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Germans in Space: Astronomy and *Anthropologie* in the Eighteenth Century

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Abstract

Physical orientation was a central philosophical problem for German thinkers in the late eighteenth century. Moses Mendelssohn, for instance, pondered in Morgenstunden, o Vorlesungen uber das Daseyn Gotten *(1785) whether one can orient oneself in the metaphysical realm with the human senses. Immanuel Kant took up the same question in "What is Orientation in Thinking?" (1786). In both works the authors struggled to understand how one can apply physical concepts —left, right, up, down— to places where the human body is not, or cannot be. These two thinkers' ideas —and many of their German contemporaries— were a response to the eighteenth century's discovery of "outer space". The astronomical contemplation of an infinite universe, populated by multiple worlds and, perhaps, intelligences raised a series of cosmological and metaphysical questions that could only be answered through a complete reassessment of the human being's physical relationship to "space".*

This essay explores one important result of this general reassessment, the rise in late eighteenth century Germany of Anthropologie*. It argues that by the end of the eighteenth century, Germans' contemplation of outer space created a wholly new orientation: human beings were both small and unique. To borrow an idea from Ernst Cassirer, although awash in a massive universe, human beings were self-fashioners, creating their own mental worlds, while leaving other worlds to other minds. In this sense, knowledge of the physical universe —in space and on the globe— opened the door on a wholly human one. By opening the stars to speculation, German thinkers re-oriented the human being in* this *world. Put another way, their exploration of space provided one context in which people could become fully human.*

Resumen

La orientación física-geográfica fue el principal problema filosófico de los pensadores alemanes a finales del siglo XVIII. Moses Mendelssohn, por ejemplo, expone en Morgenstunden, o Vorlesungen uber das Daseyn Gotten *(1785) si uno puede orientarse en el reino metafísico por medio de los sentidos humanos. Imannuel Kant se hizo la misma pregunta: ¿Qué es la orientación en el pensamiento? (1786). En ambos trabajos los autores han luchado por entender cómo se pueden aplicar los conceptos físicos —izquierda, derecha, arriba, abajo— los lugares donde el cuerpo humano podría o no estar. Las ideas de estos autores —y de muchos otros pensadores germanos contemporáneos— fueron una respuesta al descubrimiento del espacio exterior de finales del siglo XVIII. La contemplación astronómica de un universo infinito, integrado por múltiples*

palabras y, quizá, inteligencias generó una serie de preguntas cosmológicas y metafísicas que únicamente podrían haberse resuelto a partir de una nueva y completa valoración del ser humano y su relación con el espacio.

Este ensayo explora uno de los más importantes resultados de este proceso general de revalorización, el surgimiento de la Antropología en Alemania a finales del siglo XVIII. El surgimiento de este saber a fines del siglo XVIII se relacionó con las observaciones de los germanos del espacio exterior, porque íntegramente crearon una nueva orientación: los seres humanos son pequeños y únicos. Retomando una idea de Ernst Cassirer, acerca de que los seres humanos están perdidos en un universo masivo, ellos crean de su propio universo y también de su propio mundo mental, en tanto que deja a otras mentes otros mundos. En este sentido, el conocimiento del universo físico —en el espacio y en la tierra— abrió las puertas a una concepción completamente nueva del ser humano. De la misma forma, la especulación acerca de las estrellas, suscitó que los pesadores germanos reorientaran al ser humano en su mundo. Finalmente, la exploración del espacio proporcionó un contexto en el que la gente podía llegar a ser completamente humana.

Introduction

In the introduction to his classic study of heliocentrism's emergence, The Genesis of the Copernican World, Hans Blumenberg notes a thought experiment first articulated by the French mathematician Henri Poincaré.[1] Early in the twentieth century Poincaré asked whether a Copernicus could have appeared on this earth, were it enveloped by clouds that permanently obscured the heavens, or as Blumenberg put it, "would we know that the earth turned on its axis and went around the Sun if we had never been able to practice astronomy?"[2] Showing remarkable confidence in the powers of the human imagination, Poincaré held that as human technology advanced, someone would have discovered that the earth's motion, though this insight would likely have emerged centuries after the publication of Copernicus' published *De revolutionibus orbium coelestium libri vi* in 1543. For Poincaré the mathematician, the scientific truth would emerge in the end.

Blumenberg took a contrary position, arguing that one cannot separate the Copernican Revolution from humanity's physical situation. By clear skies or cloudy, human beings are too small to see the entire globe and, for that reason, have until recently lacked a position from which to apprehend its orbital movement. They have, however, long been able to watch heavenly bodies move across the sky. It was, therefore, only natural for people to believe that the heavens and not the earth were in motion, especially when an alternate vision required that humans imagine an extraterrestrial perspective (say, in orbit) to which they had no access. Thus, for Blumenberg, the Copernican Revolution must be understood both as a revolt against common sense and a grand act of imagination. On the one hand, astral contemplation led human beings to deny what their senses told them. On the other hand, they constructed an alternate universe that was more real than the one their senses presented. Following Blumenberg, we can add that Poincaré's fog-bound planet could not have nurtured Copernicus, because it closed the many intellectual avenues that humanity's status as contemplator caeli (observer of heaven) opened. Characterizing the issue in these terms highlights, however, a question that Blumenberg's text does not pursue: if astronomers had not discovered that the earth turned on its axis and went around the Sun, would anyone have discovered "Man"?[3]

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[1] Hans Blumenberg, *The Genesis of the Copernican World*, Robert M. Wallace trans. (Cambridge, Mass., 1987), 4-5.

[2] *Íbid*. On Copernicus, see Robert S. Westman, *The Copernican achievement*, Contributions of the UCLA Center for Medieval and Renaissance Studies; 7 (Berkeley, 1975).

[3] I use this term advisedly, because English-language scholarship —particularly that on the Renaissance and Reformation periods— has not infused the term "human being" with the same connotations of individual dignity and personal glory that it ascribes to Man.

In this essay I argue that post-Copernican astronomy was an essential factor in the rise of German Anthropology (*Anthropologie*), a new approach to understanding Man that arose in late eighteenth century Germany. Anthropologie was a highly philosophical cosmopolitanism that sought to unify all of humanity's drives, experiences, and contradictions in a single, broad vision of the human being as a terrestrial phenomenon. It is, therefore, not to be confused with modern anthropology, which not only emphasizes the study of (usually incommensurable) cultures, but also lacks the metaphysical context that informed this German debate. Defined early in the eighteenth century in largely Cartesian terms as the study of the human being's dual nature (body and soul), by the second half of the century thinkers such as Johann Gottfried Herder and Immanuel Kant, who were both heavily influenced by the latest astronomical literature, had reconceptualized the human being as an earthly creature whose spirit (Geist) could only be understood with reference to this world. For German thinkers in the late eighteenth century Man did not have an inherent nature, but was the result of an ongoing historical process that was anchored in a physical environment that had been created by God.

Identifying astronomy as a causal factor in the rise of Anthropologie is not, however, enough. We need to understand more specifically what it did for the new discipline and how it did it. I begin with the "what" part. I argue that astronomy created new conceptual boundaries against which German thinkers revalued the human being. Consider Immanuel Kant's famous phrase in Critique of Practical Reason (1787):

> Two things fill the mind with ever new and increasing admiration and awe, the more often and steadily reflection is occupied with them: the starry heaven above me and the moral law within me. Neither of them need I seek and merely suspect as if shrouded in obscurity or rapture beyond my own horizon; I see them before me and connect them immediately with my existence.[4]

Although Kant's specific reaction to stellar contemplation was unique, that he understood the core of his own existence through reference to the night sky was not. Johann Gottfried Herder began his Ideas on the Philosophy of the History of Mankind, perhaps the most important text in the Anthropologie literature, with these words:

> Our philosophy of the history of mankind must being with the heavens, if it is to merit the name to some degree. Since our domicile, the earth, exists not merely by and through itself, but receives its character, its structure, as well as its capacity for organization and preservation from the heavenly forces that

[4] Immanuel Kant, *Critique der praktischen Vernuft* (Frankfurt am Main, 1962), 161-162.

> extend through the universe, we must thus consider it first and foremost not alone and solitary but within a chorus of worlds in which it is set.[5]

Post-Copernican astronomy served as a mirror in front of German *contemplator caeli*'s face: in highlighting the gap between Man and the heavens it opened room for speculation that, in turn, transformed the general vision of humanity.[6]

Astronomy impelled the rise of *Anthropologie* by providing new ways of understanding space and distance. During the course of the eighteenth century, German astronomers expended great effort in teaching their compatriots how to understand the universe's great distances. In doing do they provided people with a variety of intellectual tools that allowed them not only to orient themselves with reference to heavenly phenomena —which stars were where— but also to imagine the great distances involved. This latter contribution was especially important because it emptied space of its terror. Blaise Pascal's anguished cry in the *Pensées* (1670) that, "The eternal silence of these infinite spaces frightens me", was no longer relevant to the eighteenth century, as the universe's awesome spaces had become thinkable and, thus, worth celebrating. In 1747, the Göttingen astronomer Abraham Kästner exhorted his compatriots, "Do you want to know how far the powers of human understanding extend? Study astronomy!"[7] With respect to Blumenberg's general argument, calling for the study of the heavens *because they were so huge* was the ultimate expression of confidence in human reason. As we will see, Man became worth studying systematically, because even after discovering how far he was from everything else in God's universe, he refused to blink.

Scholarship and the Birth of Anthropology

Interest in eighteenth century German anthropology (*Anthropologie*) has been on the rise, as several books have appeared on the topic since the year 2000.[8] Taken collectively recent works such as John Zammito's *Kant, Herder, and*

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[5] Johann Gottfried Herder, *Herders Werke*, vol. V, Part I (Stuttgart, 1889), 17.

[6] Thomas Broman, "The Habermasian Public Sphere and 'Science in the Enlightenment'", History of Science 36 (1998), 123-149.

[7] Blaise Pascal, *Pensèes* (Paris, 1976).

[8] Jörn Garber and Heinz Thoma, *Zwischen Empirisierung und Konstruktionsleistung*, Anthropologie im 18. Jahrhundert (Tübingen, 2004), Tanja van Hoorn, Dem Leibe abgelesen: Georg Forster im Kontext der physischen Anthropologie des 18. Jahrhunderts (Tübingen, 2004), Wolfgang Lukas, *Anthropologie und Theodizee: Studien zum Moraldiskurs im deutschsprachigen Drama der Aufklärung* (ca. 1730 bis 1770) (Göttingen, 2005), Carl Niekerk, *Zwischen Naturgeschichte und Anthropologie: Lichtenberg im Kontext der Spätaufklärung* (Tübingen, 2005), Walter Schmitz and Carsten Zelle, *Innovation und Transfer: Naturwissenschaften*, Anthropologie und Literatur im 18. Jahrhundert (Dresden, 2004), Carsten Zelle, "Vernünftige Ärzte": *Hallesche Psychomediziner und die Anfänge der Anthropologie in der deutschsprachigen Frühaufklärung* (Tübingen, 2001). I have taken this phrase from Hans-Jürgen Schings, Der ganze Mensch: Anthropologie und Literatur im 18. Jahrhundert: DFG-Symposion 1992 (Stuttgart, 1994).

the Birth of Anthropology (2002) and Jörn Garber and Heinz Thoma's edited volume *Zwischen Empirisierung und Konstruktionsleistung: Anthropologie im 18. Jahrhundert* (2004), and Wolfgang Lukas's *Anthropologie und Theodizee: Studien zum Moraldiskurs im deutschsprachigen Drama der Aufklärung (ca. 1730 bis 1770)* (2005) have traced both the rise of late eighteenth century *Anthropologie* and how it reconstructed the human being (*der Mensch*). All the recent literature sees *Anthropologie* (correctly) as a crucial intellectual development of the late eighteenth century. Zammito, for instance, puts *Anthropologie*'s origins into the context of the philosophical split between Immanuel Kant and his greatest student, Johann Gottfried Herder. Lukas places the new discipline between theological issues and the artistic world of drama, associating German literary production with the religiously inspired interest in Man's destiny. Other scholars have explored the same theme with reference to literature, holding that literature provided an intellectual realm in which Man could be both constructed and studied simultaneously. The scholarship on *Anthropologie* is, therefore, broad and varied, much like the actual discipline itself. Nonetheless, in spite of this breadth one looks in vain for specific mention of astronomy's role in the emergence of anthropological thinking.

The recent burst of scholarly production on *Anthropologie* is a welcome addition to a venerable scholarly discussion that dates back to Wilhelm Dilthey (1833-1911) but became particularly intense in Germany after the Second World War.[9] From that point on, scholars from four disciplines, theology, literature, philosophy, and history dominated both the definition and the study of *Anthropologie*. Although each discipline brought its own theoretical commitments to the issue, the literature shares two broad assumptions. First, *Anthropologie* made the human being a creature wholly of *this* world and held that he cannot be understood without reference to the terrestrial context. Second, *Anthropologie* re-dignified Man by defining him as

[9] On Dilthey's understanding of *Anthropologie*, see H. A. Hodges, *The Philosophy of Wilhelm Dilthey* (London, 1952), 8. Wilhelm Dilthey, "Psychologie als Erfahrungswissenschaft. Erster Teil: Vorlesungen zur Psychologie und Anthropologie" (ca. 1875-1894), in Gesammelte Schriften (Stuttgart, 1957). Jürgen Barkhoff and Eda Sagarra, eds., *Anthropologie und Literatur um 1800* (München, 1992), Gabriele Dürbeck, *Einbildungskraft und Aufklärung: Perspektiven der Philosophie, Anthropologie und Ästhetik um 1750*, Studien zur deutschen Literatur, Bd. 148 (Tübingen, 1998), Werner Krauss, Hans Kortum and Christa Gohrisch, Zur Anthropologie des 18. *Jahrhunderts: die Frühgeschichte der Menschheit im Blickpunkt der Aufklärung* (Berlin, 1978), Mareta Linden, Untersuchungen zum Anthropologiebegriff des 18. Jahrhunderts (Bern, 1976), Wilhelm E. Mühlmann, *Geschichte der Anthropologie, Geschichte der Wissenschaften*. 1. Geisteswissenschaften (Bonn, 1948), Michael Müller, *Philosophie und Anthropologie der Spätaufklärung: der Romanzyklus Friedrich Maximilian Klingers*, 1. Aufl. ed. (Passau, 1992), Wolfhart Pannenberg, *Anthropologie in theologischer Perspektive* (Göttingen, 1983), Wolfhart Pannenberg, *Anthropology in theological perspective*, 1st ed. (Philadelphia, 1985), Wolfhart Pannenberg, *Was ist der Mensch? die Anthropologie der Gegenwart im Lichte der Theologi* (Göttingen, 1962), Helmut Pfotenhauer, *Literarische Anthropologie: Selbstbiographien und ihre Geschichte, am Leitfaden des Leibes* (Stuttgart, 1987), Helmuth Plessner, "Der Mensch als Lebewesen," in *Philosophische Anthropologie*, ed. Werner Schüssler (München, 2000), 71-83, Max Scheler, "Die Stellung des Menschen im Kosmos," in *Philosophische Anthropologie*, ed. Werner Schüssler, Alber-Texte Philosophie (München, 2000), 49-69.

a complicated, independent consciousness whose diverse drives and talents, including the ability to see the stars, justified systematic scholarly study. Man became a fascinating beast, in part, because he understood his own existence as suspended between both the earth and the heavens.

Keeping these commonalities in mind, let us consider two scholars of *Anthropologie*, the philosopher Max Scheler and the theologian Wolfhart Pannenberg. In 1927, Scheler delivered a lecture in Darmstadt entitled, "The Human Being's Exceptional Position", which was published twenty years later as *The Human Being's Position in the Cosmos*.[10] In this work Scheler argued that the human being was unique among the earth's many creatures, because this species was "open to the world" (*weltoffen*), by which he meant that unlike animals human beings experience this world as a unity in which events happen, which is just another way of saying that we are conscious of our surroundings. Scheler's approach emerged from Edmund Husserl's phenomenology, which posited that being (*Dasein*) was the point from which one had to analyze space and time.[11] According to this approach, experience itself would be impossible without the natural ability to put all phenomena in a specific place (*Ort*).

Scheler's work highlights a long-standing characteristic of German philosophy, namely the belief that human beings fashion their worlds. Regardless of the individual German philosopher's epistemic commitments, this idea courses through the period from the late eighteenth into the twentieth century. For example, that Man is a self-fashioner is fundamental to Kant's *Critique of Pure Reason* (1781), runs through the German Idealism of the early nineteenth century, and remains prominent in such twentieth century thinkers as Ernst Cassirer, Edmund Husserl, whom I have mentioned, and Jürgen Habermas. In particular, Husserl's concept of the "life-world" as a way of understanding the context in which human consciousness develops enjoys great significance here, because he heavily influenced both Scheler and Habermas.[12]

Wolfhart Pannenberg puts a theological spin on Scheler's idea of "openness to the world" (*Weltoffenheit*).[13] He asserts that Man is fundamentally *weltoffen* and for that reason any attempt to understand his relationship to God must begin with the recognition that he exists on this planet:

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[10] Max Scheler, Die Stellung des Menschen im Kosmos (München, 1947).

[11] *Íbid.*, 41. Manfred S. Frings, *The Mind of Max Scheler: The First Comprehensive Guide Based on the Complete Works* (Milwaukee, 1997), 185-188.

[12] On Scheler and Husserl, see *Frings, The Mind of Max Scheler: The First Comprehensive Guide Based on the Complete Works.* On Habermas and the "life-world", see John W. Tate, "Kant, Habermas, and the 'Philosophical Legitimation' of Modernity," *Journal of European Studies* 27 (1997).

[13] Wolfhart Pannenberg, *Was ist der Mensch? Die Anthropologie der Gegenwart im Lichte der Theologie*, 7 ed. (Göttingen, 1962).

> In view of the indubitable embedding of the individual into the phylogenetic process of humanity and thus into the events of all of nature, the assertion that God has created "me" remains an emotional exaggeration unless other reasons than the subjective feeling of finiteness urge us to bring natural events into connection with the question of God.[14]

Man's religions feelings can only be legitimized if mediated through the natural world. Pannenberg's Anthropologie is a wholly modern construct, in so far as he wants to understand Man's essence for today. However, he also makes clear that his approach dates back to the eighteenth century, when he writes:

> It is significant that Johann Gottfried Herder, a theologian, stands at the origins of modern Anthropologie. In his Ideas on the Philosophy of the History of Humanity (1784) Herder described the human being [der Mensch] as the first freedman (Freigelassene) of Creation.[15]

This is an exaggeration. Herder thought deeply about theological issues but he never took a degree in theology, nor did he ever occupy a position as a theologian. Moreover, very little of his work fits under the disciplinary rubric of theology, at least as it was understood at the time. Still, Pannenberg's distinct association of human freedom with Creation highlights, from another angle, the central assumption of all Anthropologie, namely that man's destiny was shaped by, and must be understood within, the world that he has always confronted.

Scheler and Pannenberg's work suggests, however, a problem that scholars of Anthropologie have yet adequately to address: given that human beings have been put on this world, how do they find their way around it? Put another way, how do they know where they are within Creation? Pannenberg was aware of this issue, writing, "For that reasoning order to gain perspective, it is necessary to orient oneself". He then went on to note, "In being exposed to his surroundings he [der Mensch] always builds for himself an artificial world, in order to restrain the diversity of sensations that assail him".[16] Man creates an artificial world within the world that God has created.

Pannenberg's insight brings us back to the eighteenth century, perhaps the great era of orientation, for it was in this time that the explorers and astronomers filled in many blanks on the terrestrial and celestial spheres. (Both the Australian Continent and the planet Uranus were officially "discovered" in the eighteenth century). One result of the general expansion

[14] Wolfhart Pannenberg, Toward a Theology of Nature: Essays on Science and Faith (Louisville, KY, 1993), 74.
[15] Pannenberg, Was ist der Mensch? Die Anthropologie der Gegenwart im Lichte der Theologie,12.
[16] *Íbid.*, 14.

of geographic and astronomical knowledge was that the problem of orientation entered the general discussion. Consider Immanuel Kant's words in "What is Orientation in Thinking?" (1786):

> To orient oneself means, in the literal meaning of the word: to find the East [Kant uses the word Aufgang] from a given region of the world, [given that] we divide the Horizon into four parts. If I see the Sun in the sky, and know that it is afternoon, now I know how to find South, West, North, and East. For this purpose, however, I require a feeling of a difference within my own subject, namely [that of] the right and left hand.[17]

Here, already in the eighteenth century, we see how one philosopher connected natural signposts with the human being's inner life. Anthropologie cannot be understood without the world into which the human being was born.

Astronomy and the Problem of Orientation

Keeping in mind the problem of orientation, as I have outlined it above, let us now consider two books, one published in the seventeenth century and the other in the eighteenth, in order to frame this broader anthropological trend. In 1669, Wilhelm Schickard's *Short Instruction on How to Make Artificial Maps on Correct Grounds* was published posthumously in the German university town of Tübingen.[18] Schickard had died of the plague thirty-five years before, but his scholarly reputation endured. The book's preface, which was written anonymously, noted how this notable author had called for Germans to use science as a means for improving their maps, with the goal of:

> Giv[ing] a hand not only to the traveler but also the homebody that amuses and improves himself by reading works of…world history, [should they be] led astray in the darkness and become ensnared in error—in body or mind—and [find themselves] at a loss, lost in the world.[19]

The text's general spirit and Schickard's academic background were intimately related. Well versed in Arabic, astronomy, and mathematics, Schickard cultivated disciplines that, when combined, extended his imagination far beyond his native Württemberg. Schickard studied of far away

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[17] Immanuel Kant, "Was heißt: sich im Denken orientiren?" *Berlinische Monatschrift* (1786), 304-329, 307.

[18] Wilhelm Schickard, *Kurze Anweisung wie künstliche Land-Tafeln auss rechtem Grund zu machen/ und die biss her begangne Irrthumb zu verbessern/ Sampt etlich New erfundenen Vörtheln/ die Polus Höhin auffs leichtest/ und doch scharpff gnug zu forschen* (Tübingen, 1669). Rochus Wilhelm Liliencron *et al.*, eds., *Allegemeine deutsche Biographie*, vol. 31 (Leipzig, 1875). 174-175.

[19] *Íbid.*, preface (unpaginated).

cultures and distant places, and this suggested the need to him and his publishers for better forms of orientation.

Now, let us consider the second text. In 1784, appeared the first two parts of Johann Gottfried Herder's unfinished four-part opus *Ideas on the Philosophy of History of Mankind* (the last part appeared in 1791). As I have already noted, this is the most important text in the history of *Anthropologie*, and it is, therefore, of no small importance that the first book describes the earth as one planet within a universe of worlds. Indeed, the first chapter's heading is, "Our Earth is One Star among Stars", while that of the second is, "Our Earth is in the Middle Grade of Planets". Herder, thus, began with the universal context before turning to the terrestrial, which he then also described in the broadest terms, as he dedicated the second and third books to describing the plant and animal kingdoms and Man's position among them. The attention to context is significant. Herder was a thoroughgoing representative of the Enlightenment in Germany, and yet he only took up the human being as a rational creature in the text's fourth book. What Herder suggests, thus, is that human rationality has a specific natural context and must, for that reason, always be put in a place. This is, perhaps, an extreme approach to the larger issue of orientation, but Herder's work shows how fundamental was the instinct in the eighteenth century to *locate* Man before evaluating him.

The desire to know where one was became a fundamental theme for German culture in the eighteenth century, growing ever more prominent as both science and European colonialism expanded around the globe. Questions about where humans were on the globe, in the universe, and in the metaphysical realm were conditioned by the early-modern world's discovery of new planets and new spaces.

In this context it is significant that the *Short Instruction* appeared eight years before Isaac Newton's *Principia Mathematica*, *the* epochal text in the early-modern world, for it reveals Hans Blumenberg's active post-Copernican mind already at work.[20] Moreover, it also highlights an important theme within the history of German science: astronomy and Newtonianism were not equivalent. As Mary Terrall's work on the Prussian Academy of Sciences makes clear, eighteenth century Germany hosted a number of scientific currents, including Wolffianism, Cartesianism, and Newtonianism.[21] In fact, enthusiasm for Newton was muted in Germany until well after 1750. The context in which *Anthropological* thought developed was extremely rich, as a variety of scientific languages and methods competed for prominence in the German scientific world.

[20] Blumenberg, *The Genesis of the Copernican World.*

[21] Mary Terrall, "The Culture of Science in Frederick the Great's Berlin", *History of Science* 28 (1990), 333-364, Mary Terrall, *The Man Who Flattened the Earth: Maupertuis and the Sciences in the Enlightenment* (Chicago, 2002).

The German scientific world cultivated deep connections with science from other parts of Europe. This relationship to foreign thought was long and complicated. Hence, in order to understand the role and function of German science, we need to embed it in an older European discussion. To the extent that we can talk about an early-modern mind —à la Paul Hazard— that mind's worldview confronted successive shocks, during the fifteenth and sixteenth centuries.[22] The first came in 1492, with Christopher Columbus' landing in the New World, the second with the publication of Copernicus' *De revolutionibus*.[23] This is a retrospective evaluation, of course. It took decades before Europe fully plumbed the implications of Columbus' new-world encounters, and Copernicus' "victory" over Ptolemy was mostly ignored in the years after his book appeared.[24] Nonetheless, taken together these events augured the end of the medieval Aristotelian worldview that not only had placed man and the earth comfortably in the universe's center but also valued the humanity through its relationship to God.[25]

By the early seventeenth century, as a result of European exploration and scientific work in a variety of disciplines, the traditional signposts for *locating* and, therefore, *valuing* the human being were weakened, if not fully undermined. These two things had always worked together; that is, humanity's assessment of its worth was connected to *where* it believed itself to be. Early-modern Europeans knew where they were on the globe, how their position related to the places of others, and how their lives fit into a larger, divine plan. Yet, the New World and the heliocentric universe changed everyone's footing, and this tectonic shift had to be processed. In 1611, for example, John Donne noted the problem, writing in "An Anatomy of the World: The First Anniversary":

> T'is all in peeces, all cohaerence gone;
> All just supply, and all Relation:
> Prince, Subject, Father, Son, are things forgot,
> For every man alone thinkes he hath got
> To be a Phoenix, and that then can bee
> None of that kind, of which he is, but hee.[26]

[22] Paul Hazard, *The European mind, 1680-1715* (London, 1953), 199.

[23] Ironically, Copernicus' ideas emerged from a thoroughly medieval context. On the medieval roots of Copernicus' work, see Michael A. Hoskin and Owen Gingerich, "Medieval Latin Astronomy," in *The Cambridge Concise History of Astronomy*, (Cambridge, 1999), 68-93.

[24] On Europe and the New World, see John Huxtable Elliott, *The Old World and the New, 1492-1650* (Cambridge, 1970), Anthony Pagden, *European Encounters with the New World: from Renaissance to Romanticism* (New Haven, 1993), Robert S. Westman, "The Astronomer's Role", History of Science 18 (1980), 105-147.

[25] Edward Grant, "The Medieval Cosmos: Its Structure and Operation", *Journal for the History of Astronomy* 28 (1997), 147-167.

[26] Charles M. Coffin, ed., *The Complete Poetry and Selected Prose of John Donne* (New York, 2001).

Donne's lamentation was partly related to domestic politics, as the text mourned the passing of an Age, as much as the noble woman to whom it was dedicated. Nonetheless, similar concerns about space and orientation were expressed on the Continent by Pascal, as I have already noted. As a result, the intellectually engaged European now found himself awash in space. The earth which once sat comfortably at the universe's center became merely one planet circling around one star in a universe of unimaginable size. Moreover, the known world, which had once consisted of Europe, Asia, and Africa, had two new continents, North and South America, complete with peoples whom God had forgotten. (And by the end of the eighteenth century, another continent, Australia, would be added definitively). Against this backdrop some measure of existential angst was to be expected.

It has often been argued that the intellectual spade work in creating a new, stable worldview was done in the sixteenth and seventeenth centuries.[27] In science, the Kepler-Galieo-Newton trinity completed the project begun by Copernicus, providing human beings with a complete explanation of heavenly phenomena.[28] It is, of course, convenient for this view that Newton's *Philosophiae Naturalis Principia Mathematica* appeared in 1687, near the century's end. Newton's work and that of his predecessors was startlingly original, if not heroic, and as a result the idea perdures that little was left to do in Newton's wake, or as the oft-quoted Pope put it in 1707: "Nature and nature's laws lay hid in night: God said, 'Let Newton Be!' and all was light". In the geographic realm, the responses included advances in cartography —Gerardus Mercator's first projection appeared in 1559— scientific expeditions, and the development of ideologies of empire. Using their naval experiences to the fullest, Spain, Britain, France, and the Netherlands constructed their own national populations not only with respect to distant empires and peoples —to whom they felt superior— but also to each other.[29] Knowing where one was relative to others was an essential component for the development of things such as Eurocentrism, nationalism, and racism.[30]

Pope's poetic sentiments connect my general discussion with a problem in the history of science: if the seventeenth century is considered an age of genius, the eighteenth century is often an age of epigoni.[31] After all, it only

[27] The classic general expression of this approach is Theodore K. Rabb, *The struggle for stability in early modern Europe* (New York, 1975). The same sentiment can be found in histories of science. See, for example, A. Rupert Hall, *From Galileo to Newton* (New York, 1981), A. Rupert Hall, *The Revolution in Science, 1500-1750,* 3rd ed. (London, 1983), A. Rupert Hall, *The Scientific Revolution, 1500-1800: The Formation of the Modern Scientific Attitude* (London, 1962).

[28] Steven Shapin, *The Scientific Revolution* (Chicago, 1996). This text follows Newtonianism carefully, and from a very English perspective. Unlike some of the older literature, however, the author makes clear that this was a conscious choice and he holds England to be a representative example, though not the only part of the story.

[29] Anthony Pagden, *Lords of all the World: Ideologies of Empire in Spain, Britain and France, c. 1500-c. 1800* (New Haven, 1995).

[30] See Bartolomé de las Casas and Nigel Griffin, *A Short Account of the Destruction of the Indies* (London, 1992).

[31] I. Bernard Cohen, *Revolution in Science* (Cambridge, Mass., 1985); Hall, *From Galileo to Newton*; *The Revolution in Science, 1500-1750*; *The Scientific Revolution, 1500-1800: The Formation of the Modern Scientific Attitude*.

remained to confirm Newton's findings, to map the territories the first explorers encountered, and then to disseminate the new knowledge. There is some truth to this position. Voltaire and Emilie du Châtelet brought Newton to the Continent through their popular texts.[32] Maupertuis' Lapland expedition, however hazardous, merely confirmed Newton's hypotheses. Worse, perhaps, when Comet Halley returned in 1759, it was first spotted by a Saxon peasant who was also an amateur astronomer.[33] This is hardly an heroic picture. Moreover, most eighteenth century exploration merely charted territories whose existence was already suspected. In sum, in comparison to the sixteenth and seventeenth centuries, the eighteenth can easily appear less than glorious. The rest of this essay will consider why this position is wrong.

Astronomy and the Eighteenth Century

The eighteenth century's position as heir to an earlier age's genius has prevented a fuller understanding of its science and the cultural effects of its spread. As Jan Golinski and Thomas Broman have noted separately, historians routinely under-appreciate eighteenth century science, because the great discoveries were seemingly already made.[34] In response Golinksi has argued that the growth of chemistry —together with botany one of the eighteenth century's "legitimate" scientific contributions— was intimately connected with the growth of a literate public. How chemistry was diffused in practice shaped the research agendas of its practitioners, and determined what kind of science it would be. For his part, Broman has argued with respect to medicine that science's growing connection to the eighteenth century public sphere is exactly what makes that century's science so significant. As he sees it, the breadth and depth of public discussions reveals not only that science was being done in new places and in new ways, but that new sectors of the European population were learning to connect to science.[35] That science had

[32] On Newtonianism in France, see Sarah Hutton, "Emilie du Chatelet's Institutions de Physique as a Document in the History of French Newtonianism", *Studies in the History of the Philosophy of Science* 35 (2004), 515-531; Voltaire, *Elémens de la philosophie de Neuton: mis à la portée de tout le monde* (Amsterdam, 1738). On Germany, see Thomas Ahnert, "Newtonianism in Early Enlightenment Germany, c. 1720 to 1750: Metaphysics and the Critique of Dogmatic Philosophy", *Studies in the History of the Philosophy of Science* 35 (2004), 471-491. On England, Betty Jo Teeter Dobbs and Margaret C. Jacob, *Newton and the culture of Newtonianism* (Atlantic Highlands, N.J., 1995).

[33] On Maupertuis, see Terrall, *The Man Who Flattened the Earth: Maupertuis and the Sciences in the Enlightenment*. On Comet Halley, see Simon Schaffer, "Authorized Prophets: Comets and Astronomers after 1759", *Studies in Eighteenth Century Culture* 17 (1987), 45-74.

[34] Terrall, *The Man Who Flattened the Earth: Maupertuis and the Sciences in the Enlightenment*. Jan V. Golinski, "Utility and Audience in Eighteenth-Century Chemistry: Case Studies of William Cullen and Joseph Priestley", *British Journal for the History of Science* 21 (1988): 1-31. Broman, "The Habermasian Public Sphere and 'Science in the Enlightenment'", Thomas Broman, "Rethinking Professionalization: Theory, Practice, and Professional Ideology in Eighteenth Century German Medicine", *The Journal of Modern History* 67 (1995): 835-872, Jan V. Golinski, *Science as Public Culture: Chemistry and Enlightenment in Britain, 1760-1820* (Cambridge, 1992).

[35] Science had to be done in new ways, since scientists were spread around Europe and had no choice but to develop methods of communication and persuasion. On theoretical aspect of this growth in numbers of

entered the public sphere was the eighteenth century's most important contribution.

Golinski's insights into chemistry and Broman's into medicine are equally relevant for the historiography of astronomy, in which the eighteenth century has been relegated to a secondary position, in spite of the extensive work by, among others, Simon Schaffer, J. A. Bennett, and Eric Forbes.[36] Although the eighteenth century saw great advances in telescope technology, William Herschel's discovery of Uranus, and the completion of Tobias Mayer's lunar tables, the sense remains that eighteenth century astronomers merely filled in the blanks left by their seventeenth century forebears.[37] Granted, much of the eighteenth century project was a practical affair, as Europeans expended much energy on developing surveying techniques, maps, and aids to navigation. Donne noted these efforts already in the seventeenth century:

> This is the world's condition now, and now
> She that should all parts to reunion bow,
> She that had all Magnetique forces alone,
> To draw, and fasten sundred parts in one;
> She whom wise nature had invented then
> When she observ'd that every sort of men
> Did in their voyage in this worlds Sea stray,
> And needed a new compasse for their way.[38]

The eighteenth century's search for a method of calculating longitude was the final end of this practical process.[39] Nonetheless, elite astronomical discussion was vigorous and not simply derivative of previous work, as it posed fundamental (and new) questions about the universe's structure. In 1759, for example, Johann Heinrich Lambert became the first to posit the nebular hypothesis, which held that our solar system began as a large cloud of gas that enveloped the sun, before forming into the system in which we live. In addition to being a stunning early insight into the nature of matter, this idea represented a significant new current of thinking, in which the universe became an historical entity whose development could only be understood *through time*. In keeping with Broman's argument, the public readily recognized the significance of eighteenth century astronomical work, and as a

practitioners was the need to determine whom to believe. See, Steven Shapin, *A Social History of Truth: Civility and Science in Seventeenth Century England* (Chicago, 1994).

[36] J. A. Bennett, "The English Quadrant in Europe: Instruments and the Growth of Consensus in Practical Astronomy", *Journal for the History of Astronomy* 23 (1992): 1-14, Eric G. Forbes, "Tobias Mayer's Contributions to Observational Astronomy", *Journal for the History of Astronomy* 11 (1980), 28-49, Schaffer, "Authorized Prophets: Comets and Astronomers after 1759", Simon Schaffer, "Uranus and the Establishment of Herschel's Astronomy", *Journal for the History of Astronomy* 12 (1981), 11-26. See also Nicholas Jardine, "The Places of Astronomy in Early-Modern Culture", *Journal for the History of Astronomy* 29 (1998), 49-62.

[37] Michael A. Hoskin, *The Cambridge Concise History of Astronomy* (Cambridge, 1999).

[38] Coffin, ed., *The Complete Poetry and Selected Prose of John Donne* (2001).

[39] Derek Howse, *Greenwich Time and the Discovery of the Longitude* (Oxford: Oxford University Press, 1980).

result astronomy shaped the knowledge that poured in from exploration and other scientific work.[40] This organizational role then became fundamental for subsequent speculation about the nature of humanity.

My point in this article is not to rescue eighteenth century astronomy as a science, for others have already undertaken that task. Instead, I want to pursue a different tack, which is to understand how astronomy's diffusion through a non-specialist public had profound and productive cultural effects. Here I assume that astronomy's low profile in the literature has encouraged disregard for its wider effects. Just to take one example: it has long been accepted that Immanuel Kant's Copernican Revolution in *Critique of Pure Reason* (1781), in which time and space became subjective aspects of human reason in general, was a response to Newtonian physics.[41] This position is true, but incomplete. Kant was also interested in astronomy. Indeed, he wrote an astronomical text in 1755 that made use of the latest astronomical knowledge, especially that collated by Christian Wolff.[42] Given the significance of Kant's later work, I would suggest that astronomy was a fundamental backdrop against which new philosophical questions were asked. My position is also informed by Daniel Brewer's recent discussion of eighteenth century space.[43] In "Lights in Space", Brewer argues that a new way of seeing space appeared in the eighteenth century and proposes five categories of eighteenth century space to guide further research: physical space, social space, colonized space, epistemological space, and aesthetic space. His arrangement is systematic and plausible. In each of these areas, eighteenth century Europeans changed the way they saw and represented new spaces: among other things maps were systematized, cities were recognized as valuable places, and writers created new ways of imagining the world through literature. I would add another category, however, astronomical space, and the reasons are two-fold: the spaces I noted above were constructed against the backdrop of the new astronomy; none of these spaces could be experienced, but had to be "thought". On the one hand, astronomers suggested new ways of thinking about space outside the earth. On the other, an audience appeared during the eighteenth century that was interested in discussing this new space.

Astronomy's influence was connected to the vogue for collecting knowledge about the world. The public sphere provided a market for the new knowledge, and members of the cultural elite across Europe eagerly read

[40] Rainer Baasner, *Das Lob der Sternkunst: Astronomie in der deutschen Aufklärung* (Göttingen, 1987).
[41] Lewis White Beck, *Early German Philosophy: Kant and his Predecessors* (South Bend, IN, 1999).
[42] Immanuel Kant, *Allgemeine Naturgeschichte und Theorie des Himmels: oder Versuch von der Verfassung und dem mechanischen Ursprunge des ganzen Weltgebäudes nach Newtonischen Grundsätzen abgehandelt* (Königsberg, 1755).
[43] Daniel Brewer, "Lights in Space", *Eighteenth Century Studies* 37 (2004): 171-186.

about and discussed recent discoveries.[44] Voltaire and company's popularization of Newtonian physics is a good example, for popularization transformed knowledge into entertainment. Another, more literary example, is Bernard de Fontenelle's *Treatise on the Plurality of Worlds*, first published in 1696, which used a dialogic format to explain the universe's structure.[45] Still another aspect, and equally important, was the proliferation of travel literature, which allowed armchair travelers everywhere to encounter strange places without leaving home.[46] Such literature was not a new phenomenon, of course, as Marco Polo and others had published works on their travels in China and the Middle East already in the fourteenth century. What was new, however, was the combination of a systematic understanding of space with the interest in cultural difference.

Travel literature and travel fantasies opened a new way of understanding space and the humans who lived in it. In Baron Montesquieu's *Persian Letters* a Persian travels to France and sends his observations back to his homeland, a faraway but real place. In Daniel Defoe's *Robinson Crusoe*, Crusoe is in an unknown space, but his mysterious island was actually made real against the backdrop of contemporary English exploration. We can also add numerous examples from the German context: Johann Gottfried Herder's description of his trip to England, Johann Wolfgang Goethe's writings on Italy, and most famously Johann and Georg Forster's reports from the Pacific.[47] Another example, hardly discussed, is the consistent use, during the eighteenth century, of pocket sundials. These dials not only required general geographic knowledge to be used properly, since they were built for use in specific latitudes, but they also included information about exotic geographic zones, such as Istanbul, that the user would only have visited through reading.[48] Thus, by the eighteenth century's end, a wide network of people was aware of the latest discoveries and was putting them into public practice.

By the end of the eighteenth century, to be au courant was to be familiar not only with the new physics but also the scientific and travel reports from exotic places around the globe.[49] Celebrated scientific missions, such as Maupertuis' visit to Lapland (1736), or Captain Cook's Pacific voyages (1768–71; 1772–75; 1776–79) expressly connected exotic parts of the globe

[44] I am referring here to the massive literature on the eighteenth century public sphere. Broman, "The Habermasian Public Sphere and 'Science in the Enlightenment'", has a good discussion of the relevant citations.

[45] I had access to a later edition: Bernard de Fontenelle, *Entretiens sur la Pluralité des Mondes* (Amsterdam, 1719).

[46] Brewer, "Lights in Space", Thomas Kleinknecht, "'Reise der Aufklärung': Selbstverortung, Empirie und epistemologischer Diskurs bei Herder, Lessing, Lichtenberg und anderen", *Berichte zur Wissenschaftsgeschichte* 22 (1999), 95-111.

[47] In general see, Kleinknecht, "'Reise der Aufklärung': Selbstverortung, Empirie und epistemologischer Diskurs bei Herder, Lessing, Lichtenberg und anderen". On Herder and his travels, see Anthony J. La Vopa, "Herder's Publikum: Language, Print, and Sociability in Eighteenth Century Germany", *Eighteenth Century Studies* 29 (1995), 5-24.

[48] Sara Schechner, "The Material Culture of Astronomy in Daily Life: Sundials, Science, and Social Change", *Journal for the History of Astronomy* 32 (2001), 189-222.

[49] The desire to know the latest information rapidly became pedagogical, see James A. Secord, "Newton in the Nursery: Tom Telescope and the Philosophy of Tops and Balls, 1761-1838", *History of Science* 32(1985), 127-151.

with space.[50] Maupertuis' journal, for instance, included extensive discussions of how he calculated his ship's location via the stars.[51] Captain Cook's second mission connected space and place in a different way, since it included the testing of Harrison's H-1 chronometer as way for measuring longitude.[52] Of course, none of this could be done without accurate astronomical observations. As was the case with pocket sundials, space, time and the sky were intimately connected in the eighteenth century.[53]

The connection between scientific exploration to distant parts and a new understanding of global position came to fruition in Alexander von Humboldt's travels and publications during the last years of the eighteenth and into the nineteenth century, including his *Aspects of Nature, in Different Lands and Different Climates* (1808), and *Personal Narrative of Travels to the Equinoctial Regions of the New Continent During the Years 1799–1804* (1805-1834). When Humboldt published his *Cosmos: A Sketch of a Physical Description of the Universe* (1845-1862), it was the last word in early-modern Europe's great process of reorientation that had begun with Columbus and Copernicus.[54]

Astronomy and scientific exploration were fundamental early-modern sciences. Although Europe's discoveries destroyed the medieval worldview, they did not simply replace it with another static one. Rather, the new vision of the universe also changed the viewer, as it inculcated people with a new attitude toward the natural world.[55] God's creation was now something to be explored by the human mind, and the exploration would, by definition, be long, since so much needed to be understood and such great distances were involved. This exploration continued well into the nineteenth century, and this is why eighteenth century astronomy was so important: in order to explore this new world, Europeans needed not only to understand *where* they stood, with respect to other countries and other planets, but also to have better ways of measuring space, especially the extraterrestrial kind. It was the application to other problems of the skills and attitudes that astronomy cultivated that, ultimately, changed how people viewed humanity.

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[50] In the German context, see Johann Reinhold Forster *et al.*, *Observations made during a voyage around the world* (Honolulu, 1996), Georg Foster, Nicholas Thomas and Oliver Berghof, *A voyage around the world* (Honolulu, 2000).

[51] Terrall, *The Man Who Flattened the Earth: Maupertuis and the Sciences in the Enlightenment.*

[52] Derek Howse, *Greenwich Time and the Discovery of the Longitude* (Oxford, 1980).

[53] Daniel Brewer notes rightly that in the eighteenth century time was an aspect of space. Unfortunately, I cannot go into that topic here.

[54] Alexander von Humboldt, *Kosmos: Entwurf einer physischen Weltbeschreibung*, 5 vols. (Stuttgart, 1845-1862).

[55] My thinking on this issue has been heavily influenced by Hans Blumenberg, *Die Genesis der kopernikanischen Welt* (Frankfurt am Main, 1975), Brewer, "Lights in Space".

Astronomy in Eighteenth Century Germany

Germany's discussions about the universe were part of a European trend, but took on a particular flavor. A product of the Holy Roman Empire's fractured politics, early-modern Germany lacked a single state or new world colonies. Thus, much of the German interest in the globe was mediated through scholarly discussion about what others had discovered, as Germans voraciously consumed scientific and travel reports especially from the Anglophone and Francophone spheres.[56] In addition, German works such as the Fosters' reports from the Pacific and the burgeoning travel literature that told of journeys to places such as Italy or the Ottoman Empire piqued German interest in the world, even though German politics was not directly enmeshed in this particular competition.[57]

Nonetheless, whatever Germany may have lacked in political unity and colonies, it more than made up for with its centers for astronomical inquiry.[58] Their growing presence will be crucial for the elaboration of a new understanding of creation. Germany had many princes, and supporting astronomy became one way for them to increase their prestige. Just consider, for a moment, that one of Germany's leading centers for astronomical research in the late eighteenth and early nineteenth century was tiny Gotha in Thuringia, whose first-class observatory was the product of ducal interest in astronomy.[59] And Gotha, through the correspondence of its chief astronomer Franz Xaver von Zach, became a clearinghouse for information and data on astronomical observation. As new observations rolled in and moved out, the data were immediately converted into maps and globes which, in turn, shaped Germans' vision of the world.

A simple, if rough, measure of astronomy's prominence and the German commitment to it is the proliferation of observatories. The Academy of Sciences in Berlin built the first state-sponsored observatory between 1701 and 1711.[60] The universities in Altdorf, Ingolstadt, and Jena each followed suit in 1711. Real growth came later, as between 1740 and 1811 fourteen professional observatories appeared across Germany. (The relevant locations and dates are listed in figure 1.) In most cases, the observatory had the

[56] On Germany's relationship to colonialism, see Susanne Zantop, *Colonial Fantasies: Conquest, Family, and nation in Precolonial Germany, 1770-1870* (Durham, 1997).

[57] See, for example, Forster *et al.*, *Observations made during a voyage around the world*, Domenico Seftini, "Beschreibung des Kanals von Konstantinopel, des dasigen Wein- Acker- und Garten-Baues, und der Jagd der Türken", in *Neue Sammlung der Reisebeschreibungen* (Hamburg, 1786), 5-174.

[58] On observatories in Germany, see Rainer Baasner, *Das Lob der Sternkunst: Astronomie in der deutschen Aufklärung* (Göttingen, 1987), 28-31.

[59] Peter Brosche, "Franz Xaver von Zach und die Gründung der Seeberg-Sternwarte bei Gotha 1788", in *Jahrbuch der Coburger Landesstiftung*, ed. Georg Aumann (Coburg, 1988).

[60] Hans Ludendorff, "Zur Frühgeschichte der Astronomie in Berlin", *Preussische Akademie der Wissenschaften: Vorträge und Schriften* (1942), 1-23.

government's express support. For example, the Landgrave of Hessen backed the observatories in Giessen and Kassel, and the Duke of Gotha had two observatories built, as did the burghers in Göttingen. Thus, in many German cities astronomy became a visible daily presence through the presence of the buildings where it was practiced.

I argue here that if we consider things such as travel literature and newspaper reports through astronomy's growth as a discipline, then we can trace how the German mind recreated the globe, the universe, and humanity in the eighteenth century. Put most simply, Germans projected the mind from a known place into unknown ones and created, thereby, new spaces into which the human imagination could flow.[61] This included delineating clearly the path, there and back, from Tübingen to Stuttgart (see figure 2), from the Old World to the New, or from earth to the comet of 1769, which you see depicted here in figure 3.

Let us consider this process through a visual example. Figure 4 is the frontispiece to part I of Johann Wolfgang Müller's Instruction in Knowledge and Use of Celestial and Terrestrial Globes.[62] In *the center is the celestial globe, with the signs of the zodiac imprinted on it*. At the top right are the moon and the Big Dipper, celestial phenomena essential for global orientation. Then there are the various instruments necessary for taking readings and making calculations. The celestial globe was a complete fiction, of course, since the various stars are located at different distances from the earth. Nonetheless, it is a necessary fiction for any study of the heavens, a fact that German astronomers made clear for all readers. Hence, German astronomy created a new heavenly (unreal) sphere that provided an anchor for further contemplation. A full understanding of abstract space was, therefore, the foundation for understanding outer space.

Now consider figure 5, the frontispiece to volume two of the same work.[63] In the center is the terrestrial globe. Then notice, again, the collection of scientific tools necessary for orientation. Also note, however, the inclusion of recent events and discoveries around the globe. On the left is a ship flying the Tricolor, representing French exploration. In the middle is Australia, called Hollandia, which Europeans only encountered in 1606 and first settled in 1788. To the right are British troops firing on indigenous people in Hawaii, which is probably a reference to the misunderstanding that led to James Cook's death in 1776. This globe is also founded on abstract space, as the earth is really a geometric sphere in which an image of the globe had been inscribed. Locating oneself on this sphere was impossible without the

[61] Kleinknecht, "'Reise der Aufklärung': Selbstverortung, Empirie und epistemologischer Diskurs bei Herder, Lessing, Lichtenberg und anderen".
[62] Johann Wolfgang Müller, *Anweisung zur Kenntnis und dem Gebrauch der künstlichen Himmels- und Erdkugeln besonders in Rücksicht auf die neuesten nürnberger Globen, für die höhern Classen der Schulen und Liebhaber der Sphaerologie*, 2 vols., vol. 1 (Nuremberg, 1791).
[63] *Íbid.,* vol. 2 (Nuremberg, 1792).

assumption of a celestial sphere. In both cases the understanding of space in its abstract form became fundamental to understanding real space.

By the mid-eighteenth century astronomy as a field of inquiry organized human knowledge about the globe, the universe, and Man.[64] To take merely one example of astronomy's fundamental role in structuring the German imagination, consider Abraham Gotthelf Kästner's "In Praise of Astronomy", which appeared in a 1747 issue of the *Hamburgisches Magazin*.[65] In this text Kästner, the chief astronomer at the observatory in Göttingen, wrote, "But we can ascertain truths from the motion and attributes of the heavenly spheres. Had the Creator not wished that we should do this, he would not have given us such a comfortable observatory".[66] Astronomy, could teach humanity more than just how to get from one part of its world to another; it could also reveal the human being's place in God's universe. Johann Christoph Gottsched agreed. In 1743, he published a *laudatio* of Nicolaus Copernicus in commemoration of the two hundredth anniversary of the latter's death, in which Gottsched noted that Copernicus showed us that the uncertainty of our knowledge of the heavens represented nothing more than the incompleteness of human reason.[67] Outer space was, therefore, an opportunity to put human reason in motion. Herder followed a similar line in an article he published on Copernicus, noting that the real issue in understanding Copernicus' significance lay in the human spirit. He wrote, "still, here we speak not of the heavens' revolutions, but of a revolution in the human spirit [*Geist*]".[68] The human being's essence was always at the center of all astronomical contemplation. In this respect, the public cultivation of astronomical knowledge in Germany brought together two streams of thought: the Continental-wide attempt to understand the laws of Newton's universe and the philosophical discourse about the powers and limits of human reason.

Kästner's contribution was only one of many in what became a broad discussion about the nature of universe and humanity's position in it. Here I return to that celebrated literary event, the publication of Bernard de Fontenelle's *On the Plurality of Worlds*. Originally published in French in 1686, this text subsequently went through at least eight German editions over the next century, four of which stemmed from the Academy of Sciences in

[64] On eighteenth century Germany's love affair with astronomy, see Baasner, *Das Lob der Sternkunst: Astronomie in der deutschen Aufklärung*.

[65] Abraham G. Kästner, "Das Lob der Sternkunst". *Hamburgisches Magazin, oder gesammlete Schriften, zum Unterricht und Vergnügen* 1 (1747), 206-222.

[66] Kästner, "Das Lob der Sternkunst", 222.

[67] Johann Christoph Gottsched, *Gedächtnissrede auf den unsterblich verdienten Domherrn in Frauenberg Nicolaus Copernikus, als den Erfinder des wahren Weltbaues, welche in hoher Gegenwart Zweyer Durchlaucht. Königl. Pohln. und Churfürstl. Sächsicher Prinzen, auf der Universitätsbibliothek zu Leipzig, im Maymonate des 1743 Jahres und also zweyhundert Jahre nach seinem Tode, gehalten worden* (Leipzig, 1743).

[68] Johann Gottfried Herder, "Etwas von Nikolaus Kopernikus Leben", *Der Teutsche Merkur* (1776), 169-179, 170.

Berlin, about which more in a moment.[69] Fontenelle's book took the reader on a delightful tour of the heavens, describing in detail the universe's structure of a sun plus the then-known six planets, in addition to speculating on what inhabitants on the other planets must look like, given the environments in which they lived.

Fontenelle's text was the first salvo in what became a popular pedagogical campaign, as numerous astronomical texts began to appear across Germany. In 1744, for example, Eberhard Christian Kindermann's *Complete Astronomy, or Curious Meditations on the Grandest Planets and Stars Found in the Firmament* appeared in little Rudolstadt in Thuringia. Other works appeared in larger cities. The aforementioned Kästner published the first volume of *Fundamentals of Astronomy* in Göttingen in 1759. In 1768, Johann Elert Bode published *Guide to the Knowledge of the Starry Heavens* in Hamburg, before moving to Berlin to be head of the royal observatory, where he published a long series of astronomical texts into the next century.[70] Bode also became Fontenelle's translator in Berlin, completing a German translation that included interpretive and critical footnotes.[71] (Figure 6 shows the frontispiece to this edition). By the eighteenth century's end, Bode had become a leading figure in German astronomy, and his widely read translations, pedagogical texts, and scientific publications spread many of Fontenelle's basic insights around the German cultural zone.

Typical of German debate, the discussion of astronomy was rapidly systematized, as early translations of Fontenelle gave way to an academic German discussion about the solar system's structure. The writers involved included people such as Christian Wolff, Johann Heinrich Lambert, Georg Lichtenberg, Tobias Mayer, and Johann Elert Bode.[72] Wolff, for example,

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[69] The original French edition is Bernard de Fontenelle, *Entretiens sur la Pluralité des Mondes* (Paris, 1686). An example of an edition translated and printed in Berlin is Fontenelle, Bernhard von Fontenelle *Dialogen über die Mehrheit der Welten: Mit Anmerkungen und Kupfertafeln / von Johann Elert Bode, Astronom der Königl. Akademie der Wissenschaften zu Berlin* (Berlin, 1780).

[70] Johann Elert Bode, *Anleitung zur Kenntniß des gestirnten Himmels auf jede einzelne Monate des Jahres eingerichtet* (Hamburg, 1768), Johann Elert Bode, *Kurzer Entwurf der astronomischen Wissenschaften* (Berlin, 1794), Johann Elert Bode, *Kurzgefaßte Abhandlung von dem im Herbst dieses 1769sten Jahres erschienenen Kometen nebst einem geometrischen Entwurf seiner wahren Laufbahn um die Sonne* (Hamburg, 1769), Johann Elert Bode, *Monatliche Anleitung zur Kenntniß des Standes und der Bewegung der Planeten und des Mondes vom Monat May 1774 bis Monat December 1775 nebst Berechnung der mittlerweile vorfallenden Himmelsbegebenheiten* (Berlin, 1774), Johann Elert Bode, *Von dem neu endeckten Planeten* (Berlin, 1784), Johann Elert Bode, ed., *Astronomisches Jahrbuch für das Jahr 1784. nebst eine Sammlung der neuesten in die astronomischen Wissenschaften einschlagenden Abhandlungen, Beobachtungen und Nachrichten* (Berlin, 1781).

[71] Bernard de Fontenelle, *Entretiens sur la Pluralité de Mondes* (Berlin, 1783).

[72] See, for example, Johann Elert Bode, *Anleitung zur allgemeinen Kenntniss der Erdkugel (Berlin, 1786); Bode, Kurzer Entwurf der astronomischen Wissenschaften* (Berlin, 1794); Johann Tobias Mayer, *Bericht von den Mondskugeln, welche bey der kosmographischen Gesellschaft in Nürnberg, Aus den neuen Beobachtungen verfertiget werden durch Tobias Mayern, Mitgliede derselben Gesellschaft* (Nuremberg, 1750); Franz Xaver von Zach, *Nachrichten von Der Königl. Preussischen trigonometrischen und astronomischen Aufnahme von Thüringen und dem Eichsfelde, und von deren Herzogl. Sachsen-Gothaischen Gradmessung zur Bestimmung der Wahren Gestalt der Erde* (Gotha, 1806); Zach, *Astronomische Tafeln der mittleren geraden Aufsteigungen der Sonne in Zeit und Ihrer mittlern Bewegungen für Monate und Tage zur Verwandlung der*

published two books that dealt with astronomy and the universe's structure, both of which highlight for us the systematic nature of German debate. Wolff's *Rational Thoughts on the Workings of Nature*, which appeared in 1746, spent 746 pages discussing every imaginable detail of God's universe. It began with the nature of bodies and matter in the abstract, before moving through a description of the solar system, the earth, the moon, and the sun, and the stars. It then ended with a discussion of the earth's weather, geography, and the plant and animal kingdoms. Almost every subsequent survey of the universe that I have come across followed this basic arrangement.

Within Wolff's astronomical work two themes strike me as essential. First, Wolff went to great lengths to explain just how big the universe is. Noting that more stars became visible with the use of more powerful telescopes, he wrote that: "the universe has endless size, which we can comprehend as little through our reason as we can measure it with our senses".[73] Second, he used the distances involved as an opportunity to speculate on extraterrestrial life. Borrowing directly from Christian Huyghens and Fontenelle, Wolff held that since plants and people populate our planet, we have no reason to doubt that other planets are populated in similar fashion.[74]

The same dedication to thorough description as the precursor to speculation on the extraterrestrial life appears in Johann Heinrich Lambert's *Cosmological Letters on the Arrangement of the World-Edifice*, first published in 1761. Although it uses an epistolary format, this text guides the reader through the Wolffian blueprint, explaining the nature of the universe and the solar system before suggesting the likelihood of sentient life on other planets. After 1750, this is standard. Lambert's also text makes explicit, however, the active role that human intelligence played in exploring and mapping the universe. As he has one of his correspondents write:

> To each fixed star I gave a similar crowd of such bodies which must receive from it their light and heat, and on each of these I placed innumerable inhabitants of all possible kind and form. I have thereby stretched the imagination as far as the world-edifice reaches, and it is now no problem for me to take the distance of our sun from a fiftieth magnitude star as a yardstick, and, by laying it off a million times, to set it up as a measure against the limits of the system of those stars which we see with telescopes and of those which are still beyond.[75]

Sternzeit in mittlere Sonnenzeit und umgekehrt. aus des obersten Freyherrn von Zach verbesserten Sonnen-Tafeln gezogen und auf den Mittagskreis der Seeberger Sternwarte berechnet (Gotha, 1804).

[73] Christian Wolff, *Gesammelte Werke*, vol. 1, 6 (Hildesheim, 1962).

[74] *Íbid.,* 225-6.

[75] Johann Heinrich Lambert, *Cosmological Letters on the Arrangement of the World-Edifice*, Stanley L. Jaki trans. (New York, 1976).

It is, therefore, significant that Lambert also believed that other sentient beings existed in the universe. Thus, for both Wolff and Lambert the very emptiness of space suggested that it was populated with sentient beings, though ones probably unlike us.

Conclusions

What I am suggesting is that the growing desire to understand space via astronomical discussion had anthropological effects. The stirrings of a space-based "anthropology" already appeared in Immanuel Kant's *General History of Nature and Theory of the Heavens* (1755), when Kant noted that, "The Earth's and Venus' inhabitants cannot exchange their homes without their mutual destruction". For the early Kant, sentient beings were *of* the planet they inhabited. The later Kant went on to assume the same thing in his *Critique of Practical Reason* (1787), but here aliens also had their own form of reason that was inaccessible to us, a point that he picked up again in his *Anthropology from a Pragmatic Point of View* (1798). This is not to say that Kant's philosophy was based solely in his the contemplation of the starry heavens above, but simply to note that astronomy's growth as a field of inquiry provided an essential backdrop for German metaphysical speculation. The importance of the universe as a backdrop to scholarly debate is clearest in Johann Gottfried Herder's *Ideas on the Philosophy of the History of Mankind* (1784-1791), which I have already mentioned. The first chapter of this unfinished work is entitled, "Our Earth is one Star among Stars". The first sentence reads, "Our philosophy of the history of humanity must start with the Heavens". And by the end of the first paragraph, Herder has expressly cited the contributions of Copernicus, Kepler, Newton, Huyghens, and Kant to the discussion of the universe, and he even mentions Lambert's *Cosmological Letters* in a footnote to that same paragraph.[76] Herder then follows the same organizational plan that Wolff used, moving from a general description of earth's place in the universe to its topography and, finally, its organic life. Speculating on humanity's place in the universe necessarily came after a description of that universe.

All of this was, I believe, part of the same journey of imagination that Lambert's characters made in 1761. It is significant that that Lambert's text was entitled *Cosmological Letters*, because it underscores how astronomy posed cosmological questions, the pursuit of which led to a new understanding of humanity. When Herder contemplated the earth as a giant organism in the second book of the *Ideas*, he did so from a position *in orbit* around the globe, looking down on the earth and (implicitly) glancing back to the other planets and the distant stars. This god-like perspective was an essential part of Herder's conclusion, "Wherever and whoever I may be, …[I am] a being in the unforeseeable Harmony of one of God's worlds."

Thus, by the end of the eighteenth century, the German contemplation of space created a wholly new cosmological orientation: human beings were

[76] Herder, *Herders Werke*, 17.

small *and* unique. Although awash in a massive universe, human beings were self-fashioners, creating their mental world(s), while leaving other worlds to God and alien minds. As Lambert had his correspondent say:

> Just as we discover with magnifying glasses in each speck of dust a living world and in each droplet of water a sea of creatures, these astronomers find the sky full of celestial bodies. And just a few hours go by in our reflections, thousands of years pass during their considerations of entire solar systems. You know, of course, Sir, that time and space are neither great nor small, but that they should be considered only in their relation to one another, for both become bigger and smaller with one another. A sailor who travels to India has long been accustomed to measure his voyage not in hours but in months, and daily experience teaches us that years can go by like single days and, on the contrary, hours may seem to us longer than days as often as we are forced to wish that they be soon over.[77]

In this sense, knowledge of the physical universe, in space and on the globe, opened the door on a wholly human one. In seizing the opportunity to speculate that the stars presented, German thinkers re-oriented the human being in his world. Put another way, it was the eighteenth century exploration of space that provided the context in which people could become fully human.

[77] Lambert, *Cosmological Letters on the Arrangement of the World-Edifice.*

Figure 1. Observatories in the German States

Year	German States
1711	Berlin, Altdorf, Ingolstadt, and Jena
1740	Giessen
1751	Göttingen
1752	Tübingen
1756	Vienna
1775	Greifswald, Mannheim
1785	Kassel
1786	Leipzig
1788	Gotha
1790	Breslau
1802	Göttingen
1805	Würzburg
1810	Königsberg
1811	Jena

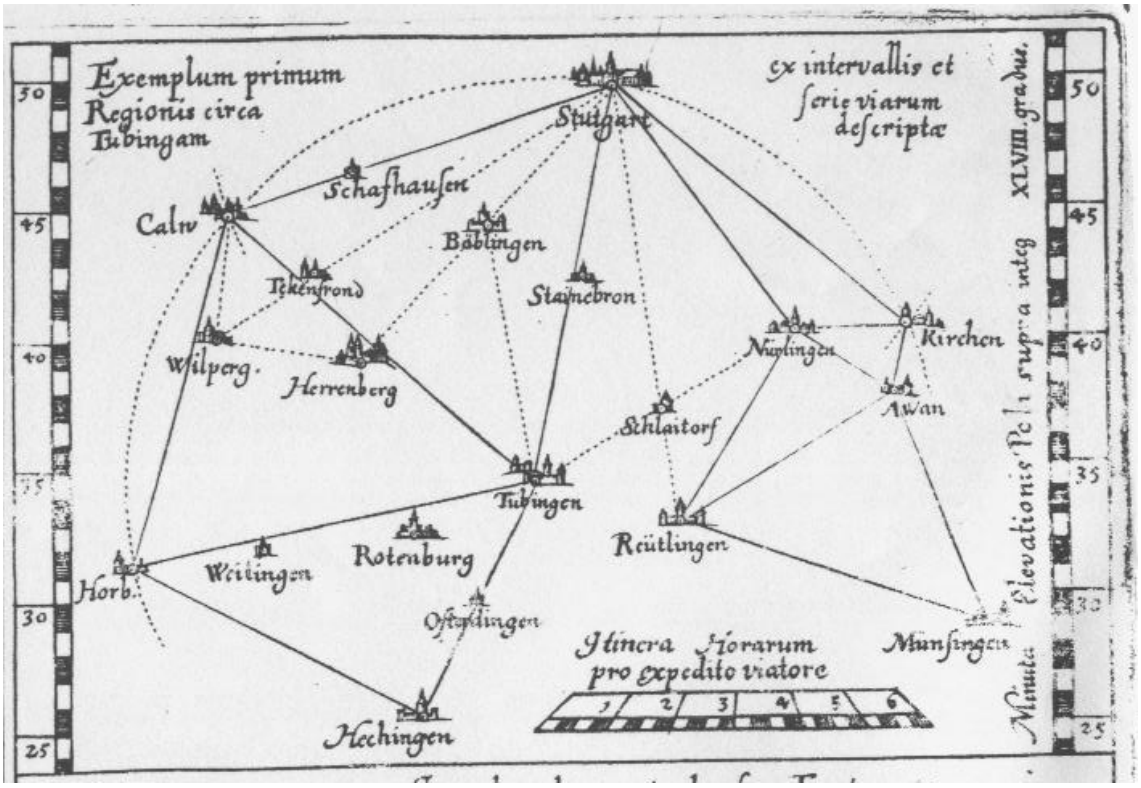

Figure 2. Wilhelm Schickhardt, *Kurze Anweisung wie künstliche Land-Tafeln auss rechtem Grund zu machen/ und die biss her begangne Irrthumb zu verbessern/ Sampt etlich New erfundenen Vörtheln/ die Polus Höhin auffs leichtest/ und doch scharpff gnug zu forschen* (Tübingen, 1669).

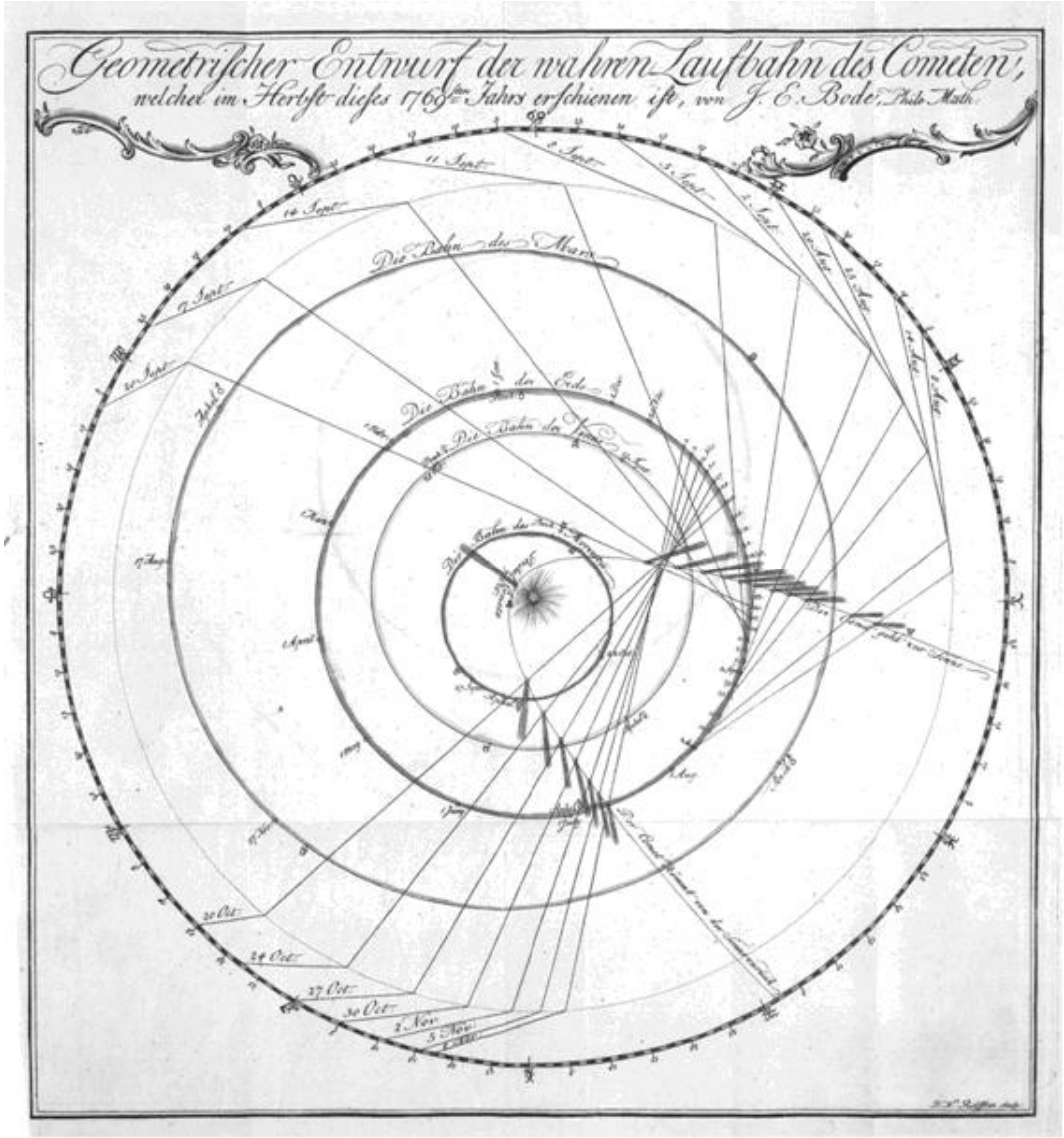

Figure 3. J. E. Bode, *Kurzgefaßte Abhandlung von dem im Herbst dieses 1769sten Jahres erschienenen Kometen nebst einem geometrischen Entwurf seiner wahren Laufbahn um die Sonne* (Hamburg, 1769).

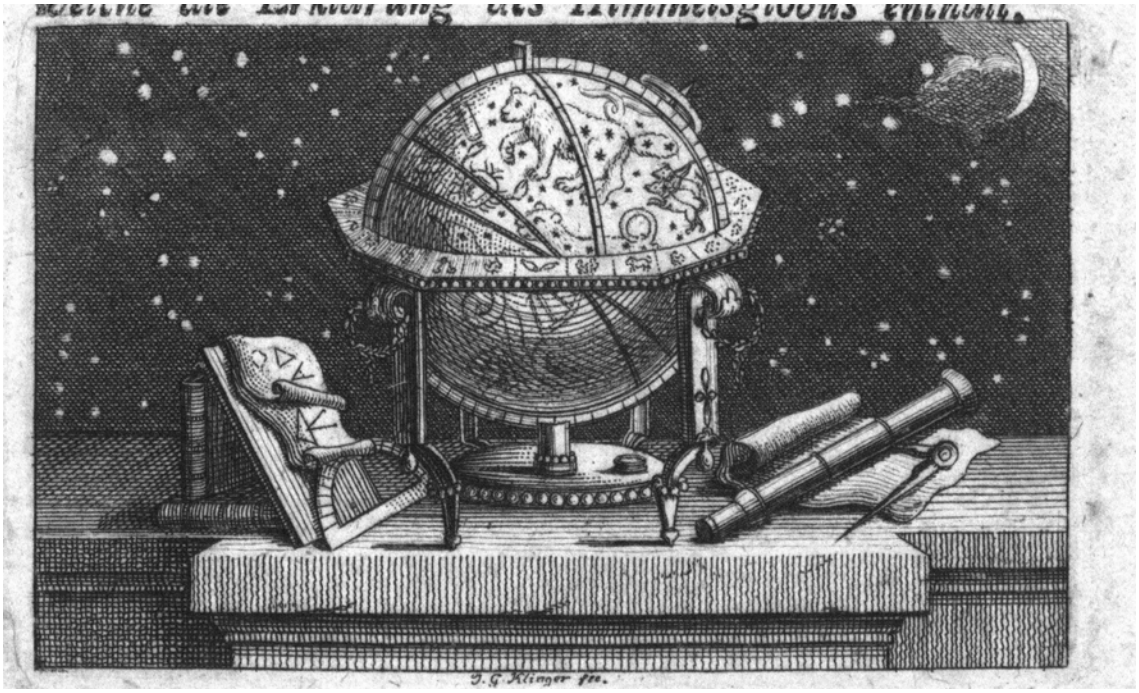

Figure 4. J. W. Müller, *Anweisung zur Kenntnis und dem Gebrauch der künstlichen Himmels- und Erdkugeln besonders in Rücksicht auf die neuesten nürnberger Globen, für die höhern Classen der Schulen und Liebhaber der Sphaerologie* (Nuremberg, 1791).

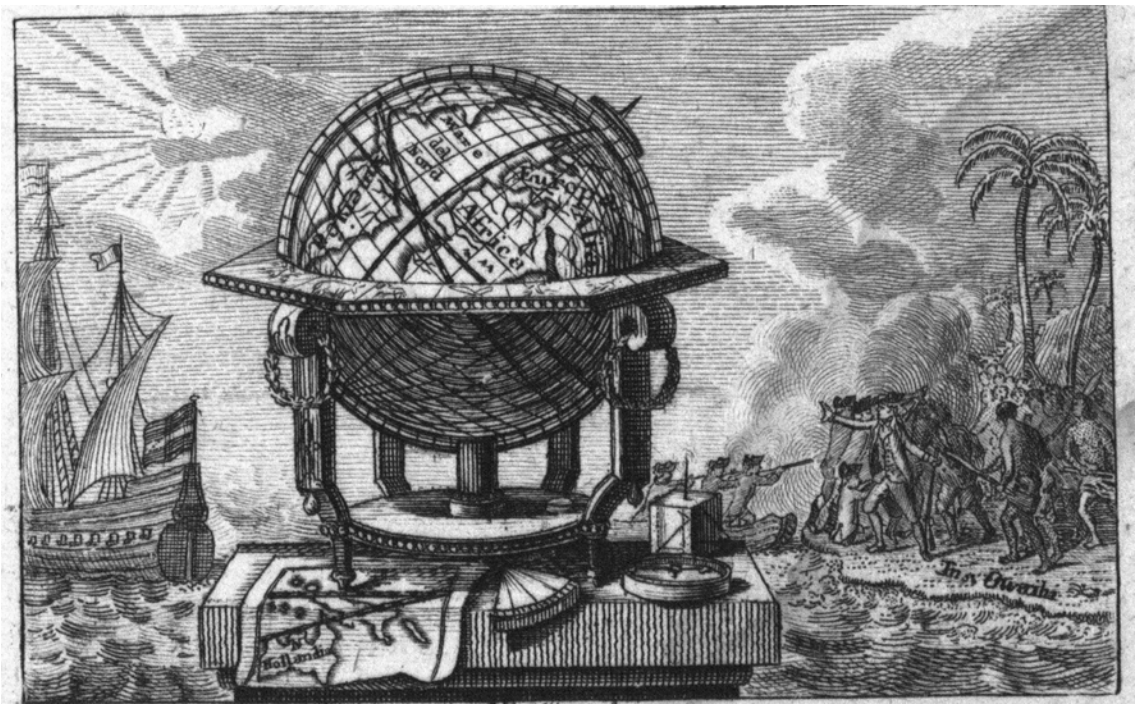

Figure 5. J. W. Müller, *Anweisung zur Kenntnis und dem Gebrauch der künstlichen Himmels- und Erdkugeln besonders in Rücksicht auf die neuesten nürnberger Globen, für die höhern Classen der Schulen und Liebhaber der Sphaerologie* (Nuremberg,1792).

Figure 6. B. d. Fontenelle, *Entretiens sur la Pluralité de Mondes* (Berlin, 1783).

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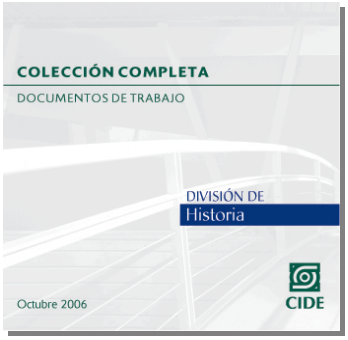

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