Astronomical Exegesis

An Early Modern Jewish Interpretation of the Heavens

By Noah J. Efron* and Menachem Fisch**

IN 1611, John Donne ruefully observed that the "new Philosophy calls all in doubt," leaving the firmament "all in peeces, all coherence gone."[1] One year later, when the first Hebrew description of the new astronomies was published, it was neither rueful nor especially concerned with "coherence." In fact, its author dismissed the notion that arriving at a single, demonstrable, and coherent view of the heavens was a praiseworthy or attainable goal. In this essay, we speculate about why the author of this first account came to this conclusion, and why he was seemingly persuaded that his readers would find it congenial.

The author was a German Jew living in Prague named David b. Solomon Gans (1541–1613). When he wrote the account, he was seventy-one years old and beginning what would be his final year. In the preceding decades, Gans had written prolifically about a variety of liberal arts subjects, and his works taken together comprise a fair portion of an encyclopedia of the liberal arts, especially the disciplines subsumed by natural philosophy.[2] Among them, Gans offered his readers at least glancing acquaintance with developments in history, politics, mathematics, geometry, astronomy, astrology, geography, and medicine, as well as with many of the greatest inventions and discoveries and marvels of his own time. Gans had given his life to producing a body of "secular" books the breadth of which was unprecedented and would remain unparalleled in Ashkenazi culture for centuries. He was perhaps the only Jew of his epoch to take as his sole vocation the education of other Jews in the liberal arts, particularly natural philosophy.[3] Though he was educated in rigorous

* Program for History and Philosophy of Science, Bar-Ilan University, Ramat-Gan, Israel 52900
**The Cohn Institute for History and Philosophy of Science and Ideas, University of Tel Aviv, Gilman Bldg., Rms. 383/384, Ramat Aviv, Tel Aviv, Israel 69978

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[1] *The First Anniversarie: An Anatomy Of The World Wherein, By Occasion Of The Untimely Death Of Mistris Elizabeth Drury, The Frailtie And The Decay Of The Whole World Is Represented* (London, 1611).

[2] Only a fraction of his work was ever published, and much was lost. Only one of his books—his chronicle of world history, *Tsemah David* (The offshoot [or shoot, or bud] of David)—was printed in its entirety during his lifetime (Prague, 1592). After this, he began work on his epitome of contemporary astronomy, which we discuss shortly. Gans also wrote other books that were never printed. About Gans's publication history, as well as the outlines of his biography, see Noah J. Efron's article about him in the forthcoming *Encyclopedia of the Renaissance* (Charles Scribner's Sons).

[3] Gans was certainly not, however, the only Jew of his epoch to write at length and with sophistication about the liberal arts, particularly natural philosophy. Astronomy especially was the subject

talmudic academies of superior reputation, and though he was fluent in the corpus of traditional religious texts of his day, Gans wrote nothing that might be considered "rabbinics." In this, he was unique among the men of Hebrew letters of his day.

Of the books Gans wrote, his epitome of astronomy was his *summa.* A 1596 manuscript of this epitome, which Gans called "Magen David" (The shield of David), has survived. Gans continued to work on the manuscript, adding passages describing his meetings in 1600 with Tycho Brahe, Johannes Kepler, and others and expanding his descriptions of the heavens. In 1612, he published in Prague a prospectus (also entitled *Magen David* [Prague, 1612]) for an expanded version of the book, including in the prospectus the introduction, table of contents, and rabbinic approbations. Gans died in 1613, before the book could be published, and it was finally printed only 130 years later, this time under the name *Neḥmad ve-Na'im* (Pleasant and agreeable) (Jessnitz, 1743). Gans wrote that his epitome was meant for two sorts of readers: schoolchildren eager to augment their rabbinic education, and "householders" seeking an enjoyable diversion. It included little technical detail. But Gans did not take the subject lightly.[4] Astronomy was, for Gans, "the exalted and profound wisdom"; it was the body of knowledge to which God referred when he instructed the Jews (Deut. 4.6), "[T]his is your wisdom in the eyes of the nations."[5] Gans himself had studied astronomy fitfully for many years, developing a knowledge of contemporary theory that was far more sophisticated than that of all but one or two of his Jewish contemporaries. But Gans's primary commitment seemed to be pedagogic. To his own day, Gans wrote, astronomy remained a discipline to which "many of the students are strongly attracted." The publication of his epitome, Gans expected, would help these students and "all men of wisdom, even those who had never received or learned even the slightest introduction to astronomy . . . , to learn and understand . . . without any teacher or instructor."[6] This was to be Gans's legacy.

DAVID GANS AND THE COSMOLOGICAL SYSTEMS

Gans was careful to emphasize, early in the introduction to the epitome, that in his day several very different systems provided very different descriptions of the heav-

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of alert interest among Jewish intellectuals in Renaissance and Reformation Europe. E.g., as Bernard R. Goldstein has observed "Abraham Zacut (1452–1515) was the foremost astronomer in the Iberian peninsula at the end of the fifteenth century." "Abraham Zacut and the Medieval Hebrew Astronomical Tradition," *J. Hist. Astron.* 29 (1998):177–86, on p. 177. In his review of Hebrew translations of and commentaries on Georg Peurbach's (1423–1461) *Theoricae navae planetarum* (1472), Y. Tzvi Langermann finds that "the scope of the Hebrew materials connected with his text furnishes convincing evidence that, during the sixteenth century at least, many Jews maintained a strong interest in astronomy." "Peurbach in the Hebrew Tradition," *J. Hist. Astron.* 29 (1998):137–150 p. 137. Among the leading commentators on Peurbach was Moses Isserles, at whose talmudic academy Gans studied, and to whom Gans attributed his early astronomical education. As Langermann has shown, Isserles evinces little awareness of contemporaneous developments in astronomy (e.g., making no mention of Copernicus) and, like most of his Jewish contemporaries, "belongs to the history of medieval astronomy" (p. 145). Also see idem, "The Astronomy of R. Moses Isserles," in *Physics, Cosmology and Astronomy, 1300–1700: Tension and Accommodation,* ed. Sabetai Unguru (Dordrecht: Reidel, 1991), pp. 83–98. We thank Bernard R. Goldstein for emphasizing to us the importance of the vibrant tradition of Hebrew astronomy of which Gans took himself to be a part and for redirecting us to the relevant literature.

[4] David b. Solomon Gans, "Magen David," Cod. Hebr. 273, Staats und Universitätsbibliothek, Hamburg.

[5] David b. Solomon Gans, *Neḥmad ve-Na'im* (Jessnitz, 1743), p. 7b. Unless otherwise noted, all translations of Gans are by the authors.

[6] David b. Solomon Gans, *Magen David* (Prague, 1612), frontispiece.

ens. Gans introduced Claudius Ptolemy (c. 85–c. 165) as "the chief of those who speak of astronomy."[7] Right after that he introduced Nicholus Copernicus (1473–1543):

> Near our time, about seventy years [ago], a man arose named Nicholas Copernicus, a great scholar of astronomy, more excellent than all the men of his generation. And they said of him that from the days of Ptolemy, there was none like him. . . . [I]n order to resolve several great doubts and perplexities and to delve into the causes and reasons of all the motions and changes that are found in them, he judged and determined and wanted to prove with his great sharpness of mind that the spheres are quiet and at rest, and that the earth perpetually revolves. And he composed a great and very very profound book about this, of which there is no limit to its sharpness.[8]

Later, in the book's conclusion, Gans was similarly complimentary with respect to Tycho Brahe (1546–1601), calling him "a great researcher, wondrous in the wisdom of the stars, and singular in his generation. . . . Tycho Brahe studied and changed many things in the Ptolemaic foundations of astronomy, all with reason and good taste, new matters, very wondrous things that the ancients never imagined."[9] One of the things that Brahe had "proven clearly" was the fact that for Saturn, Jupiter, Mars, Venus, and Mercury "the center of the earth is not their center. . . . It is the center "only for the solar and lunar spheres. The center of the remaining five planets is the center of the Sun itself." Among the "very wonderful things" that Brahe achieved, in Gans's view, was the framing of the Tychonic planetary system.

Gans was enthusiastic about both the Copernican and Tychonic systems, in part because both seemed to vindicate a rabbinic view of the heavens reported in the Babylonian Talmud.[10] As Gans interpreted the talmudic passage, Jewish and gentile scholars disagreed about whether the planets traveled within fluid orbs or were fixed within solid orbs. The "Jewish" view was that the planets traveled within fluid orbs, while the view of the gentile scholars was that they were fixed within solid orbs and moved by those orbs. The rabbis had conceded that the view of the gentiles was most likely true. Gans considered contemporary cosmological systems against the backdrop of this debate and took recent developments in astronomy to vindicate the erstwhile rabbinic position. He wrote,

> Most of the ancient and recent scholars ruled and stated that all of the heavenly bodies—each of the seven planets and each of the rest of the stars,—do not have any motion at all of their own. Rather, each of them is fixed and attached within the space of its sphere. The revolutions of the stars, their rise and setting, their veering to the north and the south is caused by nothing other than the motions of their spheres which carry them like people sitting on a ship or like nails hammered into the wheel of a wagon in such

[7] Ibid., p. 1a.
[8] Ibid., p. 3a.
[9] Gans, *Neḥmad ve-Naʿim* (cit. n. 5), p. 82b.
[10] The passage Gans refers to appears in Tractate Pesahim, p. 94b: "The Rabbis taught: The scholars of Israel say, 'The sphere is fixed and the constellations revolve,' and the scholars of the nations of the world say, 'The sphere revolves and the constellations are fixed.' . . . The scholars of Israel say that in the day, the sun travels beneath the firmament and at night above the firmament. And the scholars of the nations of the world say that in the day the sun travels beneath the firmament and at night beneath the earth. Rabbi said, 'and their statements seem preferable to our statements, because in the day the springs are cold and at night [they are] warm.'"

> a way that the star is fixed and the sphere revolves and not like he who says that the sphere is fixed and the star revolves. And the scholars of Israel admitted this to the scholars of the nations, as is written in [tractate] Pesahim, (94b). But know that the great and wondrous researcher into the wisdom of the stars, singular in his generation, chief among the scholars who reside before our Lord, the Emperor Rudolf (may his glory increase), the minister Tycho Brahe, told me that our scholars did not do well when they conceded to the scholars of the nations about a falsehood, because the verdict is with the scholars of Israel when they said that the stars revolve in their independent paths, undetermined by the motions of the spheres, but rather on their own they fly like a bird that flies in the air. And he provided much evidence. And he wrote about this a book and proved with theoretical demonstrations that some of the stars revolve within the sphere of the sun and pass over the circle of the path of the sun and with sight that is unmatched anywhere in the world, he saw all of this with his wonderful instruments and by virtue of this judged and ruled that a star revolves independent of the motions of its sphere. And I have likewise heard from the excellent scholar Kepler who said that, since it seems to our eyes that some of the planets sometimes . . . circumnavigate in the pattern of a [Hebrew letter] *kaf* and also in different patterns aside from their tracks to the north of the track and also to the south, it is impossible to understand and to resolve the crookedness of the paths of the stars if we do not say that the stars sometimes sail in the heaven as a bird flies in the air.[11]

Gans continued, noting that the famous Spanish exegete and philosopher Isaac Abarbanel (1437–1508) had reported in his commentary on Genesis that ancient philosophers such as Plotinus (205–270), whose books were revered by the gentiles, had also argued that the planets and stars move independently of the spheres. Gans concluded by quoting Abarbanel's conclusion: "[I]t is not proper to decide whether what the [Jewish] scholars, may their memories be blessed, said about the spheres being fixed is superseded. At least this matter is in doubt among some of them."[12] Thus, despite the normative centrality of the talmudic texts to Gans's world of thought, conduct, and discourse, their content, though Gans considered it, did not affect his choice of cosmological theory. In fact, Gans seems to have chosen not to choose among the planetary systems, despite the fact that the talmudic text under consideration could be taken as deliberating about the paths of the planets with a view to settling the issue.

Aside from this and similar considerations of the Copernican and Tychonic cosmologies, Gans couched almost all of his epitome in a conventionally Ptolemaic idiom. It is noteworthy that Gans described the Copernican, Tychonic, and Ptolemaic systems, all with great approbation—in some respects with equal approbation—in a book purporting to explain the motions of the heavenly bodies. More significant still is the fact that he did not feel called upon to adjudicate among the differing systems or even to describe their proponents as doing battle. Indeed, as we shall see shortly, he dismissed the idea that such adjudication was desirable.

It is not surprising, in and of itself, that Gans reported the major cosmological systems without concluding that one was superior to the others. This was not uncom-

[11] Gans, *Neḥmad ve-Na'im* (cit. n. 5), chap. 25, p. 15b. For the background to the analogy of stars and birds, see P. Barker and B. R. Goldstein, "Distance and Velocity in Kepler's Astronomy," *Ann. Sci.* 51 (1994):59–73, especially p. 62 and n. 12. Precisely what the comment about the Hebrew letter means is unclear. The kaf is ovular or elliptical.

[12] Gans, *Neḥmad ve-Na'im,* chap. 25, p. 15b.

mon in astronomical epitomes of the epoch, for reasons that are easy to understand. First, it was exceedingly difficult to adjudicate among the three systems at the time when Gans wrote, and impossible to do so conclusively. Even if it had been possible, the purpose of an educational text like Gans's was to introduce readers to current theories about the heavens, not to provide a single, coherent planetary system. We consider this point at greater length later in this essay.

Still, Gans's treatment of the alternative planetary systems was different from what one might have expected. He himself made much of the fact that he had learned of contemporary planetary systems directly from Brahe and Johannes Kepler (1571–1630), and he acknowledges that Brahe was partial to his own system and Kepler was partial to the Copernican system. In light of this, one might expect Gans to meditate, at least briefly, about the relative merits of the different systems. At the very least, one might expect Gans to explain the different implications of the various planetary systems. But he did nothing of the sort. Though he described the different systems in broad detail, he made no effort to sort them out or to treat them as mutually excluding alternatives. As a review or survey of the current state of astronomical theory, Gans's presentation was extraordinarily uncommitted.

It is tempting to attribute this uncommitted portrayal to a conventional belief that astronomical theories are validated only by agreement among philosophers rather than by faithfully mapping the true state of the heavens. But Gans's position was more complicated than this. For despite his pluralism in presenting the planetary systems, Gans was, at least in principle, what we would today call a realist, and he was confident that the notion that the observations and calculations of the astronomers could mirror the true workings of the heavens was more than a mere conceit or idle hope that could never be realized.

Near the beginning of the introduction to *Magen David,* Gans described the power and the limitations of the reasoning that led astronomers to their conclusions:

> Most of these things the ancient scholars investigated and studied with wisdom, understanding, and intelligence. Some through scrutiny and experience. Some with strong demonstrations and clear and true evidence—demonstrations that cannot be denied, except by the contrary and crooked. Because it is already clear to every educated person that a true demonstration is unlike anything else in the world. . . .
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> Scoundrels and fools deny this. They are like one who denies the sunshine during the light of day, and says that it is dead of night and dark. And there is no difference between the two deniers, save that one denies his sense of sight and one denies the light of theoretical reason [*shekhel ʿiyyuni*]. Because the scholars of astronomy did not speak from a dream, and they did not make judgments according to the tales of old women, and they did not render proofs according to the observations of children. Rather, they investigated and found with intelligence and wisdom in their studies and their profound scholarship.[13]

All of this suggests that Gans believed that the evidence and demonstrations of the scholars could produce reliable knowledge.

Still, Gans continued, "[W]e do not say that all matters are all precisely in the states and positions and revolutions as the astronomers claim, and that it is not possible to find another way." Ptolemy himself admitted in the *Almagest,* Gans wrote, that whether the Ptolemaic system "is true or not, [only] God knows. It is enough

[13] Gans, *Magen David* (cit. n. 6), author's introduction, unnumbered.

for us that we found a way in which it is possible to sustain all that appears to us concerning the motions of the luminaries." Gans then notes that Isaac Israeli had written in *Yesod 'Olam* (The foundation of the universe) about "a man who shook [the world], who . . . with his great sharp-wittedness became profoundly expert in the wisdom of astronomy until he chose to find a new way and was persuaded to reject all the fundamental elements of Ptolemaic astronomy."[14] There was good precedent, Gans continued, in the controversy documented in the Talmud between the one "who says that the sphere is fixed and the star revolves" and the one "who says that the star is fixed and the sphere revolves. And for each of these two opinions there are reasons and explanations."[15]

In light of all this, what can one conclude about Gans's epistemology? Prima facie, one can conclude that it was in many ways similar to the epistemology that was prevalent in his day. Gans, like many others, believed that astronomers could produce knowledge of the heavens through a combination of rational and empirical means. He, like many others, was in principle a realist. Yet Gans, like many others, also believed that in certain circumstances it was not possible to adjudicate with certainty among different theories.

At the same time, Gans was less interested in adjudicating among different theories than most of his contemporaries. He linked a conviction in principle that astronomers could produce knowledge of the heavens with a fundamental lack of interest in trying to establish which astronomers, if any, had accurately described the positions and motions of the planets. Indeed, he combined a principled belief that astronomers could establish the true state of the heavens with another principled belief that one need not—perhaps cannot—establish which astronomer had actually done so. Further, he took the multiplicity of theories as a sign of the robustness of astronomy in his day, not at as a sign that the discipline was unsettled. This is an odd state of affairs. In light of Gans's faith that the "strong demonstrations and clear and true evidence [of the astronomers] cannot be denied," why was he so disinterested in adjudicating among theories? Was this lack of interest a result of his epistemic commitments? Was it a result of exegetical sensibilities? Does it reflect pedagogic exigencies? Gans himself did not say. But a close reading of his work suggests that all of these, and more, are possible explanations.

REASONS FOR THE MULTIPLICITY OF COSMOLOGIES

We wish to consider several possible reasons for Gans's indifference to adjudicating among astronomical systems. One concerns theology, especially the beliefs and exegetical traditions that were prevalent among Jews in Gans's day. With respect to that, the question we ask is, Did traditional Jewish beliefs or practices (including exegetical practices) somehow encourage Gans not to adjudicate among the different cosmological theories he presented (or discourage him from adjudicating among them)? Two other possible reasons for Gans's indifference have nothing to do with

[14] The "man who shook" almost certainly refers to al-Bitruji (d. 1204). See Al-Bitruji, *On the Principles of Astronomy*, ed. B. R. Goldstein, 2 vols. (New Haven: Yale Univ. Press, 1971), especially vol. 1, p. 43. Isaac b. Joseph Israeli (fl. 1310) was a Spanish-Jewish astronomer working in Toledo. *Yesod 'Olam* was written c. 1310.

[15] Ibid., introduction.

traditional Jewish attitudes toward God, nature, or texts. These, which we will consider first, include his social goals and the conventions of the astronomical genre in which he wrote.

Social Goals

Perhaps Gans was reluctant to adjudicate among theories because he was eager for his readers to become at least glancingly familiar with all current theories while remaining partisan to none. This eagerness, in turn, may have reflected the social goals that informed his work.

Gans hoped to promote what might be called, anachronistically, historical and scientific literacy rather than profound understanding of or real proficiency in history and natural philosophy. Such literacy would serve his more general goal of improving the image of the Jew in the eyes of neighboring Christians. Jews ignorant of the most elementary liberal arts, Gans feared, could only seem like ignorant Jews to Christian scholars. He emphasized this in his introductions to his chronicle and his astronomy textbook. Describing one of the "benefits" that would accrue to the reader of *Tsemaḥ David,* Gans wrote,

> [S]ince we are foreign residents [*gerim ve-toshavim*] among the gentiles, and when they tell or ask us of the first days of ancient dynasties we put our hands to our mouths and we do not know what to answer, and we seem to them like beasts who do not know their left from their right, and it is as if we were all born yesterday. But with this book, the respondent can answer and say a tiny bit about every epoch, and through this we will appeal to and impress them.[16]

Describing the "benefits" that would accrue to the reader of *Neḥmad ve-Naʿim,* Gans wrote,

> When the Gentiles see that we are devoid of this wisdom, they wonder about us and they taunt and curse us [Isa. 37.23], and they say, "[I]s this the great nation about which Scripture said 'This great nation [comprises] only wise and understanding people?'" [Deut. 4.6] And what will we do on the day that the wise men of the nations speak to us and ask us the reasons behind the foundation of our intercalation, and for them the fact that we received [this wisdom] will not suffice. Is it proper for us to put our hands before us and appear as a mute who cannot open his mouth? Is this [to] our honor, or the honor of our creator?[17]

Among Gans's motivations, then, was a desire to educate Jews about matters that might help them to capture the respect of Christian intellectuals. A complementary motivation was a desire to increase the respect with which Jews regarded Christians. Gans's portrayals of Christian explorers and natural philosophers were heroic, as were his portrayals of Christian soldiers and statesmen. Columbus, in *Tsemaḥ David,* is described as a great philosopher and scholar; Vespucci, Magellan, Juan Sebastian

[16] Gans, *Tsemaḥ David* (cit. n. 2), p. 166–7.
[17] Gans, *Neḥmad ve-Naʿim* (cit. n. 5), p. 10a.

de Elcano,[18] Drake, and others are all highly praised in *Neḥmad ve-Na'im.* The monarchs of Spain, Portugal, France, and England, who funded their voyages, are likewise lauded as scholars and men of vision and beneficence.[19] Gans emphasized the bravery of Christian soldiers in fighting against vicious Turks.[20] He especially praised the genius of contemporary Christian astronomers. He warned in his introduction to the prospectus for *Neḥmad ve-Na'im* that "the value of my statements in this, my book, are to the value of the statements of the books by the great astronomers who can be found in our time among the Christians, as the value of a drop is to the ocean."[21] The wondrous work done nightly at the observatory in Benatky produced "great things the likes of which in our days we have never seen nor have we heard, and our forefathers did not tell us, and we did not find them written in the books of the Jews or the nations of the world, not to compare the two."[22] His tone was similar when, in *Tsemaḥ David,* he described Gutenberg's "incomparably" great invention, emphasizing that Gutenberg was a "Christian man from Mainz."[23] Gans described Christian rulers, popes, and reformers alike as educated, scholarly, and wise men.[24] The general picture that emerged for Gans's readers was of a Christendom of admirable leaders and scholars, significant accomplishment, and some grace.

In sum, Gans believed that Jews educated about human events and natural philosophy would be more positively disposed toward Christians and more easily accepted by them. Through his writing, he aimed to facilitate a dual rehabilitation: rehabilitating Jews in the eyes of Christians (by educating them about important matters in the liberal arts, hence rendering them more worthy intellectual partners, more deserving of esteem) and rehabilitating Christians in the eyes of Jews (by portraying them as more human and humane, and thus more worthy intellectual partners, and by portraying their accomplishments as more deserving of esteem).

These goals may explain why Gans did not judge it necessary, or even desirable, to adjudicate among the conflicting cosmological systems of his day. In the first years of the seventeenth century, when Gans completed the bulk of his astronomical writings, just which system was preferable was an open (and in some circles contentious) question. If Gans wanted more than all else to render his readers literate about the debate, it was not necessary for him to answer this question. In fact, the readers' familiarity with the debate itself was far more important than their persuasion that

[18] In 1521, Juan Sebastián de Elcano sailed on a mission for the king of Spain, sailing from Spain around Africa to India. As Gans relates, there he was attacked by natives who killed some of his men, forcing him to sail off again. He continued east until he reached the point of the earth opposite that from which he had originally sailed in Spain ("the place in which our feet are opposite the feet of the people of his country"). He decided not to turn back, attempting instead to circumnavigate the globe. He circled the New World and continued to travel until he returned to Seville. There he added to his seal the image of the earth, with the legend "You are the first who circled me." Ibid., p. 23a.

[19] For Gans's account of the discovery of the New World, see ibid., pp. 27b–28b, and *Tsemaḥ David* (cit. n. 2), and pp. 397 and 391.

[20] E.g., see *Tsemaḥ David* (cit. n. 2), p. 405.

[21] Gans, *Magen David* (cit. n. 6), p. 3a.

[22] Gans, *Neḥmad ve-Na'im* (cit. n. 5), p. 82b. Benatky was the summer palace of the Holy Roman Emperor Rudolf II, in which Tycho Brahe set out to build an observatory at the beginning of the seventeenth century. Kepler visited him there, as did other leading astronomers of the day.

[23] Gans, *Tsemaḥ David* (cit. n. 2), p. 369.

[24] E.g., see, ibid., pp. 143, 145, and 405.

one or another system was best. A dogmatic certainty that any of the systems was superior to the others might well be taken as a mark of ignorance among some Christian contemporaries.[25] A principled recognition of the virtues of each and all systems was most consonant with his overarching goal of increasing the esteem with which Jews were regarded by Christians and with which Jews regarded Christians.

Rhetorical Convention

Gans may have chosen not to compare and decide among astronomical systems because his principal sources did not do so, and because doing so was not appropriate to the genre in which he wrote, the astronomical epitome.[26] Lynn Thorndike long ago observed the following of such epitomes:

> Apparently almost every university had at least one elementary astronomical text produced for local consumption produced during this period. Their authors seldom reached the theory of the planets, the intricacies of which they usually postponed to a future volume which never appeared. The intricacies of the Copernican theory likewise were eschewed by such writers as beyond the reach of the beginning students for whom they wrote. They commonly adhered strictly to the Ptolemaic system, both as customary and as presenting the heavens the way they looked to an observer on earth. . . . Hardly a single elementary textbook was written on the Copernican basis. Usually a passing sentence or two was all the recognition given to it.[27]

Thorndike exaggerated the true state of affairs somewhat, and his tone is oddly stern. In fact, some of the most renowned astronomy texts of the late sixteenth century—for example, Michael Maestlin (1550–1631), *Epitome astronomiae* (Heidelberg, 1582), Caspar Peucer's (1525–1602) *Elementa doctrinae de ciuculis coelestibus et primo motu* (Wittenberg, 1551), and the commentary by Christopher Clavius (1538–1612) on Johannes de Sacrobosco's *Sphaera*—each devoted quite a bit more than "a passing sentence or two" to Copernican theory. Still, Thorndike's basic point is correct; the most popular astronomy teaching texts of the late sixteenth century mentioned Copernicus, often admiringly, but did not trouble to establish whether his planetary system was superior to Ptolemy's. Thorndike was also right in noting that these books failed to adjudicate among competing planetary systems, not for polemical reasons but because the question was too complicated for readers of an introductory primer. In light of this, Thorndike's exasperation with these textbooks was misplaced. It is unreasonable to expect these early textbooks to have done much more than present a general description of Copernican theory, which is precisely what

[25] Though certainly not all. It would not be hard, as Bernard R. Goldstein has pointed out to us, to find "Christian scholars who asserted the truth of one or another 'system.'" Our point is simply that when Gans was writing, there was no consensus about the structure of the heavens and that, in light of this, Gans may reasonably have chosen not to advocate one or another hypothesis.

[26] Not all of the sources Gans used while writing *Nehmad ve-Na'im* have been identified. Large portions were adapted from the two most popular medieval Hebrew astronomical manuscripts, "Yesod 'Olam," by Isaac Israeli, and "Tsurat ha-Arez," by Abraham bar Hiyya. But his contemporary sources remain a mystery. He mentions that he had a collection of books by Brahe in his library, and he was familiar with at least five German-language chronologies and compendia from which he derived some of his information. The coordinates that he provides suggest that he derived much of his geographical information from an atlas that has not been identified. He also consulted contemporary astronomic epitomes while writing his own, though unfortunately he does not indicate which.

[27] Lynn Thorndike, *History of Magic and Experimental Science* (New York: Macmillan, 1923–1958), vol. 6, pp. 6–7.

they did.[28] Not surprisingly, this lack of rigor was yet more evident in books (like Gans's own) intended for use outside of the university by less scholarly readers.[29]

The approach adopted by Latin and vernacular astronomical epitomes in Gans's day, especially in books intended for readers outside of the university, then, was not terribly different from Gans's own approach. Though this fact does not in itself explain why Gans chose not to adjudicate among theories, it raises two possibilities. First, Gans may have used one of more of these contemporary epitomes as a source for his own work (though we have been unable to identify precisely which), and he may simply have followed their approach to the planetary systems. Second, whether or not Gans was directly influenced by the epitomes of his day, the same reasoning that led their authors to include notice of Copernican astronomy without adjudicating between his system and Ptolemy's applied with equal force for Gans. Gans too was composing an introductory text for neophytes. Gans too was concerned that his book not be exceedingly complex. Gans too found the Ptolemaic system more congenial to simple diagramming than the other systems. Just as it was reasonable for Maestlin, Peucer, Clavius, and others to keep their Copernicus light, so too was it for Gans to keep his accounts of Copernicus and Brahe simple and not to provide the sort of detail needed to present his readers with an informed comparison of the different planetary systems. Common to both possibilities is the idea that the constraints of the genre in which Gans chose to write—the astronomical epitome—may themselves account for Gans's decision not to adjudicate between the Ptolemaic, Copernican, and Tychonic planetary systems.

Theological Influences

Gans may have chosen not to adjudicate among different planetary systems because there was an important, though indirect, theological benefit in not doing so. An astronomy in flux, in which the fundamental structure of the universe remains undecided, may have been especially consistent with Gans's view (or the views of influential contemporaries) of the relationship between natural and theological knowledge.

Among Gans's contemporaries, Judah Loew b. Bezalel (c. 1525–1609)—who was usually referred to by the Hebrew acronym "Maharal"—thought, preached, and wrote most influentially about this relationship between the natural and the divine. Maharal had been born in Worms and spent his adult life in small towns in Moravia, in Cracow, and especially in Prague. He was widely recognized as one of the leading Jewish scholars of the late sixteenth century and was certainly the most revered among the Jews of Prague toward the century's end. Maharal educated a cadre of students who remained influential in Prague and throughout Europe until the

[28] This view is well argued in Francis R. Johnson, "Astronomical Text-Books in the Sixteenth Century," in *Science, Medicine and History: Essays on the Evolution of Scientific Thought and Medical Practice Written in Honour of Charles Singer,* ed. E. Ashworth Underwood (Oxford: Oxford Univ. Press, 1953), pp. 285–302.

[29] Popular compendia of general knowledge such as Gregor Reisch (c. 1467–1525) *Margarita philosophica* (Freiburg, 1503), or Petrus Apianus (1495–1552), *Cosmographiae introdvctio* (Ingolstadt, 1531), and especially vernacular books such as Robert Record (c. 1510–1558), *Castle of Knowledge* (1556). These books, whose early editions all preceded the publication of *De Revolutionibus,* obviously did not present the Copernican system, but they still reflect the sort of general, nontechnical, unrigorous approach that characterized Gans's work and that of many others of his day.

beginning of the Thirty Years' War. Perhaps most significant for present purposes, Maharal wrote more than a dozen books, and these contain well over one thousand references to natural phenomena and natural philosophy, some fleeting, some sustained. Among these were a great many meditations about the relationship between the natural and its study, on the one hand, and the divine and its study, on the other.

At the core of these meditations was a belief that the temporal and spiritual worlds are perfectly distinct one from another. Maharal repeatedly insisted that there is a great divide between the spiritual realm described by the Torah and the material realm described by the "scholars of the natural world." For Maharal, the realm described by the Torah and the realm of the natural world are distinct ontological entities. So distinct, in fact, that he argued that apparently conflicting states of affair can coexist because they simultaneously pertain to the two realms. In his commentary on the verses in Joshua that describe how the sun stood still in Gibeon, for instance, Maharal wrote,

> It should be said that for Joshua and the Jews the sun stood still on the horizon, and for the entire world the sun did not stand still. . . . It is possible that the sun might go in its regular fashion, while [at the same time] miraculously standing still, because it can be that one event has two opposite elements [*le-davar eḥad shenai devarim hafukhim*], nature being one thing, and the unnatural another.[30]

It is difficult to understand the precise ontological assumptions behind this passage, and indeed Maharal embraced somewhat different ontological assumptions elsewhere in his voluminous writing.[31] What is clear, however, is that Maharal viewed "nature" and the "unnatural," or divine, as distinct from one another.

This fundamental ontological commitment is accompanied by an additional epistemic commitment, a persuasion that all statements about the natural world are uncertain and unverifiable. In his most extreme formulations, Maharal went so far as to call the statements of the natural philosophers lies, of more or less flagrant varieties. He wrote in *Be'er ha-Golah* [The well of exile] (Prague, 1593), "It is not even appropriate to call the science of astronomy a science because science is only attainable by one who actually knows something as it is, and that condition you will never find in their [so-called] science, for no one can verify its truth, and what is the

[30] Maharal, *Be'er ha-Golah* (Prague, 1598; Jerusalem, 1972), p. 15. For a parallel but different example of material and spiritual realities operating simultaneously but independently, see idem, *Gevurot ha-Shem* (Cracow, 1582; Jerusalem, 1980), chap. 43, pp. 151–2.

[31] E.g., in *Netivot 'Olam* (Prague, 1596; Jerusalem, 1980), Maharal described a two-tiered ontology that is more familiarly Platonic: "The Torah is the order of the universe. . . . That they said in the midrash that God 'looked in the Torah as he created the world' [Bereishit Raba, chap. 1], that meant that the Torah itself is the order of everything, and thus when the Blessed Name wanted to create His universe and order it, he would look in the Torah, which is the order of everything, [in order to] create his universe" (p. 3). As a result, the very existence of the physical universe is entirely dependent upon the existence of the Torah: "The statements of the Torah support and confirm all of the universe. . . . And that the statements of the Torah support the universe, this is from the sages who said [in tractate *Shabbat*, 88a] that because of that God said on the sixth day that all of creation depended upon the sixth of Sivan. If the Jews would receive the Torah [on that day], then all was well, and if not, the universe would return to chaos" (p. 3). Maharal did not try to describe a rigorously coherent philosophy, and it is perhaps inappropriate to hold him to strict standards of internal consistency. Still, what is common to his various ontological passages is his conviction that the realm of Torah and realm of the universe are functionally distinct, even if the latter is derived in some way from the former.

difference if one lies a great deal or lies a little? In the final analysis, he can never know the truth of a thing."[32]

Elsewhere, Maharal's evaluation of the sorts of knowledge acquired by natural philosophers is less dismissive. He notes that knowledge of the material universe "is wisdom too" but still insists that one would not "call someone who knows about material things 'wise,' just as a shoemaker is not called 'wise.' . . . Only the person who studies Holy matters [is called 'wise'], and this is called 'wisdom.'"[33]

In light of all this, it is easy to understand Maharal's own view of Copernicus. He wrote,

> [W]hat was said about [astronomical knowledge and intercalation] being "your wisdom in the eyes of the nations" [was said] because it is the nations who most want to become erudite in this wisdom, and were becoming learned in this very, very great wisdom. But others always came after them and negated their efforts, and what they had laboriously achieved. And [this is] just like the one who was called the Master of the New Astronomy, who provided a different picture [of the universe] and of all that the earlier scholars before him understood. . . . He contradicted them all and presented a picture of a new wisdom. Only even he himself wrote that he has still not resolved everything.[34]

Maharal does not denigrate the value of astronomical knowledge. The fact that he took the biblical verse in Deuteronomy to refer to a tradition of Jewish excellence in astronomy itself suggests that he valued the discipline. Clearly, Maharal accepted that astronomical wisdom is, after all, a sort of wisdom. But at the same time, Maharal found in Copernicanism an illustration of the temporality, and inferiority, of knowledge about the material universe. Maharal seemingly used his epistemic conviction that knowledge about the material universe was never certain to imply his ontological conviction that the material universe itself was distinct from, and inferior to, the spiritual universe. The Copernican challenge to Ptolemaic orthodoxy complemented Maharal's view of the relationship between nature and the divine. It did so by highlighting the difference between natural knowledge and theological knowledge, and by implying that the former is less reliable and less valuable than the latter.

All of this suggests a possible motivation for Gans to leave unanswered the question of which planetary system is most accurate. Gans did not articulate his own view of the relationship between natural and theological knowledge.[35] Gans may have shared Maharal's view that there were ontological and epistemic divides between natural and theological knowledge. If this was the case, then, like Maharal, he may have found it congenial to emphasize the unsettled state of astronomical theory. He too may have found there to be greater theological value in an astronomy in flux than in one with well-established basic principles.

Even if Gans did not share Maharal's views about the relationship between the natural and the divine, he may have believed that adopting such an attitude would

[32] The translation is David B. Ruderman's. See *Jewish Thought and Scientific Discovery in Early Modern Europe* (New Haven: Yale Univ. Press, 1995), p. 82.

[33] Judah Loew b. Bezalel [Maharal], *Tiferet Yisrael* (Venice, 1599; Jerusalem, 1978), p. 35.

[34] [Maharal], *Be'erha-Golah* (cit. n. 30), pp. 60–1.

[35] Though he did insist that astronomical knowledge demonstrates the majesty of God, who created the heavens. Gans wrote that "by virtue of [astronomical] knowledge the great power of him who created the world through his command becomes known to us" (*Neḥmad ve-Na'im* (cit. n. 5), p. 9b).

make his work less objectionable, more easily acceptable, by those who adopted a view like Maharal's. He may have allowed this theological disposition to affect his presentation of astronomical theory, even if he did not share the disposition itself.

The Influence of Traditional Study Practices

A second, and quite different, theological explanation of Gans's epistemic even-handedness toward rival cosmologies is also possible. It is a view that, in contrast to that of Maharal, predicates intriguing similarities rather than incongruities between the ways in which Scripture and nature are interpreted—or rather, between the ways in which the various attempts to interpret them are redacted. In canonical books that Gans studied as a student and quoted throughout his work, biblical interpretation is deliberated energetically but is invariably recorded in ways that preserve the entire polyphony of contradictory voices.[36] Gans, we suggest, may have modeled his record of the readings of God's Works on this tradition of presenting readings of God's Word, or Scripture.[37]

This discrepancy, between first-order polemical single-mindedness and second-order pluralism, is typical of the Jewish redactions of biblical exegesis with which Gans was intimately familiar. In these books, God's Word is typically read and reread in keen and critical negotiation with other reading. Exegetes go about their business much as astronomers go about theirs, criticizing the work of former and fellow exegetes and doing their very utmost to make better sense of the biblical text. Nonetheless, the exegetical debate is, in principle, never adjudicated at a higher level. In the midrashic and exegetical compilations that were studied in Gans's day, all voices were preserved and remained respectfully on record. Although the exegete might pursue his own specific agenda, to the rejection of other voices/agenda/interpretations, redactors and teachers of Hebrew biblical exegesis preserved the entire multitude of conflicting voices. Their students and readers were presented with a polyphony, not merely so that they could become acquainted with the field before they were taught the last word, but because this polyphony itself is part of the ideal of interpreting the Bible or the divine Word. These texts not only refrain as far as possible from closure, but wholly refrain from tentatively adjudicating among existing readings. In all matters exegetical, they juxtapose but never adjudicate.[38]

[36] One need look no farther than the early sixteenth-century Venetian editions of the Talmud for a good example. They were widely distributed, and their pagination was often imitated by Gans's time.

[37] In his fascinating recent book *The Bible, Protestantism and the Rise of Natural Science* (Cambridge: Cambridge Univ. Press, 1998), Peter Harrison has argued with great force that changes in traditions of interpreting sacred texts crucially affected how nature was interpreted in early modern times. The approach to texts, he writes, that was "driven by the agenda of the reformers and disseminated through Protestant religious practices . . . created the conditions which made possible the emergence of modern science" (p. 266). Among Protestants, Harrison explains, it was the emergence of biblical literalism that "opened up for the first time in the history of biblical interpretation the real possibility that parts of the Bible could be false. . . . The text of scripture was for the first time exposed to the assaults of history and science" (p. 268). It was precisely this notion—that an accurate reading of the text demanded a careful sorting of the "true" from the "false"—that was absent from the hermeneutic tradition in which Gans worked, and this fact alone may go part of the way toward explaining Gans's apparent lack of interest in adjudicating among conflicting descriptions of the heavens. We thank our anonymous reviewer for referring us to Harrison's excellent book.

[38] An illuminating, if anecdotal, example of this type of undecided exegetical pluralism is the following debate recorded in the most highly regarded and most studied rabbinic text, the Babylonian

Gans was, first and foremost, a pious and devoted product of the talmudic academy of his day, and it makes sense to argue that he viewed the traditional bookshelf of biblical exegeses as a paradigm of human wisdom and intellectual accomplishment. For those acquainted with this bookshelf, the similarity between the pluralism exhibited in Gans's surveys and the redactory pluralism of the exegetical compilations he knew so well is striking. In light of this, it could be that Gans presented planetary systems without adjudication because presenting all interpretations without adjudicating was the model of how various interpretations of the Bible are to be compiled and communicated.

John Hedley Brooke has counseled, in his invaluable contribution to this volume ("Religious Belief and the Content of the Sciences"), that historians seeking to trace how religion and the study of nature may have influenced each other turn their gaze toward religious and scientific practices and the bearing that these have had upon one another. Our fourth hypothesis does just that, suggesting that Gans may have borrowed the exegetical practices with which he interpreted religious texts in order to interpret cosmological texts. Indeed, he may have used these same hermeneutic practices to interpret nature itself. Gans's theology, in this view, had little to do with his astronomy. His notion of how religious texts ought be read, however, had everything to do with how he read, interpreted, and wrote astronomical texts.

CONCLUSION

The possible reasons behind Gans's pluralism that we have inventoried lend themselves to two very different understandings of his project.

One is that Gans's pluralism resulted from utilitarian concerns. In this view, Gans chose not to advocate one or the other planetary system because it was impolitic or

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Talmud (Tractate Sanhedrin, 108b) and related fully in the compilation of midrashic exegesis entitled *Genesis Rabbah.* In Gen. 6.18 we read, "[A]nd thou shalt come into the ark, thou, and thy sons, and thy wife, and thy son's wives with thee." Extremely sensitive to any textual irregularity, the midrash takes note of the rather artificial separation of husbands and wives in the wording of God's instructions to Noah, concluding that "when Noah entered the ark copulation was forbidden," hence, "thou and thy sons to themselves, and thy wife and thy son's wives to themselves." And Noah apparently obeyed: "So Noah did according to all that God commanded him . . . And Noah went in, and his sons, and his wife, and his sons' wives with him into the ark" (Gen. 7.5–7). Upon leaving the ark a year or so later, family life, it seems, was allowed to return to normal, for God's instructions no longer imply a separation of the sexes: "Go out of the ark, thou, and thy wife, and thy sons, and thy son's wives with thee" (Gen. 8.16). This time, however, Noah appears to have decided not to comply, choosing, seemingly on his own initiative, in the words of the midrash, "to extend the commandment": "And Noah went out, and his sons, and his wife, and his sons' wives with him" (Gen. 8.18). In the Babylonian Talmud, the following debate between Rabbi Yehuda and Rabbi Neḥemiah is recorded, apropos of Gen. 9.8–9: "And God spoke to Noah, *and to his sons with him,* saying, And behold, I establish my covenant with you etc." Rabbi Yehuda argues that since Noah had "transgressed the commandment" he was disgraced and was no longer personally addressed by God. Rabbi Neḥemiah concludes, by contrast, that "since Noah extended the commandment and elected to conduct himself in holiness, he and his sons were rewarded by God's word." The controversy is fundamental. Does the Torah teach, as Rabbi Neḥemiah would have it, that one achieves sanctification by suppressing the flesh or rather, as Rabbi Yehuda opined, by appropriately acknowledging and fulfilling one's sexual needs? Are human beings considered by the Torah to be immutable souls seeking insofar as possible to escape and transcend their confinement in the body or as a well-balanced and constructive combination of body and spirit? The two profoundly conflicting philosophies and subsequent readings of Scripture are sharply stated and played off against each other, but no attempt whatsoever is made, here or elsewhere, to decide the issue.

inappropriate to the genre, or because emphasizing the plurality of views about the heavens rendered his astronomy more convivial to the Maharalists, the followers of Maharal, a group that included influential Jewish intellectuals of his day. If this were the case, then Gans himself may have been fully persuaded that one or another of the systems he presented was superior to the others but still believed that it was prudent to present them all without articulating his own preference.

Another view is that Gans's pluralism was not utilitarian at all but rather the product of a deeply held notion of how interpretations of God's handiwork—His Works, like His Word—are properly conveyed. In this view, Gans may have assumed an essential similarity between the ways in which interpretations of God's Word and God's Works are to be redacted. He may have concluded that just as compilations of interpretations of Scripture ideally are radically pluralist, so too are compilations of interpretations of the heavens. Perhaps Gans chose not to advance one of the planetary systems because presentation of conflicting interpretations without adjudication is a well-established, traditional way of redacting interpretative enterprises.

There is no reason to choose between the options. Certainly, social benefits of broad and undogmatic portrayal of all positions and the exigencies of the genre of the epitome fit well alongside either of the "theological" explanations we have floated. There is good reason to believe, from Gans's own reports, that each played a role in determining how he chose to present his astronomy.

Of course, Gans himself could not easily have adopted simultaneously both the Maharalist view that there is a great, unbridgeable gulf between God's Words and Works and the view that they are best purveyed in the same way because they are essentially similar. But there is a way in which both concerns might have informed Gans's text. His book clearly was easily acceptable to Maharalists, and the sort of theoretical uncertainty that he emphasized was precisely the sort that Maharal used to bolster his arguments about the difference between temporal and divine knowledge. However, at the same time, Gans's book may well have been more familiar and acceptable to all—Maharalists or not—because it was ultimately written with an inclusive epistemic sensibility that is reminiscent of the exegetical texts that were common in Gans's day. In terms of the reception of the book, Gans may well have had it both ways.

But what did Gans himself believe? Sadly, we cannot know this until texts of a more private nature come to light. We have so far not found letters, diaries, or notebooks—nor anything else not written for public consumption—that illuminate Gans's own attitudes. It seems to us unlikely that Gans could have embraced the Maharalist view in toto, with its denigration of natural philosophy. Gans, after all, devoted his life to temporal knowledge. It is difficult to believe that he did so, all the while believing that such knowledge was never certain and hardly important. A Gans who embraced polyphony as an intellectual ideal, however, is a Gans whose labors and attitudes have greater integrity. It is easy to explain Gans's own life work if one assumes that he believed that teaching about God's works is an endeavor essentially similar to the teaching of God's words. Such an assumption might also explain why Gans expected his books to fit comfortably on the bookshelf of Hebrew literature of his day, and why he expected them to be easily incorporated into the curriculum of the talmudic academy. For Gans may well have expected his readers and students, whose pluralist exegetical sensibility was deeply ingrained from their

study of Scripture, easily to assume the same sensibility while studying the heavens and the rest of God's wondrous Works.

We have offered several explanations of why Gans might have adopted so pluralist an approach to presenting the planetary systems of his day in what he expected to be the foundational book of astronomy for the Jews of his epoch. We are not able to adjudicate among them and believe that several, perhaps all of them, may have pertained in combination. Of all these explanations, the most novel and suggestive claim (and admittedly the most difficult to prove, at this stage) is the one that suggests a "Jewish" Two Books analogy lurking in the background of Gans's project. It is radically different from the Two Books analogy suggested by his renowned contemporary, Francis Bacon, and enacted in the latter's utopian *New Atlantis.* In Bacon's utopia, the perfect scientific enterprise is found within a perfect Christian society. The enterprise is conducted by thirty-six sages acting in accord with a clear and effective method, in perfect harmony, collaboration, and agreement, without dispute, without debate. The latter is conducted in the light of *the* one undisputed understanding of Scripture, personally delivered by Bartholomew. In the rabbinic literature of Gans's day, the world of Torah study was imagined very differently; as a vibrant, clamorous study hall alive with a multitude of dissenting voices simultaneously interpreting texts in contradictory ways. It is tempting to read Gans's astronomical surveys as a depiction of what he and his prospective readers took to be knowledge at its very best pursued in the best possible way, the way that Torah wisdom was pursued. The authors of this essay are ourselves divided about the degree to which this temptation should be succumbed to, or resisted as insufficiently warranted. We agree, however, that Gans's presentation of conflicting interpretations of the heavens God created is markedly similar to contemporary presentations of conflicting interpretations of the scripture God bequeathed. Whether Gans patterned the former on the latter, and whether his readers took the former as an echo of the latter, remains an intriguing question, and one that will be answered conclusively only when new textual evidence is uncovered.