sense (as practical use, moral action, etc.) and also *poiesis*. (WT 70)

Ta mathemata, ultimately, are “things insofar as we take cognizance of them as what we already know them to be in advance.... This genuine learning is therefore an extremely peculiar taking, a taking where he who takes only takes what he actually already has.” (WT 73) In the particular case of number, for example, we can only count three things if we already “know” the number three. (WT 74) Generally, “the mathematical” is the prerequisite for knowledge itself, and to emphasize this point Heidegger links it both to the Socratic method of always “saying the same thing about the same thing” and the injunction above Plato’s Academy against the admittance of anyone who has not grasped mathematics (it is not a comprehension of particular theorems that qualifies a student, but a grasp of “the mathematical” as such). The breadth and primacy of “the mathematical” has two implications: first, it entails a commitment to the ontological proposition that *there are* entities about which we may know something in advance, and second, that the processes of learning which fall under “the mathematical” (that is to say, all learning) can yield *knowledge in advance* about entities – knowledge that is *a priori* and thus certain. (WT 75)¹² As we have seen, Heidegger’s critique of mathematics as exhibited in Galileo and Descartes focuses on precisely these ontological and epistemological aspects of their theories – so it is safe to say that Heidegger’s critique is in fact of “the mathematical,” rather than restricted to one academic discipline.

¹¹ I will refer to “the mathematical” in quotes throughout as required in order to further distinguish it from mathematics understood as a formalized, bounded discipline.

¹² It is not without reason, therefore, that this discussion of “the mathematical” emerges in a lecture course that is largely devoted to Kant.

The middle sections of this chapter constitute a synthesis of some of the arguments established earlier in Heidegger's career. First, he restates his approval of Aristotelian physics (along the lines of his 1924-5 course) insofar as it approaches beings as they manifest themselves (*ta physika*) rather than "mathematically," and contrasts this with Newton's doctrine of motion, which is guilty of all manner of ontological and epistemological crimes. (WT 82-88)¹³ Second, Heidegger more or less recapitulates his evaluation of Galileo from 1915, except here in the context of the experiment with free fall, noting how Galileo's project entails six conclusions about the essence of "the mathematical." First, it is a project which "skips over the things"; it is axiomatic, which is to say it prescribes certain features by which entities are to be understood before they are encountered; this prescription goes to the very essence and structure of beings; it establishes a uniform field in which all entities will be encountered; the "mathematical" realm requires that entities be accessed through experimentation; and finally, it establishes measurement, in particular numerical measurement, as the uniform determinant of things. (WT 92-93) It is only through and along with this transition to the "mathematical" approach to nature that the analytical geometry of Descartes and the calculus as developed by Newton and Leibniz could have been possible. (WT 94)

Extending the link made in *Being and Time* between modern mathematics and modern metaphysics, Heidegger adopts an even stronger stance here. He is unequivocal regarding the centrality of modern mathematics (insofar as in the 16th and 17th centuries it was the primary bearer of "mathematical" reason) to the genesis of modern Western metaphysics itself. Whereas in *Being and Time* we must discern the impact of mathematics for ourselves by considering its place in the phenomenological destruction of the tradition (BT §6), here we learn that "[T]he rise of modern natural science [and] the transformation of *Dasein*, which was basic to this event, changed the character of modern thought and thus of metaphysics." (WT 65) "The mathematical" is "a fundamental trait of modern thought... the historical mode of being (*Dasein*) at that time, of the fundamental position taken toward what is." (WT 95-6)

¹³ They are: the obliteration of the distinction between earthly and celestial bodies; the removal of the ancient priority of circular over linear motion; the neutralization of natural place, inherent force and capacity, and motion; the relativization of the ancient notion of violence against nature into a notion of violence as simple change of motion; the abandonment of nature as an inner expressive principle in favor of nature understood as aggregate of motion and forces; and therefore the establishment of a radically unjustified method for questioning nature (i.e. the scientific method).

There are several philosophically interesting implications of the link between metaphysics and the mathematical. First, the rise of the mathematical marks the emergence of a self-grounding knowledge, a self-binding form of obligation, and a new experience of freedom as such. Modern mathematics as “mathematical” coincides with the abandonment of the Church and faith as the grounds of knowledge: in the essence of the mathematical “lies a specific will to a new formation and self-grounding of the form of knowledge as such.” (WT 97) Thus modern science, mathematics, and metaphysics “sprang from the same root of the mathematical in the wider sense.” (Ibid.) Second, insofar as Descartes participated in a widespread project of extending and developing what would become the “mathematical” orientation toward the knowledge of what is (Heidegger notes the influence of Suárez and the Jesuits at La Flèche), a “simultaneous advance in the direction of a foundation of mathematics and of a reflection on metaphysics above all characterizes his fundamental philosophical position.” (WT 100) Finally, with the elevation of the *proposition* – the positing, the asserting characteristic of “mathematical” thinking – to the status of first and only given principle, reason becomes the highest ground of inquiry (rather than, for instance, accordance with rational animality). (WT 104, 106) While these implications of mathematical metaphysics can be easily related to Heidegger’s criticism of Descartes in *Being and Time*, the argument of this text removes any doubt about whether the problems of Cartesian philosophy and modern metaphysics in general could ever be determined as strictly or only *philosophical* problems.

Heidegger’s critique of the mathematical, as we have already seen, is thus comprised of two arguments: a rejection of the ontological assumptions operative in an axiomatic, neutralized, and uniform approach to the world, and a rejection of the epistemological claims implicit in the mode of being which asserts that all entities must be accessible to reason understood as a self-grounding producer or certain propositions. Heidegger opposes the mathematical on the basis of its direct effects, and not because it fails to achieve some simplistic, pre-modern, primordial “holism” which would serve as the polar opposite of mathematics as a science – otherwise he would not have repeatedly distinguished the Cartesian “mathematical” from mathematics as such (BT 129, 413-4), would not have endorsed the work of specific schools of mathematics (to which we will turn momentarily), and would not have allowed for the restricted appropriateness of the mathematical itself. (BT 121-2)

With these arguments in mind, we can approach Heidegger's analysis of the impact of and our proper relation to the mathematical. Although "The Question Concerning Technology" (1949) ostensibly belongs to those texts written by the "later Heidegger," the briefest examination shows that the argument in this text is a straightforward development of themes introduced much earlier. In his famous reflections on the global dangers posed by modern technology, Heidegger suggests that the looming threat to humanity is not posed by the apparatus of technology itself, but by a more essential change: "What is dangerous is not technology.... The essence of technology, as a destining of revealing, is the danger." (*QT* 28) And the essence of technology is called "Enframing [*Ge-stell*]," which means "the gathering together of that setting-upon which sets upon man, i.e., challenges him forth, to reveal the real, in the mode of ordering, as standing-reserve." (*QT* 20) My claim is that Enframing corresponds fairly precisely to the concept of "the mathematical" and to the theoretical attitude analyzed in *Being and Time*. Heidegger says as much: "man's ordering attitude and behavior display themselves first in the rise of modern physics as an exact science. Modern science's way of representing pursues and entraps nature as a calculable coherence of forces." (*QT* 21) Enframing, this distinctively modern attitude that approaches beings as "calculable in advance" (*QT* 21) displays precisely those ontological and epistemological features rejected in Heidegger's earlier critique of the mathematical.

II

At this point I have satisfied the first two goals of my analysis: it is evident that mathematics in particular and the mathematical in general were central concerns throughout Heidegger's career, and it should be clear that his critique of the mathematical played a vital role in both his earlier analytic of Dasein and in the latter discussion of technology. What necessitates the third task of this paper, then, is a tension between Heidegger's description of Enframing, of the mathematical, and his particular statements regarding mathematics.

On the one hand, the permeating breadth of the mathematical seems decisive for all activity that falls under it, which includes metaphysics, natural science, and mathematics. Ever since his early lectures, Heidegger saw that the mathematical was an ancient orientation traceable to Plato and a persistent problem characteristic of the modern theoretical attitude. It is for this

reason that he looks to discern the “saving power” of technology in some *techne* other than the mathematical one:

Once there was a time when the bringing-forth of the true into the beautiful was called *techne*. And the *poiesis* of the fine arts also was called *techne*.... [E]ssential reflection upon technology and decisive confrontation with it must happen in a realm that is, on the one hand, akin to the essence of technology and, on the other, fundamentally different from it. Such a realm is art. (*QT* 35)

This turn to the artistic and specifically poetic thinking of being therefore seems a direct consequence of the failure of technology under the regime of Enframing, of the mathematical. Heidegger makes a turn toward poetry because there is nowhere else to turn.

On the other hand, Heidegger gives glowing endorsements of specific mathematical schools and projects throughout his career. In particular, on several occasions he praises the intuitionist work of Hermann Weyl. (*PS* 80-1, *GAP* 75-6)¹⁴ And philosophers like Oskar Becker,¹⁵ Jacob Klein,¹⁶ and David Lachterman have developed Heidegger’s critique of the

¹⁴ Also, in *History of the Concept of Time: Prolegomena*, trans. Theodore Kisiel (Bloomington, Indiana University Press, 1985), p. 5. Weyl is affirmed as both taking up the Aristotelian heritage and as combating Newtonian physics: “Contemporary mathematics is broaching once again the question of the continuum. This is a return to Aristotelian thoughts, insofar as mathematicians are learning to understand it as something pre-given, prior to the question of an analytic penetration. The mathematician Hermann Weyl has done work in this direction, and it has been fruitful above all for the fundamental problems of mathematical physics. He arrived at this understanding of the continuum in connection with the theory of relativity in contemporary physics, for which, in opposition to the astronomical geometry that resulted from the impetus Newton gave to modern physics, the notion of field is normative.” (*PS* 80-1)

¹⁵ A truly comprehensive assessment of Heidegger’s relation to mathematics would include an analysis of Becker’s *Mathematische Existenz*, which was first published as the other half of the *Jarbuch für Philosophie* in which *Being and Time* first appeared. Becker’s treatise is an exploration and argument on behalf of intuitionism in the debate over the foundations of mathematics, arrived at through a synthesis of Husserl’s early psychologism and Heidegger’s hermeneutics. See Carl Friedrich Gethmann, “Hermeneutic Phenomenology and Logical Intuitionism: On Oskar Becker’s *Mathematical Existence*,” *The New Yearbook for Phenomenology and Phenomenological Philosophy* III (2003), pp. 143-60. In addition, see Michael Roubach, “*Being and Time* and Brouwer’s Intuitionism,” *Angelaki: Journal of the Theoretical Humanities* 10:1 (April 2005), pp. 181-186. If Gethmann and Roubach are any indication, both the mathematical and the philosophical significance of Becker’s work has since been surpassed by subsequent developments. Becker’s attempt to *visibly* intuit transfinite numbers by analogous construction of expanding squares strikes the reader as particularly incredible.

Finally, Paolo Mancosu and T. A. Ryckman, “Mathematics and Phenomenology: The Correspondence between O. Becker and H. Weyl,” *Philosophia Mathematica* 10:3 (2002), pp. 130-202 is particularly illuminating regarding the development of Weyl’s interest in phenomenology, his dissatisfaction with Becker’s work (Weyl claimed that *Mathematical Existence* would “discredit the name of phenomenology among the concrete sciences,” [p. 137]), and Weyl’s abandonment of intuitionism.

¹⁶ Jacob Klein, *Greek Mathematical Thought and the Origin of Algebra*, trans. Eva Brann (Cambridge, MA: MIT Press, 1968).

mathematical in directions beneficial to mathematics itself.¹⁷ The mathematician Gian-Carlo Rota also made limited use of Heideggerian phenomenology.¹⁸

Heidegger's continuous endorsement of specific projects within mathematics undermines the tragic assessment of mathematical Enframing as totally perverting of all the sciences: in one early lecture on Zeno of Elea, Heidegger discusses Weyl's theory of the continuum and then goes so far as to propose the equation, "Continuum: das Sein." (GAP 76) Heidegger warns that "if this Continuum is seized as multiplicity, as an act of collection, then this leads to absurdity. Thus, it must be seized as original unity and the entirety of becoming, which lies before this infinite, endless divisibility. Unity, entirety, *adiaireton*, *synekhes*, Continuum, Being itself." (GAP 75) Composed and delivered during the period he was also preparing *Being and Time*, this fragment cannot be easily dismissed. Although Heidegger's later pessimism, evident in "The Question Concerning Technology" and forward, might not favor such a bold equation, none of the commentary from his career addressed at length above provides an obvious reason why Weyl's understanding of the continuum might not constitute a viable interpretation of being as such. Furthermore, Heidegger's strategy in the *Sophist* lectures suggests his remarks on Weyl were not made casually: although Aristotle himself gives ontological priority to number, Heidegger seems to give priority to the continuum – he characterizes the priority of number as dependent on its non-analyticity, i.e. its lack of predication characteristic of the indiscriminate identity of the continuum. (PS 83)¹⁹ In short, if there are some mathematicians who can escape the modern trap of "the mathematical," there may be more of them than merely those Heidegger recognizes,²⁰ and it may be possible to temper the reach of the mathematical such that Enframing could give way to an orientation closer to the "letting be." This might even render Heidegger's ostensibly ineluctable turn to poetry, art, and the politics of resignation ("only a God can save us") in fact unnecessary.

In conclusion, I suggest that debates in the philosophy of mathematics during and since Heidegger's career between formalist, intuitionist, and platonist schools are indicative of some

¹⁷ David Rapport Lachterman, *The Ethics of Geometry: A Genealogy of Modernity* (New York: Routledge, 1989).

¹⁸ Gian-Carlo Rota, *Indiscrete Thoughts*, ed. Fabrizio Palombi (Boston: Birkhäuser, 1997). Rota seems primarily interested in phenomenology in general, and adopts Heideggerian concepts more as helpful metaphors for mathematical conclusions rather than in order to achieve any novel disciplinary interaction.

¹⁹ Though for such a consistently well-sourced text, it is curious that Heidegger offers no cite to support his interpretation of Aristotle on numbers and the continuum.

²⁰ It is particularly interesting that, at GAP 75-6 in his discussion of the continuum, Heidegger references texts by mathematicians as radically diverse as Bolzano, Cantor, Weyl, and Russell.

possible avenues for mathematics which would advance the ancient project of revealing what is knowable about “the things themselves” without committing the ontological and epistemological mistakes of modern “mathematical” mathematics.²¹ In the case of formalism, we might even conceive of Heidegger’s invective against modern mathematics as targeting the formalism exemplified by David Hilbert:²² Heidegger’s objections parallel the intuitionist rejoinders to formalism of L. E. J. Brouwer and Weyl quite closely. Hilbert famously proposed a program whereby all of mathematics could someday be secured by means of a complete and consistent axiomatization. Formalism exhibits both of the characteristics that for Heidegger are indicative of “the mathematical”: with regard to ontology it only allows for the existence of mathematical objects understood as strings of consistent statements grounded in the axioms chosen (ultimately) arbitrarily by the mathematician – analogous to the self-grounding freedom of the Cartesian subject; epistemologically, Hilbert’s program anticipates the achievement of a certain and total knowledge of the entities within this ontological realm.

Against this position, intuitionist philosophies of mathematics maintained that mathematical objects should be admissible to close examination or introspection. Intuitionism claims that ontologically, mathematical entities are constructed and hence are not analytical revelations about the properties of objects but subjective attempts to formalize the contents of mental intuitions. “The world does not exist independently but only for a consciousness.”²³ Some unusual consequences follow from this constructivism: Brouwer, intuitionism’s major proponent, rejected both the law of the excluded middle and the derivation of proofs by contradiction. This meshes nicely with Heidegger’s diagnosis of Descartes (it is supposedly

²¹ For general histories and subject matter of these positions I rely on Stephan Körner, *The Philosophy of Mathematics* (New York: Dover, 1960) and Paul Benacerraf & Hilary Putnam, eds. *Philosophy of Mathematics: Selected Readings* (Cambridge: Cambridge University Press, 1983). I intentionally omit discussion of the logicism following from Frege, first, per space limitations, and second because in this context I suspect it would meet the same objections as formalism insofar as both logicism and formalism pursue above all a secure foundation for the defense of classical mathematics. (Körner 119)

²² In the introduction to *Being and Time*, Heidegger notes the crisis in mathematics resulting from the debate then raging between formalism and intuitionism; (*BT* 29-30) given his consistent enthusiasm for the work of Weyl, it is reasonable to assume that he was not a proponent of formalism. Hilbert’s program had just been announced in 1920, and given his background in mathematics it is highly unlikely that Heidegger would not have taken an interest in such a bold proposal.

²³ Hermann Weyl, “World and Consciousness,” in *Mind and Nature* (Philadelphia: University of Pennsylvania Press, 1934), p. 21. I have noted Heidegger’s enthusiasm for Weyl; it should also be pointed out that Weyl’s affinity for phenomenology and self-identification as a Husserlian have been well documented. Cf. Mancosu & Ryckman, “Mathematics and Phenomenology,” *Philosophia Mathematica* 10:3 (2002).

Cartesian subjectivity which enables the emergence of the principle of non-contradiction [WT 107]).

Intuitionism is not, however, the dominant or even one of the more viable contenders in the current configuration. Except for delicately reconfigured positions like those of Michael Dummett, intuitionism has waned; Weyl himself abandoned intuitionism later in his career,²⁴ and it is accepted that had the philosophical commitments of intuitionism been widely adopted mathematics itself would have become nearly impossible.²⁵ It is precisely this relative impasse in the debates regarding the foundations of mathematics that have left participants reconstructing and deliberating on the some of the same basic positions almost a century after the foundational crisis began.

With Hilbert's formalism permanently undone by Gödel's second incompleteness theorem and Brouwer's intuitionism rendered untenable by the flocks of mathematicians who, as it were, voted with their feet, it is worth noting that the platonist or realist philosophy of mathematics, which never really went away, has much to recommend it. As unlikely as it may seem to claim that a philosophical position endorsed by Quine and Putnam may also satisfy key Heideggerian demands, I would simply like to suggest that neither of the ontological or epistemological mistakes characteristic of "the mathematical" are necessary features of mathematical platonism. That mathematical entities exist independently of perception – that they are discovered, not constructed or intuited, *does* entail some determination about them *a priori*, namely that they exist. But what is the impact of this determination? It is no different from the intuitionist decision that any posited mathematical entity must be comprehensible by focused introspection or else dismissed as inherently vague. If anything, intuitionism entails stricter ontological boundaries by defining away entities like transfinite numbers and the Cantorian "real infinite" simply because they cannot be comprehended by the conscious human mind. Likewise, the only epistemological corollary of mathematical platonism is that formal systems will always be approximations of the entities after which they seek – no matter how one wants to conceive a modern-day "world of Ideas" above the divided line. Modern hubris and epistemic certainty seem quite far away.

²⁴ "With Brouwer, mathematics gains the highest intuitive clarity [...]. But, full of pain, the mathematician sees the greatest part of his towering theories dissolve into fog." Quoted in Paolo Mancosu, *From Brouwer to Hilbert* (New York: Oxford University Press, 1998), p. 80.

²⁵ Carl Posy, "Intuitionism and Philosophy," *The Oxford Handbook of Philosophy of Mathematics and Logic*, ed. Stewart Shapiro (Oxford: Oxford University Press, 2005), p. 319.

A contemporary example might reinforce this general suggestion. Within Zermelo-Fraenkel set theory (ZF), for some time the relation of ZF to the continuum hypothesis (CH) was a significant cause for concern. Georg Cantor rightly worried over the process of deciding how to count the number of sets of integers in, along, or on any given continuum, since the establishment of some means for determining cardinality (the number denoting the size of a set) was crucial to his set theory as such. Although Gödel proved that the continuum hypothesis (Cantor's proposed solution to the question) was not decidable on the basis of the ZF axioms alone, or even including the axiom of choice, this nevertheless did not entail a rejection of set theory.²⁶ Whereas Brouwer rejected any cardinality higher than one – only \aleph_1 was intuitive – and formalism could not assimilate higher-cardinal sets as interpretable as human constructions, Gödel, a committed platonist, defended set theory in spite of the independence of CH. By defining a set as a collection determined by iteration (the operation “set of x 's”) rather than as a unit obtained by dividing it off from the totality of existing things – which is still the intuitionist approach – Gödel argues that we can retain all the essential features of ZF.²⁷ In this example, by restricting its realm of operations mathematical platonism is able to defend a broader and more open orientation to possible entities than the conceptions which, though adopting a supposedly more fundamental and holistic pre-phenomenal totality, fall short precisely because of their ontological presuppositions.

It might be possible, even plausible, for a Heideggerian to insist that all of the above mathematical orientations are still too “mathematical.” But this raises the problem of what to do with Heidegger's own repeated endorsements. Either those particular references were a tactical mistake on Heidegger's part – and such a thorough thinker is unlikely to make the same tactical mistake numerous times across his career – or the disastrous breadth of the modern “mathematical” theoretical attitude characteristic of Enframing is not corrosive of *all* the activity of the disciplines which take their orientation from it. If the latter situation is the case, then there is no way to predetermine the validity of particular philosophies of mathematics except as their interaction among each other and their own internal effectiveness bear out. To adopt a meta-level approach to the philosophy of mathematics and judge which orientations will yield inadmissible conclusions about the existence of entities would seem to be as typical of the odious

²⁶ Kurt Gödel, “What is Cantor's continuum problem?” in Benacerraf and Putnam, *Philosophy of Mathematics*, pp. 470-485.

²⁷ *Ibid.*, pp. 474-475.

“mathematical” as any mapping of a piece of fresh fruit onto Cartesian spatial coordinates. And if there is an open possibility that some mathematical ontology might attain innocent and valid knowledge about the world, perhaps we might obtain other such kinds of knowledge, and need not wait for a salvific, poetic “god” at all, but rather might prove quite capable of saving ourselves.