

THE RECEPTIVITY OF JEWISH THOUGHT TO THE
NEW ASTRONOMY OF THE SIXTEENTH AND SEVENTEENTH
CENTURIES: THE CASE OF ABRAHAM b. HANANIAH YAGEL*

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To readers of the Bible living at the opening of the seventeenth century, Isaiah's words, "For behold, I create new heavens and a new earth,"¹ were sure to evoke a sensation of wonder and exhilaration. For in no other age than in this blessed one had God revealed more of his marvelous secrets regarding heaven and earth. New lands, new peoples, new cultures, and new stars testified anew to the vastness and multifariousness of the divine creation. Yet at the same time the dramatic discoveries seemed to puncture the absolute certainty that "there is nothing new under the sun."² To the sensitive observer, such revelations must have undermined the comforting security he previously held in nature's constancy and predictability. To reconcile novelty with continuity, to accommodate the new with the familiar and understandable experience of the past constituted a fundamental philosophical and theological problem of the age.³

* In honor of the late Moses David Cassuto who wrote the important entry on Abraham b. Hananiah Yagel, *Encyclopaedia Judaica*, 7, Berlin 1931, pp. 70–71.

1 Isaiah 65, 17.

2 Ecclesiastes 1:9.

3 See for example: I. B. Cohen, La découverte du nouveau monde et la transformation de l'idée de la nature, *La science au seizième siècle*, Paris 1960, pp. 189–210; D. F. Lach, *Asia in the Making of Europe*, 1–2 (in 5), Chicago 1965–77 to date; R. S. Westfall, *Science and Religion in Seventeenth Century England*, Ann Arbor 1973.

For Jews who witnessed the momentous changes affecting their physical and cultural landscape, the challenges of the newly expanding universe were just as compelling to them as to anyone else. Like Christians, they had allied their own theology too long with so wrong a theory of the origin and structure of the universe; like Christians, they now were forced to reread and rethink their consecrated affirmations in the light of contradictory empirical evidence; and like Christians, they undoubtedly required ingenious hermeneutical devices to adjust their traditional responses to the newly accumulating information regarding unexplored lands and skies. And with the ascendancy of Copernicus' heliocentric theory, they also faced a revolutionary thesis for which they hardly had time to prepare.

While the receptivity of general European thought to the scientific revolution of the late sixteenth and seventeenth centuries had been studied systematically and comprehensively,⁴ no similar investigation has yet been undertaken with respect to Jewish thought.⁵ Such an inquiry into Jewish sources would be important both in assessing the awareness of Jews to the literature and technology of the new discoveries and in evaluating the ability of Jewish traditional culture to assimilate new and contradictory data and assumptions about the physical world. Furthermore, such an examination would offer a comparative perspective in which to view the Christian community's adaptation to scientific novelty and change. The only well-researched Jewish figures to have displayed considerable familiarity with the new astronomy were

David Gans (1541–1613)⁶ and Joseph Solomon Delmedigo (1591–1655).⁷ Both had the unusual good fortune of being associated personally with the astronomical revolution. Gans knew Brahe and Kepler; Delmedigo was a student of Galileo. Both were cognizant of Copernicus' new theories and wrote about them in Hebrew; Delmedigo even accepted the Copernican cosmology without reservation. Judging from so small a sampling, one might be tempted to conclude that Jewish thinkers were more open-minded and culturally progressive than some of their Christian counterparts in accepting the assumptions of the new astronomy. Such a hasty conclusion is unwarranted however, given the current lack of documentation.⁸

The writings of Abraham b. Hananiah Yagel, an Italian Jew and contemporary of Gans and Delmedigo, supply additional evidence regarding Jewish responses to the new astronomical findings.⁹ Yagel's testimony is significant since, unlike the other two, he seems to have had no personal contact with any of the scientific luminaries of his day. Furthermore, his primary interest and

6 On Gans' astronomical writings, see: A. Neher, *David Gans (1541–1613) disciple du Maharal de Prague, assistant de Tycho Brahe et de Jean Kepler*, Paris 1974; G. Alter, *Two Renaissance Astronomers: David Gans and Joseph Delmedigo*, *Kozirovsky Gakhslovenské Akademie Věd Ročník* 68 (1958), Rada MPV, sešit 2, 77 pp.

7 On Delmedigo, see: I. Barzilai, *Yoseph Shlomo Delmedigo. Yashar of Candia. His Life, Works and Times*, Leiden 1974, especially pp. 150ff. On the general involvement of Jews in astronomy in the fifteenth century and later, see: B. Goldstein, *The Hebrew Astronomical Tradition: New Sources*, *Jus* 72 (1981), pp. 237–51; idem, *The Survival of Arabic Astronomy in Hebrew*, *Journal for the History of Arabic Science* 3 (1979), pp. 31–39 (especially pp. 38–39).

8 I am referring to the conclusion drawn by Neher, *David Gans* (above n. 6), pp. 271ff.; idem, *Copernicus in the Hebraic Literature* (above n. 5).

9 Yagel apparently was born in Monseice, Italy in 1553, as he indicates in a letter he composed in 1613 on reaching the age of sixty (Ms. Moscow Günzberg 129, n. 67). He was living in San Martino as late as 1623 (see the same collection, letter to Hananiah Reini, fol. 171ff.). Other autobiographical facts are found in his *Ge' Hizayyon*, Alexandria 1897. See also: D. Ruderman, *Three Contemporary Perceptions of a Polish Wunderkind of the Seventeenth Century*, *Association for Jewish Studies Review* 4 (1979), pp. 143–63; idem, *Uncorns, Great Beasts and the Marvelous Variety of Things in Nature in the Thinking of Abraham b. Hananiah Yagel*, a paper delivered at a Symposium on Jewish Thought in the Seventeenth Century, Harvard University, March 21–24, 1982, to be published by Harvard University Press; Y. Dan, *Ha-sippur ha-ivri bi-met ha-behinyim*, Jerusalem 1974, pp. 202–21; S. Maybaum, *Abraham Yagel's Katechismus Lekachob*, Berlin 1892; C. Roth, *The Jews in the Renaissance*, Philadelphia 1959, pp. 53, 105, 330–31.

4 This is not the place to cite numerous bibliographical references, but see generally: T. S. Kuhn, *The Copernican Revolution, Planetary Astronomy in the Development of Western Thought*, Cambridge, Mass. 1957; idem, *The Structure of Scientific Revolutions*, Chicago 1962; A. Koyre, *From the Closed World to the Infinite Universe*, Baltimore 1957; K. Schöler, *Ursprung und Probleme der Birkirkrik in 17 Jahrhundert*, Munich 1966; Westfall, *Science and Religion* (above n. 3); A. Funkenstein, apud R. S. Westman (ed.), *The Dialectical Preparation for Scientific Revolutions, The Copernican Achievement*, Berkeley-Los Angeles-London 1975, pp. 165–203; A. R. Hall, *The Scientific Revolution 1500–1800*, London 1954; E. A. Burt, *The Metaphysical Foundations of Modern Physical Science* (rev. ed.), London 1932; B. Willey, *The Seventeenth Century Background*, London 1934.

5 The one exception is: A. Neher, *Copernicus in the Hebraic Literature from the Sixteenth to the Eighteenth Century*, *Journal of the History of Ideas* 38 (1977), pp. 211–26. On Neher's premature evaluation, see below.

I

In his *Be'er Sheva*, Yagel devoted a relatively long chapter to the subject of comets.¹¹ The theory on comets dominant from antiquity until the sixteenth century was that of Aristotle. Aristotle had described the origin of comets in his *Meteorology*:¹⁴

We have laid down that the outer part of the terrestrial world, that is, of all that lies beneath the celestial revolutions, is composed of a hot dry exhalation. This and the greater part of the air which is continuous with and below it are carried round the earth by the movement of the circular revolution: as it is carried round its movement, it frequently causes it to catch fire, wherever it is suitably constituted, which we maintain is the cause of scattered shooting stars. Now when as a result of the upper motion there impinges upon a suitable condensation a fiery principle which is neither so very strong as to cause a rapid and widespread conflagration, nor so feeble as to be quickly extinguished, but which is yet strong enough and widespread enough; and when besides there coincides with it an exhalation from below of suitable consistency; then a comet is produced, its exact form depending on the form taken by the exhalation.

Inextricably related to Aristotle's view of the universe, his theory of comets rested on the basic distinction between a perfect celestial realm, where motion is eternal, circular, and not subject to change and decay, and a terrestrial realm of transient motion in a straight line toward the center and of matter continuously subject to change and decay. Since comets were clearly observed as transitory phenomena, it was impossible for Aristotle to locate them in the celestial realm; he was obliged to define them as fiery exhalations, rising from the earth, carried around by the motion of the sky and catching fire when ignited by that motion. To challenge such a well established cometary theory thus required challenging Aristotle's entire cosmology.¹⁵ For that

expertise lay in natural history and medicine rather than astronomy.¹⁶ The information he acquired on the scientific discoveries came exclusively from his reading of books. Preoccupied for a considerable part of his life with the difficulties of earning a living and, especially, with the burdens of an unsuccessful moneylending career,¹⁷ nevertheless, he read broadly in Jewish and non-Jewish literature and wrote extensively on a wide variety of fields. His writings, especially the *Beir Ya'ar ha-Levanon* and *Be'er Sheva*, illuminate both his considerable knowledge as well as his capacity to accommodate the new within the framework of a traditional Jewish theology.¹⁸

To illustrate Yagel's awareness of and reaction to the astronomical discoveries of his day, I have chosen two examples from his writings. The first is his response to a new astronomical theory on comets, openly challenging the Aristotelian cosmogony. The second is his response to the discovery of the telescope, the most significant technical discovery of his generation, offering the most dramatic support for the Copernican hypothesis.

10 On Yagel's knowledge of natural history and medicine, see especially: Ruderman, *Unicorns* (above n. 9). Discussions on astronomical subjects are scattered throughout his two compositions. See especially: *Beir Ya'ar ha-Levanon*, 1, chap. 6; 2, chaps. 21, 25, 26; 4, chaps. 96, 97; *Be'er Sheva*, chaps. 2, 3, 4, 16, 17, 18, 19, and the two chapters discussed below. He also composed (or at least planned to compose) a commentary on the *Centiloquium* (פְּתִיחַת נִכְדָּת ד'), a collection of one hundred astrological aphorisms, attributed to either Ptolemy or Hermes Trismegistus. The introduction to Yagel's commentary (entitled *Permeqadm*) is extant and is located in Ms. Oxford-Bodl. 1303, fols. 101a–101b. In the introduction, Yagel claims to be familiar with Ptolemy's other astronomical works and also claims to have compared the Greek version of the *Centiloquium* with its Arabic translation. On the *Centiloquium*, see: M. Steinschneider, *Die hebraischen Uebersetzungen des Mittelalters* 2, Berlin 1893, pp. 527–29. On its currency in the sixteenth century, see the numerous references to it in L. Thorndike, *A History of Magic and Natural Science* 1–8, New York 1929–41, vol. 6, index. Ptolemy, *Centiloquium*. For Yagel's familiarity with Ptolemy's *Quadripartitum* and Cardano's commentary on it, see below.

11 On this, see especially his *Gei Hizzayon* (above n. 9).

12 These Hebrew compositions are found in manuscript, Ms. Oxford-Bodl. 1303–1306.

13 Ms. Oxford-Bodl. 1306; *Be'er Sheva*, Chap. 15, fols. 48a–53b.

14 Aristotle, *Meteorology*, I, 7. I have used the translation of: H. D. P. Lee, Cambridge Mass. 1952; also quoted and discussed in J. L. Jervis, *Cometary Theory in Fifteenth-Century Europe* (Diss.), Yale University, New Haven 1978, pp. 7–10; C. D. Hellman, *The Comet of 1577: Its Place in the History of Astronomy*, New York 1944 (reprinted: 1971), pp. 16ff.

15 Jervis, pp. 9–10.

Before turning to Yagel's treatment of Cardano's cometary theory, the entire relationship between the two writers needs to be considered more fully. For indeed Yagel was indebted to Cardano for much more than simply his views on comets. He quoted him on other occasions and appears to have relied on his views on divination, monsters and bizarre fauna. Most importantly, Cardano's *De Subtilitate* and *De Rerum Varietate* seem to have offered Yagel appropriate models to emulate when composing his own analogous Hebrew compositions. Both men were fascinated by the wonders of nature, the occult, the new discoveries in astronomy and geography, and both men approached science from a profoundly religious orientation. Yagel was too eclectic a reader to rely excessively on only one author. Nevertheless, among the wide variety of sixteenth-century writers he did consult, Cardano's broad intellectual plan as well as his specific views on individual topics unquestionably left a lasting impression on Yagel.²⁴

Yagel, however, still was capable of disagreeing with his Italian mentor, especially when the latter's views appeared to contradict what for Yagel constituted well-established truth. Such was the case regarding Cardano's emphatic rejection of Aristotle's doctrine of the four elements.²⁵ Since Cardano's position on comets seems to have placed him in an analogous position in disapproving of Aristotle, a position with which Yagel nevertheless sided, it would be useful first to consider Cardano's theory of the elements and Yagel's evaluation of it. Why in the case of the elements did Yagel reject Cardano's novel departure from Aristotle but in the case of comets, he unhesitatingly accepted it?

Yagel opens his discussion of the elements with unrestrained praise for the Bolognese doctor:

In the days of our fathers, one wise man arose from among the Christian scholars who held the opinion that the elements were three. His name was Girolamo Cardano, a philosopher, astronomer and great physician who on the basis of the wonderful strength of his wisdom and the

written words in his many books cannot be dismissed so that his name be forgotten. For beheld in his book... he concluded that the elements were three and they were earth, water, and air. And he did not mention fire, saying that fire is never an element in the universe except the heat from the sun. And since the sun heats especially the most upper region of the air, the ancients thus considered that a fourth element, derived from fire, is located there, a view which is not his view....²⁶

How Cardano arrived at such a view need not concern us here. What is more important is Yagel's reaction to Cardano's theory. After summarizing it completely, Yagel seems to admire the logic of the argument. Although predisposed to maintain his belief in the four elements, Yagel readily admits that even a false assumption can yield correct conclusions.²⁷ But in this case, good logic is not enough when confronting the weight and time-honored authority of all previous generations:

What further justification is needed when every sect of scholars, ancients and moderns, [accept the thesis of four elements] and the matter is publicized in the world and everyone has accepted [the reality of the four elements] as a primary proposition? If the natural philosophers built their entire philosophies on them [on the theory of the four elements]; if the doctors who came after them established and inquired regarding changing compositions on the basis of the truthfulness of the four elements; if the astronomers similarly assumed their reality....

Also the rabbis of sacred memory mentioned the four elements in an accepted and publicized manner for anyone.... thus who are we to enlarge upon a matter which even schoolchildren know and anyone who disputes this fact is like one who disputes the senses and that accepted by all authorities? For these wise men did not count the four elements as kinds of mixtures so that we might consider whether to

24 Consult the aforementioned articles of Ruderman (above n. 9). In addition to the quotations of Cardano cited by Yagel (mentioned in Ruderman, *Three Contemporary Perceptions*, p. 156 n. 46), he also quotes Cardano's commentary on Ptolemy in: *De rerum Varietate*, chap. 19.
25 Cardano, *Opera Omnia* (above n. 18), pp. 7–8 (*De Rerum Varietate*, I, chap. 2). Yagel's discussion of the elements is found in *De rerum Varietate*, Ms. Oxford-Bodl. 1306, chap. 10, fols. 36a–38a.

26 יבני אבותינו קם חכם אחד מנחמי הנוצרי שדיבר ברעיון שדורשות שלושה: ארץ, מים ואש ידועים קאודאוד פילוסוף חוכר ורופא גורל שעל פליאה עז חכמתו ודבריו הנכבדים בספרו הרביעי אין להשליכו מנגד לכל דבר ויפקד שמה והנה בספרו... נמר אומר... שדורשות שלושה והם הארץ והמים והאוויר ולא זכר יסוד האש ואמר שאין יסוד האש כלל בעולם לכן התקיימה מה שהמשמש ושומעני כי השמש מתחם בייתר החלק הנבונה מהאוייר על כן יחסו הראשונים ותשבו ששם יסוד רבועי מהאש מה שאינו לפי דיעתנו....
27 Yagel, fol. 37a: באופן שמדקדמה נהנה הליך תולדות אמתית: ארץ, מים ואש ידועים קאודאוד פילוסוף חוכר ורופא גורל שעל פליאה עז חכמתו ודבריו הנכבדים בספרו הרביעי אין להשליכו מנגד לכל דבר ויפקד שמה והנה בספרו... נמר אומר... שדורשות שלושה והם הארץ והמים והאוויר ולא זכר יסוד האש ואמר שאין יסוד האש כלל בעולם לכן התקיימה מה שהמשמש ושומעני כי השמש מתחם בייתר החלק הנבונה מהאוייר על כן יחסו הראשונים ותשבו ששם יסוד רבועי מהאש מה שאינו לפי דיעתנו....

lightening, one says: Blessed be He whose strength fills the world. What are *zikin*? Samuel said a *kokhava de-shavit* [comet]. And Samuel stated: "The paths of the heavens are as familiar to me as the streets of Nehardea with the exception of the comet of which I am ignorant. What is it? For it was taught that [no comet] ever passed through the constellation of Orion for if it passed through, the world would be destroyed. But has it not appeared to have passed through? Its splendor passed through which made it appear to have passed through'"⁴⁷

Yagel proceeds to explain that Samuel's *kokhava de-shavit* can only refer to a comet, and since Samuel "was a great wise man in the science of astrology," Yagel assumed that comets could be neither an earthly creation nor a fixed star in the heavens; that is why Samuel acknowledged his ignorance in explaining their origin. "For there is no doubt that he had learned much wisdom from the writing of the Greeks who had preceded him by some five hundred years and if he had been inclined to accept his [=Aristotle's] words, he would not have asked: What is it?"⁴⁸ But, Yagel explains, Samuel's answer is totally consistent with Cardano's position; since the comet is only the gathering place of light rays from the stars and assumes no definable form, Samuel had no idea what it was. Furthermore, when he taught that a comet never passes through the constellation of Orion, he simply was stating that comets move in the direction of the North Pole (the location of Orion) from the Equator. When he suggested that the world would be destroyed if a comet crossed over Orion, he was indicating that a comet moving past the North Pole becomes stationary since the pole is stationary. Thus the motion of most comets is usually below the pole but if they enter the vicinity of the pole, they engender a condition of dryness, famine and earthly destruction.⁴⁹

47. ואם הוא נגד דעת החכמי' היסולופוסים הנמשכי' אחר דעת אריסטו ושטירתו: 49b. Yagel, fol. 49b. ודעתו הוה נחמתי כי הוא ישר בעיני בראייתו של שמואל הכבלי' . . . על הזיקן ועל הזוערת ועל הרעפי' ועל הדוחות ועל הברקים אומר ברוך שכתו מלא עולם מאי זיקן אמר שמואל כוונתו דשביט ואמר שמואל נהירי' לי שביט' דרדייעא כשביט' דהורדעא לכך מוכונת דשביט דלא ידענא מאי ניהו ונמוי' דלא עבר כסלא ואי עבר כסלא חתך עלמא דהוה קא חזינן דעבר זיזיה הוה דעבר ואתחיי' כדלעב' . . .

The reference is from B. T. Berakhot 58b.

48. שאין ספק כי לכו ראה הרבה חכמה ודעת כדברי הייני שקדמוהו סביב לתי' ק"ל: 50b. Yagel, fol. 50b. שבה ואלו היה רוחו נוטה לדבריו לא אמר מאי ניהו

49. Yagel, fol. 50b.

However forced Yagel's exegesis of Samuel's words might appear, they seem to have provided him with sufficient support for Cardano's position. Cardano adequately had demonstrated to him the insurmountable problems related to Aristotle's theory. He also had seen how Cardano had recruited Ptolemy and Abri'l-Ridjal to his side. All he needed was a familiar rabbinic precursor whose view seemed to approximate that of Cardano, and this he found in Samuel. And if any lingering doubt remained about the reliability of this novel approach, he always could take comfort in the fact that even Samuel never fully understood the nature of the comet: ". . . for we are not haughty enough to believe that we better understood what Samuel of sacred memory understood for the secret things are to God"⁵⁰

II

Of all the inventions of the seventeenth century, Galileo's telescope certainly was the most important, and of all the publications of that era, his *Sidereus*

50. ולא נבה לבנו להאריך שרבינו בה יתיר נמה שדרכן שמואל ז"ל כי הנסתרות ז"ל: 53b. Yagel, fol. 53b. לדי' אלקי' . . .

Isaac Cardoza (*Philosophia Libera*, Venice 1673, p. 210), and David Gans (referred to in: Neher, *David Gans* [above n. 6], pp. 274–75), also mention the astronomical passage of Samuel. For a similar example of exegesis of a Rabbinic passage (B. T. Pesahim 94b), reconciling the Rabbis with the new astronomy, see: Neher, *David Gans*, pp. 304ff.; idem, *L'exégèse biblique juive face à Copernic au XVIème et au XVIIème siècles, Travels in the World of the Old Testament, Studies . . . to Prof. M. A. Beck*, Assen 1974, pp. 190–96. For earlier exegesis on the same passage, see the numerous references collected by I. Twersky, Joseph Ibn Kaspi, Portrait of a Medieval Jewish Intellectual, *Studies in Medieval Jewish History and Literature*, Cambridge, Mass. – London 1979, p. 256 n. 52. On the same general question of the receptivity of traditional Jewish thought to new cultural configurations in the Renaissance period, see: R. Bonfil, Expressions of the Uniqueness of the Jewish People During the Period of the Renaissance (Hebrew), *Sinai* 76 (1975), pp. 36–46; idem, *Ha-Rabbanu be-Italyah bi-tekufat ha-Renessans*, Jerusalem 1979, chap. 5. For other contemporary Jewish opinions on Aristotle's cometary theory, see: David Gans, *Mehmad ve-Nafim*, Jessnitz 1743, Sh'ar 12, fols. 79b–80b, who still supports it; Joseph Delmedigo, *Sefer Elim*, Amsterdam 1679, pp. 431–33; Barzilai (above n. 7), pp. 162–63; J. Fünin (ed.), *Ha-Carnel* 6 (1867), pp. 342–44, who openly criticizes it.

Nuncius undoubtedly generated the most enthusiasm.⁵¹ Printed in Venice in 1610 in a limited edition of five hundred copies, it instantly became a best seller. The full title of the work already conveyed its fever of excitement:

The Starry Messenger, revealing great, unusual and remarkable spectacles, opening these to the consideration of every man, and especially of philosophers and astronomers;... with the aid of a spyglass lately invented by him, in the surface of the moon, in innumerable fixed stars, in nebulae and above all in four planets, swiftly revolving around Jupiter... and known to no one before the Author recently perceived them and decided they should be named the Medicæan Stars.

Galileo, in a crisp engaging style, announced to his countrymen the remarkable revelation of peering through his lead tube fitted with two glass lenses, and focusing on the surface of the moon, the constellations of Orion, Taurus, the Pleiades, the Milky Way and the planets of Jupiter. The impact on European culture was almost instantaneous. The spyglass soon stirred the imagination of poets, prose writers, philosophers and theologians to new heights and especially to a greater awareness of the vastness of the universe and the minuteness of man.

This sensation was shared also by Abraham Yagel. He opens a small chapter of his *Beir Yatar ha-Levanon* on the subject of Galileo's discovery the following manner:

● Our words were sincere, that in every generation things will be revealed to humanity which never were imagined by the ancients... for behold you have seen among the fruits of the earth and the animals of the forest what we wrote in previous chapters of our composition, and also now in this chapter you shall truly see that my witness that is in heaven and my work that is on high⁵² will appear regarding the words of a wise Gentile

51 See especially M. Nicolson, *Science and Imagination*, Ithaca, N.Y., 1956, chap. 1: The Telescope and Imagination, S. Drake, *Discoveries and Opinions of Galileo*, Garden City, N.Y., 1957, which includes a translation of the *Siderius Nuncius* which I consulted; E. McMullin (ed.), *Galileo, Man of Science*, New York 1967; E. Cochrane, *Florence in the Forgotten Centuries 1529–1800*, Chicago–London 1973, pp. 165ff. On the problem of the name of the instrument Galileo used, see: E. Rosen, *The Naming of the Telescope*, New York 1947.

52 Paraphrasing Job 16:19.

man who in our day found several stars from the nebula which the ancients never saw and he placed their signs and their markings in a book and also spoke of the appearances seen on the moon and not in puzzles but the true opinion and what are the analogous figures to the human face [seen] from above....⁵³

Paraphrasing the Talmud's praise of Samuel, Yagel could not contain his intense admiration for the man: "The paths of the Heavens are as familiar to him as the streets of Florence where he dwells."⁵⁴

Yagel's Hebrew report on the *Starry Messenger* was composed probably only a short time after the book first appeared.⁵⁵ Yagel was not the only Jew to describe Galileo's findings with the aid of the telescope; Joseph Delmedigo had heard of the instrument and even had looked through it on numerous occasions under the supervision and guidance of Galileo himself.⁵⁶ But Yagel's chapter still is of historical interest as the spontaneous reaction of a Jew who first learned of the spectacular disclosure by reading simply Galileo's book. We may appreciate more fully Yagel's general response to the novelty of scientific discovery by focusing on his report of the most significant discovery of his day.

What most impressed Yagel about Galileo's report was the construction of the telescope itself and its manifold uses. His first inclination was to understate the novelty of the instrument by locating precursors within Jewish cultural history. His search yielded two other analogous inventions. He describes the first: "That is found in the words of our Rabbis of blessed memory in the [Talmudic tractate] *Eruvin*, regarding the same tube that was in the hand of Rabban Gamaliel, which allowed him to see as far as 2,000 cubits

53 Yagel, *Beir Yatar ha-Levanon*, Ms. Oxford-Bodl. 1305, chap. 98, fols. 226b–227b. The passage is found on fol. 226a: אשר לא: 226a: תגלו לבי חבלי דברבים אשר יער לאה ראיית מה שכתבנו בפרקי מאמרנו שעלום הראשונים... והנה בפירות הארץ הויתנו יער לאה ראיית מה שכתבנו בפרקי מאמרנו הקדומים גם עתה נפרק זה וראה חסדא כי יאמר בישמים ובספרי ובתולדות הארץ אשר חכם לומר אשר בימינו מצאנו כותבים אחריהם מהנבוכי אשר לא ראו אותם הראשונים ושם בספרי האמורתי ומה הן ומראיתו וגם דבר אותם המוראות הנבואות כללנה במראה ולא הויתו את הדעת האמורתי ומה הן הוצרות הויתו לפי דעתו פני אדם כללעלה.

54 Yagel, fol. 226a: אשר יער לאה ראיית מה שכתבנו בפרקי מאמרנו הקדומים גם עתה נפרק זה וראה חסדא כי יאמר בישמים ובספרי ובתולדות הארץ אשר חכם לומר אשר בימינו מצאנו כותבים אחריהם מהנבוכי אשר לא ראו אותם הראשונים ושם בספרי האמורתי ומה הן ומראיתו וגם דבר אותם המוראות הנבואות כללנה במראה ולא הויתו את הדעת האמורתי ומה הן הוצרות הויתו לפי דעתו פני אדם כללעלה.

55 The chapter is not dated but was probably written close to 1613, the date of chap. 97, the previous chapter.

56 See Barzilai (above n. 7), p. 150; Delmedigo, *Sofar Elim* (above n. 50), pp. 300–01, 417, 432, 433.

within the Sabbath boundary.”⁵⁷ The second he discovered in the tenth-century commentary of the *Sefer Yezirah* of the Italian Jewish doctor, Shabbetai Donnolo. In the introduction to this work, Donnolo describes his teacher in astronomy, an Arab named Bagdash, whose teaching agreed with that of the ancients and the Jews, especially the *Baraita de-Samuel*, and who taught him how to use an instrument which Yagel considered to be the same as Galileo’s spyglass. “And thus this secret of the instrument in which the paths of heaven are seen was covered up, for our forefathers never imagined it and now it has been revealed, for there is nothing new under the sun.”⁵⁸

But the fact that the instrument already had been discovered by Jews in no way diminished Yagel’s gratitude to Galileo for his ‘rediscovery’: “For we are to praise this emissary selected for this, by whose words the moderns are capable of seeing the paths of the firmaments and things that were hidden from their eyes. And also this instrument can be used by them in sea passages, to estimate boundaries, fortified cities and towers.”⁵⁹ Yagel also noticed, beyond its scientific value, the economic and military utility of so useful an invention.

He then proceeds to describe the materials of the instrument, its construction, and precise directions for its use. He comes to relate briefly what was seen by Galileo through the instrument: the surface of the moon, the cluster of small stars making up the Milky Way, and other clusters never before visible to the naked eye.⁶⁰

Most importantly, Yagel noticeably is aware of the revolutionary impact of these discoveries on the Aristotelian conception of the universe:

For in this [the discovery of new star clusters], he shocked all the traditional astronomers, forcing them to augment the heavenly spheres

57 כי נמצא ברובי רז"ל בעירובין מאותו תקנה שרוב ביד ר"ג שברו היה רואה אם יאגל, fol. 226b. The reference is to B. T. Erubin 43b.

58 ותכמה הסוד הזה מהכלי אשר נראים בו שכלי השמיא מאבותינו לא שערנו בו. 227a. Yagel, fol. 227a. See: Shabbetai Donnolo, apud D. Castelli (ed.), *Il Commento di Sabbatai Donnolo sul Libro della Creazione*, Florence 1880, p. 5. On the *Baraita de Samuel* mentioned by Donnolo, see: *Jewish Encyclopedia* 2, New York 1902, p. 520.

59 וכלינו לשבח לאיש עת נזנחון לכך ששל פה ראה ראה האחרונים שכלי: 227a. Yagel, fol. 227a. הרקיעים ודברים שהיו מפורסם מנוג עניניהם וגם יהיה הפלי מהו מוכן לידם בהלכות ימים ולשנת תמוזי וע"י מכתב ומגדלים תמוזי וע"י 227b–227a. Yagel, fols. 227a–227b.

and totally upsetting the apple cart regarding the theory of the ancients which was held tenaciously until this day. For in his judgments and arguments he will destroy all of the wisdom of Ptolemy and his associates if one does not answer him with the words of the philosophers. For Maimonides wrote in the *Guide* [I: 73] that the senses will deceive us, for already great authorities of our generation in learning and in number have arisen to write libelously against him, presenting counter-arguments against him....⁶¹

The commotion Galileo stirred in the intellectual world is parallel for Yagel to that engendered by the Arab astronomer, Al Birrūjī, who, in his day, openly attacked the astronomical structure of Aristotle and Ptolemy. This Arab also “requested to destroy the foundations of learning in astronomy and his words have remained as a closed book until the present generation.”⁶²

What precisely Yagel had in mind in describing Galileo as a destroyer of the foundations of astronomy is not apparent from his words. Did he truly appreciate that Galileo’s evidence now could be used to confirm the Copernican universe, that Jupiter’s moons as celestial bodies are subject to the same laws of motion to bodies observable on earth, that the planets appear to revolve around the sun, and that the earth is “a wandering body surpassing the moon in splendor”?⁶³ Nowhere in his writing does he mention Copernicus. Unlike David Gans and Joseph Delmedigo, Yagel makes no explicit reference to the heliocentric theory; on the contrary, his usual descriptions of the universe offer no traces of deviation from the Aristotelian cosmology.⁶⁴

61 ובהו הערש כל חכמי קדם מהאסטונונים לחייב אותם שירבו נלגלים כמורומים: 227b. Yagel, fol. 227b. ולתפוז הקערה על פיה כמה שהיה רעה הקדמונים אשר אחזו שער עז היים הזה. וכמשפטי ודינו יהרוס כל תכמה שולומיא והבויי אם לא ישר לר כדברי המלכרים. כתי הרב כמורה שהחויים יעזבו לנו וכבר קמו עמדו גדולי הדור בתכמה ובמען וכתבו עליו פלסטר והבויחו ברברים גרתי.

62 כדברי האיש המערש... אשר גם הו' בקש לחרסם סודי התכמה מהתנוה: 227b. Yagel, fol. 227b. ר'איש המדעיש Or' ושאר דבריו לדרו אחור כדברי הספר החתום. S. Heller-Wienksy, *R. Yizhak Arama u-Mishno ha-Philosofit*, Jerusalem–Tel-Aviv 1956, p. 117; M. Steinschneider, *Die hebraischen Uebersetzungen des Mittelalters und die Juden als Dolmetscher*, Berlin 1893, pp. 550–52; B. Goldstein, Ha-Astronomia Bim-ei Habeinayim Lefi Mektoret Ivritim, *Korot* 4 (1968), pp. 679–90; idem, *Al-Birruji on the Principles of Astronomy* 1–2, New Haven 1971; J. Samsó, *Dictionary of Scientific Biography* 15, New York 1978, pp. 33–36.

63 Quoted from Galileo by Cochrane (above n. 51), p. 166.

64 Compare, for example, his description of the universe in: *Be'er Sheva*, chaps. 2–4.

Nevertheless, as his sentiment about Galileo confirms, he knew more than he chose to describe here. Elsewhere he refers favorably to Giovanni Antonio Magini of Padua, who in 1589 published in Venice a work entitled *New Theories of Celestial Orbs Agreeing with the Observations of Copernicus*.⁶⁵ He also was familiar with the writings of Francesco Giuntini, another Italian who had presented the Copernican hypothesis in a favorable light.⁶⁶

Apparently, Yagel's silence betrays a lack of confidence in the new theory and also a note of discomfort. How could this Galileo, he writes, so bombastically pronounce the death of the traditional system with so much assurance and arrogance:

For who is this man who comes after the 'king' who established the foundations of learning followed by all scholars in every generation? He is no other than a man precipitous in his work haughtily rising up to proclaim: 'I will rule over all in riddles and guileful secrets...' but his associates will not listen to him.⁶⁷

In the end, however, Yagel's annoyance is tempered by a calming sense of security that God will reveal in due course what He chooses to reveal. The disclosures of this turbulent era, no matter how startling, are to be understood from the perspective of an optimistic faith in God's bountiful goodness. So Yagel repeats, "There is nothing new under the sun and what will be will be in controversies, in differences of opinion, in the order of all degrees and fields of learning secret and hidden... for the truth will follow its course and God sits in heaven laughing, for to Him all the mysteries will be revealed."⁶⁸ The discomfort and insecurity induced by the new disclosures are only of temporary duration. Ultimately, Galileo's conclusions will be judged one way or the other, while all along humanity's vision of God's omniscience and purposefulness shall remain firmly intact.

65 See: *Beit Y'ar ha-Levantom*, Ms. Oxford-Bodl. 1305, book 4, chap. 35.

66 See: *Beit Y'ar ha-Levantom*, book 4, chap. 97; *Be'er Sheva*, chap. 20.

67 Yagel, *Beit Y'ar ha-Levantom*, book 4, fol. 227b. שכתב כל החכמים שבכל דור ודור איך זה כי אם איש מהדור במלאכתו מתנשא בה לאמור אני אמלך על כלם בהידות ותעלמו העזרותי. כי תכירו לא ישמעו עלי.

68 Yagel, fol. 227b. הדעות: 227ב. יאגל. וכמו כל המדרגות נסתרות ונעלמות... והאמת יעשה דרכו ויחשב בשמים וישתה כי כי נתגלו כל העלמות

III

A comparison of Yagel's two responses — to Cardano's comet theory and to Galileo's telescope — suggests the following conclusions. In both cases, Yagel's reactions reveal a distinct familiarity with current astronomical literature, impressive especially for one who was not a trained astronomer. He not only cites classical and medieval sources but has read a leading sixteenth-century theorist on comets and reports on Galileo's famous tract only some three years after it was first published. When viewed in the context of his notable erudition in medical, botanical and zoological literature, as well as rabbinic, kabbalistic, philosophical and magical sources, the encyclopedic character of Yagel's scholarship, especially in scientific matters, is apparent and compares favorably with that of Yosef Delmedigo, David Gans, Abraham Porracone, and other distinguished Jewish scholars of his generation.

Yagel's reaction to scientific novelty is cautiously skeptical but never closed minded. The implications of Galileo's findings evoke noticeable discomfort for him but not anxiety. The sanctified authority of Jewish sources still is a dominant element of his thinking. When a new theory such as Cardano's can be linked successfully with an earlier Rabbinic statement, the theory is made credible, even against the weighted authority of the Aristotelian tradition. Similarly, Galileo's telescope, when viewed as a 'rediscovery' of a previous invention known to a Jewish authority centuries before, also appears more plausible to Yagel. In the case of this Italian Jew, his religious convictions in no way obstruct his ability to admit the new. On the contrary, by locating precedents within Jewish tradition for the discoveries, he makes the new more comprehensible and more compatible with his own experience. The testimony of Yagel thus offers an interesting example of the distinct capacity of Jewish thought to re-orient itself to a new cultural situation while retaining a continuous bond with the past.

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