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VOLUME 7

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6. THE FIRST HEBREW ENCYCLOPEDIA OF SCIENCE
ABRAHAM BAR ḤIYYA'S
YESODEI HA-TEVUNAH U-MIGDAL HA-EMUNAH

MERCEDES RUBIO

Introduction

Abraham bar Ḥiyya, a twelfth-century Spanish Jew, stands out as the first writer to undertake the task of compiling a Hebrew encyclopedia of scientific knowledge. He wrote his encyclopedia, *Yesodei ha-Teḇunah u-Migdal ha-Emunah*,¹ at the request of the Jews of France, who longed for translations of scientific works.² At the time, science was accessible only to those Jews who read Arabic.

We know very little about this first Hebrew encyclopedist. He was known as *ha-Bargeloni* (also as *ha-sefardi*) which indicates that he was either born in Barcelona or, at least, settled and was active in that city for several years. He was also called *Savasorda* (with its variations *Sabasorda* and *Xabaxorda*), a Latin transcription of the Arabic *ṣāhib al-shurṭah* ("head of the guard"). This title was granted for having served and attained high dignity in the court of a king. It is also clear from his knowledge of Arabic that he lived for some time in an Arab environment. Millás Vallicrosa has suggested that he might have lived in the kingdom of Saragossa-Lerida, which at that time was under the rule of the Banû Hūd dynasty.³ Most of his

¹ Ed. and Spanish trans. José María Millás Vallicrosa, *La obra enciclopédica 'Yesodei ha-teḇuná u-migdal ha-emuna' de R. Abraham bar Ḥiyya ha-bargeloni* (Madrid-Barcelona, 1952). References to the encyclopedia (henceforth, *Yesodei*) will be to the page and line numbers of the Hebrew edition. All translations from the encyclopedia in this article are my own.

² Cf. *Yesodei* 10, 15-17: "I did not undertake this task of my own will, nor to gain glory. Rather, many among the great in my generation, whose advise I am obliged to take, have urged me to do so *because there was not one single book written in Hebrew on these matters in the whole land of Šarfat*. Therefore, I translated them from Arabic books into Hebrew according to my ability" (italics added).

³ José María Millás Vallicrosa devoted several years to the study and edition of Bar Ḥiyya's works. For more information about Bar Ḥiyya's life and his role in the history of Spanish science, see his *Estudios sobre historia de la ciencia española* (Barcelona, 1949), 219-62. Millás provides a list of the nine scientific works

works are dated in Barcelona, between 1134-45.⁴ However, one of his earliest extant works, *Sefer ha-Ibbur*,⁵ a book on calendrical intercalation, seems to have been written before 1124, for it appears to refer to that year as a future one. Bar Ḥiyya's encyclopedia also was likely written in the first quarter of the twelfth century.⁶ If these datings are correct, they would place these works at the very earliest stages in the transmission of Arabic science.⁷

Bar Ḥiyya may also be credited with the pioneering effort to establish the Hebrew language as a vehicle for scientific knowledge.⁸ His philosophic and scientific vocabulary has been studied by Israel Efros in two studies, one of which is based primarily on Bar Ḥiyya's encyclopedia, which, as Efros shows, "abounds in new terms, in old terms invested with new meanings, and in new combinations of terms." Efros' studies point to the role of Bar Ḥiyya in the development of a Hebrew scientific vocabulary.⁹ In

attributed to Bar Ḥiyya, and a summary of their contents. See also his *Nuevos estudios sobre historia de la ciencia española* (Barcelona, 1960), 183-90. With regard to Bar Ḥiyya's stay in the territory ruled by the Bânû Hud dynasty, see Millás, *Estudios*, 221. His hypothesis is based on a document, dated August 1137, that is preserved in the archives of the Cathedral of Huesca, which mentions a piece of land "que fuit de Xabaxorda iudeo."

⁴ See David Romano, *La ciencia hispanojudía* (Madrid, 1992), 96.

⁵ Ed. H. Filipowski (London, 1851).

⁶ On the early dating of *Yesodei ha-Tevunah u-Migdal ha-Emunah*, see Martin Levey, "Abraham Savasorda and his Algorithm: A Study in Early European Logistic," *Osiris* 11 (1954): 50-64, esp. 53.

⁷ Bar Ḥiyya indicates his awareness of being a pioneer in the transmission of this knowledge to the Latin West, when he writes in the introduction to his *Hibbur ha-Meshihah ve-ha-Tishboret*: "I have seen that most of the sages of the land of France have not been taught the measurement of lands, nor are they skilled in the way of its partition." Michael Guttman edited the text of this treatise (Berlin, 1931). Millás translated it into Catalan in *Bibliotheca Hebraico-Catalana* 3 (Barcelona, 1931). Plato of Tivoli translated this treatise into Latin, and it had a great influence in Europe. For a summary of its contents, see Millás, *Estudios*, 228-39. The importance of Bar Ḥiyya as a pioneer in the transmission of scientific knowledge to the West has been recognized since the last century. See, e.g., Moritz Steinschneider, "Abraham Judaeus Savasorda und Ibn Ezra," *Zeitschrift für Mathematik und Physik* 12 (1867): 1-44.

⁸ The medievals would have spoken of the *recovery* of the Hebrew language as a vehicle for scientific knowledge. On Bar Ḥiyya's role in this, see Chaim Rabin, "Abraham bar Hiyya and the Revival of Our Language in the Middle Ages" (Hebrew), *Metzuda* 3-4 (1945): 158-70.

⁹ The two studies are in Israel Efros, *Studies in Medieval Jewish Philosophy* (New York, 1974). They are "The Philosophical Terms and Ideas of Abraham bar Ḥiyya," 171-232, and "More about Abraham bar Ḥiyya's Philosophical Terminology," 233-52. The quotation is from 233.

order to understand the place of his encyclopedia in the history of the development of sciences in the West, it is useful to review the situation regarding scientific knowledge in Europe in the early Middle Ages.

The widening political, cultural and religious gap between the Byzantine Empire in the East, and the Latin Empire in the West, gave rise to two different cultural worlds that coexisted for centuries with very little communication between them.¹⁰ With the Arab conquest of the Byzantine Empire in the seventh and eighth centuries, Arabic gradually replaced Greek as the language of science. Arabic brought with it new sources and new interests that profoundly shaped the cultural development in the area. The Arabic world that in this period vanquished the southwestern lands of the former Roman Empire—North Africa and the Iberian Peninsula—set itself to the transmission and development of the scientific knowledge of the time. This knowledge had been inherited from Greece and the Far East, especially India.

The Latin kingdoms of the West, direct heirs of Roman culture, remained committed to that culture. The conquering barbarian tribes from the North to a great extent absorbed the culture and the practical bent of the Romans. Law, politics, oratory, ethics and, in general, the humanistic knowledge inherited from the ancient Roman institutions, attracted their attention and were developed and transmitted to new generations. Scientific knowledge, however, was developed for practical purposes only: geometry for the measurement of surfaces, astronomy for the benefit of agriculture, mathematics for musical measurement, etc. This knowledge was poor and very incomplete.¹¹ The Europeans who were aware of the much more advanced scientific works that had been written in the East longed for translations or summaries of their contents. Christians and Jews who had a knowledge of Arabic and were able to translate into Latin or a Romance language were precious transmitters. It is not surprising then that the Spanish peninsula, during the eight centuries of coexistence of Christian and Islamic

¹⁰ Although the time of the final break between the two empires is traditionally set towards the middle of the eleventh century, the mutual distancing had begun much earlier and was a very slow process, influenced to some extent by the lack of good communications between them.

¹¹ On this issue, see Millás, *Nuevos estudios*, 79-81.

kingdoms, was a favored place for intellectual contact between the two cultural worlds. Bar Ḥiyya's collaboration with the Christian Plato of Tivoli in the translation of scientific texts was also among the first examples of this cooperation for the sake of knowledge that was so widespread in the Spanish Middle Ages.¹²

In this study, I intend to analyze Bar Ḥiyya's encyclopedia in light of his conception of the study of sciences as a necessary means for the attainment of human perfection. Through this analysis, I hope to shed some light on Bar Ḥiyya's humanistic approach to the sciences. This approach should, according to him, characterize the teaching and transmission of any scientific knowledge.¹³ I will begin by giving a brief account of the contents of the encyclopedia. Then I will describe the part of the text that is not found in any of the extant manuscripts on the basis of the information given about it in the table of contents of the introduction. I will not here concern myself with the Greek and Arabic sources of the encyclopedia, as Millás Vallicrosa has already focused on them.¹⁴

The Plan of Bar Ḥiyya's Encyclopedia

What was the general picture of Bar Ḥiyya's encyclopedia?¹⁵ The author's interest in conciliating science and faith is announced in

¹² David Romano published a list of the Latin translations that are attributed to the joint effort of Bar Ḥiyya and Plato of Tivoli. See his *La ciencia hispanojudía*, 104.

¹³ On the philosophical thought of Bar Ḥiyya, see the studies by Jacob Guttman, "Die philosophischen und ethischen Anschauungen in Abraham Bar Chijja's *Hegjon ha-Nefesch*," *Monatsschrift für Geschichte und Wissenschaft des Judentums* 44 (1900): 193-217; *idem*, "Über Abraham Bar Chijja's Buch der Enthüllung," *Monatsschrift für Geschichte und Wissenschaft des Judentums* 47 (1903): 446-68 and 545-69; Georges Vajda, "Abraham Bar Ḥiyya et Al-Fârâbi," *Revue des études juives* 104 (1938): 113-19; *idem*, "Les Idées théologiques et philosophiques d'Abraham Bar Ḥiyya," *Archives d'histoire doctrinale et littéraire du Moyen-Âge* 15 (1946): 191-223; *idem*, *Introduction à la pensée juive du moyen-âge* (Paris, 1947): 97-102; and Sara Klein-Braslavy, "Abraham Bar Ḥiyya's Commentary on the Story of the Creation of Man and the Story of the Garden of Eden" (Hebrew), in *Yisra'el Efrot—Meshorer ve-Hogeh* (Tel-Aviv, 1981). Bar Ḥiyya's two philosophic treatises have been translated. See *The Meditation of the Sad Soul*, trans. Geoffrey Wigoder (New York, 1969), and *Bar Ḥiyya's Megillat ha-megalle. Libre revelador*, Catalan trans. Millás Vallicrosa (Barcelona, 1929).

¹⁴ See Millás, *Estudios*, 225-7.

¹⁵ For an extensive study, see Martin Levey, "Abraham Savasorda and his Encyclopedia" (Ph.D. diss., Dropsie College, 1952).

the book's title, *Yesodei ha-Te'vunah u-Migdal ha-Emunah*, "The Foundations of Intelligence and the Tower of Belief," and is expressed in the two parts or treatises in which the encyclopedia was divided. The names of these treatises are taken from the book's title: treatise 1, "The Foundations of Intelligence," was intended to contain all scientific knowledge; treatise 2, "The Tower of Belief," was a summary of religious knowledge. According to Bar Hiyya, scientific knowledge was the foundation upon which the wise had to build their religious life and their study of the Holy Law. He shows his concern for the conciliation of the two fields of knowledge when in the chapter on optics, after a digression on the interpretation of the sciences with which the biblical artist Bezalel was endowed, he writes: "I explained this matter, which is not directly connected with the previous discourse, here because I thought that if I were dealing with profane things, perhaps in this way I could purify the profane with the sacred."¹⁶

Very little remains of the encyclopedia as originally planned, if we are to rely on the table of contents. According to its description of the whole work, the only part of the text that is still extant is the introduction and the beginning of the first treatise, "The Foundations of Intelligence." The second treatise, "The Tower of Belief," is not extant at all.¹⁷

The first treatise was divided into four parts, which Bar Hiyya calls "foundations" (*yesodot*), because the sciences that are included in these parts are the basis for the building of true wisdom. The first foundation, called *hokhmat ha-musar* (literally "the science of morals" or more accurately here, the propaedeutic science) and *hokhmat ha-medabber* (from *dibbur* = *logos*),¹⁸ had five "pillars" (*'ammudim*): a summary of the sciences of arithmetic, geometry, music, astronomy and logic. Only the first two pillars and the

¹⁶ *Yesodei*, 51, 29-30.

¹⁷ The original text has been preserved in the manuscripts of Munich, Bayerische Staats-Bibliothek, Hebrew MS 36, fols. 203v-209; Oxford Bodleian Library, Hebrew MS 1268, fols. 118 ff.; Berlin, Hebrew MS 79, fols. 121r-136v, and Bibliotheca Apostolica Vaticana, Hebrew MS 400, fols. 66r-75r. M. Steinschneider found the text of the introduction to the encyclopedia preserved only in Parma MS 1170, and published his discovery in "Die Encyklopädie des Abraham bar Chijja," *Hebräische Bibliographie* 7 (1864): 84-95 (reprint, Hildesheim, 1972).

¹⁸ On these two terms, see below, n. 27.

beginning of the third have been preserved. Yet these pillars are sufficient to show how the name of the first foundation, "the propaedeutic science," applies to a summary of scientific notions.

The contents of the two pillars that have been preserved have been studied in depth by Steinschneider, Millás Vallicrosa, David Romano and Martin Levey,¹⁹ among others. I will deal with them briefly, and then focus on the contents of the introduction.

The pillar on arithmetic, *hokhmat ha-minyan*, is divided into two parts: (1) a theoretical approach to mathematics, and (2) its practical applications. The theoretical part, *hokhmat ha-mispar* (lit. "the science of number"), is for the most part an abridged translation of Nicomachus of Gerasa's *Introduction to Arithmetic*, although following the custom of the time, he does not mention his name.²⁰ For the practical part, *hokhmat ha-ḥeshbon* (lit. "the science of calculation"), he follows the Arabic works on arithmetic by al-Khwârizmî and al-Kârkhî.²¹ This part is completed with a chapter entitled *derekh tashlumei ha-ḥalakim* (lit. "the way of partial payments"), which contains the basics of merchandising.

The second pillar, the one on geometry, *hokhmat ha-shi'ur* (lit. "the science of measure"), has two parts. The first consists of the definitions of the basic concepts relevant to this science: body, dimension, space, surface, line, point, angle, etc. This part is completed with descriptions of the different geometrical bodies. The second part is devoted to the science of optics. Bar Ḥiyya incorporates some of the first propositions from the *Optics* of Euclid. Then after some reflections of his own on visual perception, he translates almost literally the chapter on optics in Alfarabi's *Iḥṣâ' al-'ulûm*. At the end of this pillar there is an appendix entitled "capital [*koteret*] of the second pillar," which is preserved in a single manuscript.²²

¹⁹ See the references noted above.

²⁰ Cf. Nicomachus of Gerasa, *Introduction to Arithmetic*, trans. M. L. D'ooge (New York 1926). It is not, however, based entirely on Nicomachus. On Bar Ḥiyya's divergence from Nicomachus, see Martin Levey, "The Encyclopedia of Abraham Savasorda: A Departure in Mathematical Methodology," *Isis* 43 (1952): 258.

²¹ Cf. the list of the books that Bar Ḥiyya may have used for his translations in George Sarton, *Introduction to the History of Science* (Washington, DC, 1927), 563. See further, Levey, "Encyclopedia of Abraham Savasorda," 259 and 263.

²² Munich, Hebrew MS 36.

Apart from these two pillars, only the title of the third pillar, the science of music, has been preserved. This is all that remains of Bar Ḥiyya's encyclopedia. Our knowledge of the other three foundations of intelligence derives entirely from the introduction to the work.

The second foundation dealt with physics, *ḥokhmat ha-yešivot* (lit. "the science of created beings"), and had eight pillars: the principles of beings, the simple beings, generation and corruption, the elements of creation, minerals, plants, animals, and human beings.

The third foundation was the science of politics and had three pillars: on the relation of man with himself, on the relation of man with his family and servants, and on the government of kings and princes.

The fourth foundation dealt with divine science or the science of sciences, namely metaphysics, and it had two pillars: (1) previous questions, and (2) the unity of God and spiritual beings. Nothing is said in the introduction about the contents or parts of treatise 2, except that the author would undertake that task when treatise 1 was completed.

Both the capital of the second pillar and the introduction cast some light on Bar Ḥiyya's conception of the role of the study of particular sciences as an instrument for attaining human perfection. I will deal with the exegetical explanation for the hierarchy of sciences, which is found in the introduction, then with the parallel commentary in the capital, and with the connection of the study of the sciences with human perfection.

Scripture, Wisdom, and the Hierarchy of Sciences

Bar Ḥiyya opens the introduction with a quotation from Jeremiah 9:22-3: "Thus says the Lord: let not the wise man boast in his wisdom, let not the mighty man boast in his strength, let not the rich man boast in his riches; but let the one who glories boast in this: that he understands and knows Me, that I am the Lord, who practices lovingkindness, justice and righteousness in the earth, for in these I delight, says the Lord."²³ This quotation from

²³ On Bar Ḥiyya's use of Jeremiah 9:22-3, see Abraham Melamed, "Philoso-

Scripture offers Bar Ḥiyya an occasion to elaborate on his conception of the subject of wisdom, man, and in what consists his wisdom, and then to justify the structure and hierarchy of all the sciences that he has included in his encyclopedia.²⁴

Man, writes Bar Ḥiyya, has been endowed with three souls, or rather one soul with three faculties: vegetative, animal, and rational or spiritual. But it is this third faculty or "soul" that alone lets us offer a proper definition of man, for his vegetative soul does not distinguish him from the vegetal kingdom, and his animal soul does not distinguish him from the animal kingdom. Bar Ḥiyya defines man as a living being who is rational and mortal. This definition sets the boundaries both with the lower kingdoms, vegetal and animal, whose beings are living and mortal but not rational, and with the upper kingdom of the angels, who are living and intelligent, but do not die. The "wise man" according to the quoted passage is the one whose rational soul is good in its task of dominating the lower ones; the "mighty man" is the one whose animal soul is good in quality; and the "rich man" is the one whose vegetative soul is likewise good in fulfilling its duties.

Bar Ḥiyya's conception of the sciences is correlative to a description of the universe as a hierarchical organization of beings, and of man as an image of the universe. Man is part of all three kingdoms by means of his three "souls" or faculties, also organized hierarchically. Of them, the highest one fulfills man's perfection according to its level of development and the proper use of this rational capacity. Thus to be "wise" is not simply to act according to the upper, rational capacity, but, in addition, to know how to use the other, lower faculties in a proper way as well. To fulfill one's perfection means not only to develop the intellectual faculty

phical Commentaries to Jeremiah 9:22-3 in *Medieval and Renaissance Jewish Thought* (Hebrew), *Jerusalem Studies in Jewish Thought* 4 (1984-5): 31-82, esp. 33-9.

²⁴ Georges Vajda discovered that the section on the classification of the sciences in Bar Ḥiyya's encyclopedia is identical to a text preserved in Judah ben Barzilai's *Commentary on the Book of Creation*. Vajda concluded that it was certainly not Bar Ḥiyya who took Barzilai's text as a source, but rather either the opposite, or both of them used a common, still unidentified, source. See G. Vajda, "Le système des sciences exposé par Abraham Bar Ḥiyya et une page de Juda ben Barzilai," *Sefarad* 22 (1962): 60-8. I am grateful to Tony Lévy for drawing my attention to this article.

to the highest capacity, but also to know how to fulfill the needs of the animal and vegetal organs according to the intellect.

These are the foundations of the sciences of this world: the virtues of wisdom, strength and wealth (*'osher*). The understanding of the Holy Law is rooted in all three of them. The rational soul is the faculty in charge of dominating the other ones, and the only faculty for which man may be praised, if he develops the good spiritual qualities. The two main qualities man needs to dominate and to guide himself are wisdom and intelligence, and through these qualities he is also able to attain the highest truth, the knowledge of God. But this knowledge is only attainable if the Spirit of God helps him understand the words of the Prophets. It is for this last and highest human capacity that man, according to the words of Jeremiah, may be praised. Man is conceived by Bar Ḥiyya as a microcosm, a faithful image of the universe in which he is placed. His fulfillment as a human being is achieved in accordance with the degree of his knowledge of God, the highest truth. In this sense, wisdom is the attainment of that ultimate goal for which man has been appointed, but which can only be attained through God's help, through his Spirit.

Bar Ḥiyya next defines the word "wisdom" (*hokhmah*) upon which the hierarchy of all the sciences is built. Wisdom is "the knowledge or science of all beings in the consideration of their constitution, the disposition of their nature, and the truth of their existence."²⁵ This threefold definition contains the hierarchy of sciences in the following way: the "constitution of the beings" (*kol ha-nimša'ot 'al 'omed tavnitán*) is studied by the science of numbers or calculation, that is arithmetic, geometry, and any other science dealing with measurement. The "disposition of their nature" (*tokhen yeširatam*) means the shapes of the bodies and their disposition in the heavens or on earth, that is cosmology, astronomy, the natural sciences, etc. The "truth of their existence" (*'omen netinatan*) is contained in the science above all sciences, which is the knowledge of the Holy Law. The first two groups of sciences are the sciences of the intellect, and correspond to treatise 1 of the encyclopedia, "The Foundations of Intelligence." These two groups are connected with the three qualities of man's

²⁵ *Yesodei*, 3, 16-17.

soul: wisdom (in the sense of science or knowledge), strength, and wealth. A fourth quality, intelligence, is the foundation of treatise 2, "The Tower of Belief." Thus, the first foundation is the basis for the building of all the virtues as described in the Holy Text; the second foundation or science of physics corresponds to the virtue of strength; the third one, politics, is related to the soul's quality of wealth; and the fourth foundation, divine science, refers to the words wisdom and understanding.

The three kinds of sciences—mathematics, natural science, and divine science—have three levels of certainty: the first one, the exact science, is easy and clear to everyone and there is no discussion about it. The second one is not so evident, and there are great discrepancies among scholars, and therefore each one is free to adhere to the theory of the scholar whom he thinks gives the best explanation. Finally, the third one, the one that offers knowledge of God, is a wisdom that comes from the Spirit of God and deals with matters unattainable solely by the human mind. This last wisdom, which contains the greatest truths, is so difficult to grasp that only through the words of the Prophets can we attain it. It leads to a divine knowledge, whose contents no one can change or correct. We can only attempt to explain it and clarify it.

Bar Ḥiyya offers a second meaning for the term "wisdom" as practical knowledge (*hokhmah 'amlanit*) or artistic ability. In this sense, "wisdom" is defined as "the faculty that human beings have for reproducing with their hands all the shapes and figures that they find in their hearts." This practical art is accordingly called by him *hokhmat ha-lev* (lit. "the science of the heart").

In the capital of the second pillar, mentioned above, Bar Ḥiyya provides another Scriptural proof-text for his division of scientific knowledge, using the figure of Bezalel as a model of wisdom. Scripture states that Bezalel "had been filled with the Spirit of God" (Ex. 31:3), which means that he was wise in all sciences. Bezalel was endowed with the four good qualities, which correspond to the four foundations of the sciences that have been explained in the introduction: wisdom, strength, wealth and understanding. But on this occasion, the hierarchy of the sciences is changed: the first good quality with which Bezalel is said to be endowed is the Spirit of God, which according to Bar Ḥiyya stands for "divine wisdom—or knowledge of the divine—and the

knowledge of the Holy Law," contained in the fourth foundation of sciences. This Spirit of God is composed of three good dispositions: the first one is called "*hokhmat ha-musar*," because it is the first foundation of all the sciences "that correct the inclinations of the heart and adjust it according to the intellect."²⁶ The second one is called *tevunah* (lit. "understanding") because it deals with the disposition of the natures of the created beings. The third one is *da'at* (lit. "opinion"), which is interpreted by Bar Ḥiyya as the science of experience, accompanied by the virtue of prudence in all human matters, and the ability of good counseling.

The reason for this change in the hierarchy of the sciences compared to the one that was drawn from Jeremiah in the introduction is due to the different points of view in the consideration of these sciences. The hierarchy described in the introduction considers every science from the point of view of the excellence of their goals, from the lowest to the highest one. Therefore, it begins with the science of ethical correction, which studies *takhlit ha-nimṣa'ot* (lit. "the end of the beings"), and it finishes with the divine science, namely, metaphysics. The hierarchy which is described according to Bezalel's good qualities begins with the Spirit of God, because it is the beginning for the correct acquisition of the sciences: first, the study of the Holy Law and *yir'at ha-Shem* (lit. "fear of God"), and then the rest of the sciences, from the easiest and less doubtful to the one that is most difficult due to the abstractness of its subject. In both orders, according to Bar Ḥiyya, *hokhmat ha-musar* is considered the science *par excellence*, because of its simplicity and the proximity of its subject.

Bar Ḥiyya shows his understanding of the role of the first foundation as propaedeutic science or *conditio sine qua non* for the attainment of all the above mentioned qualities of the soul and as the basis for ethical knowledge when he explains that the study of this scientific discipline has as its goal the education of the inclinations of the heart according to the intellect. The set of scientific notions that are contained in the five pillars of the first foundation would then be the basis for any other knowledge. The exact sciences are the first foundation because they have the very important role of beginning the training of the mind that enables

²⁶ *Yesodei*, 50, 10-11.

it to rule over the lower faculties, which, as was explained by Bar Ḥiyya in the introduction, is the task of the rational soul that is found in a wise man. Moreover, training in mathematics and logic is the best way to educate the mind for issuing correct judgment. This capacity of drawing correct conclusions, which is common to both these disciplines, is also the first foundation of a higher science, the science of morals, the science that teaches correct judgment about human issues regarding oneself, others and God. This capacity, common to both mathematics and logic, may explain the double name, *ḥokhmat ha-musar* and *ḥokhmat ha-medabber*,²⁷ given by Bar Ḥiyya to the first foundation.

The last science with which Bezalel was endowed was the practical or technical one. Therefore, Bezalel was a model of every speculative and practical science.

This scheme or hierarchy of the sciences corresponds, according to Bar Ḥiyya's conception of the role of scientific knowledge, to the path through which the human intellect should be educated in order to attain its own perfection.

Did Bar Ḥiyya Complete His Encyclopedia?

As we have seen, only a small part of Bar Ḥiyya's encyclopedia—essentially the introduction and the first two pillars of the first foundation of treatise 1—is still extant. What became of the rest of the text? Millás Vallicrosa has suggested the possibility that some of Bar Ḥiyya's other writings may in fact be parts of his encyclopedia.²⁸ Indeed we find lengthy expositions of various issues mentioned in the introduction in at least six of the other eight works attributed to him. For example, in the definition of "wisdom" based on Jeremiah, mentioned above, Bar Ḥiyya discusses briefly

²⁷ Millás explicitly writes that he deviates in his translation from the meaning "mathematics" and "logic" attributed by Jacob Klatzkin to these two terms (cf. Jacob Klatzkin, *Thesaurus philosophicus*, [New York, 1968], part 2, 163). See further, Efros, "More about Abraham bar Ḥiyya's Philosophical Terminology" (above, n. 9), 236-8. Millás prefers to translate them "ciencia de la enseñanza" and "ciencia de lo discursivo" (see *Yesodei*, 35). In the capital of the second pillar, the ethical connotation of the first term is stressed by Millás' translation more explicitly: "ciencia de la corrección ética" and "disciplina ética." He does not elaborate on the reason for his interpretation, but I consider it fully in accordance with Bar Ḥiyya's intention.

²⁸ Millás, *Obra enciclopédica* (above, n. 1), 13.

the three souls or kinds of soul with which man is endowed. This subject is expounded at length in his philosophic book *Meditation of the Sad Soul*.²⁹ Again, one might wonder whether his three works on cosmography and astronomy derive from the fourth pillar of the first foundation. But it is clear from the outline in the introductions of both the encyclopedia and his works on astronomy, especially *Sefer Surat ha-Areṣ*, that their goals were different.³⁰ Moreover, if we can base ourselves on the extant sections of the encyclopedia, Bar Ḥiyya's exposition of the science in the writings on astronomy likely did not conform to the way in which they were presented in the encyclopedia.³¹ In the former, he writes on the different issues in detail and at length, whereas in the encyclopedia his treatment is general and extremely condensed, more appropriate for his intention of giving a panoramic view of every science.

There is no evidence that Bar Ḥiyya completed his encyclopedia. If he did, it would not be the first medieval work that has come to us incomplete. Yet it is certainly suspicious that the lost sections of the encyclopedia have disappeared without a trace. No quotations from or even mention of the lost parts of the encyclopedia are found in the writings of Bar Ḥiyya's contemporaries or of his successors. There are, however, explanations for this. For example, as Bar Ḥiyya himself revealed, the main goal of the work was to make available to Hebrew readers in France the most important scientific achievements of the Arab scholars.³² Yet to attain this goal it was hardly necessary to compile a comprehensive work including the human and divine sciences. The twelfth-century French scholars, we can imagine, who beseeched Bar Ḥiyya to write the encyclopedia, did not feel a lack in their knowledge of theological subjects, but rather were aware of such a lack in

²⁹ See *Meditation of the Sad Soul* (above, n. 13), esp. 62 ff.

³⁰ See the edition and Spanish translation of the three works by Millás: *Sefer Surat ha-Areṣ* (Madrid-Barcelona, 1956); *Sefer Heshbon Mahalakhhot ha-Kokhavim* (Barcelona, 1959); and *Luhot* (Madrid-Barcelona, 1959).

³¹ See, e.g., Levey's comments on the difference between Bar Ḥiyya's *Hibbur ha-Meshihah* and his encyclopedia. Levey speaks of the *Hibbur's* "more complete mathematical terminology and more mature arrangement of the mathematical contents" ("Abraham Savasorda and His Algorism" [above, n. 6], 58; cf. idem, "Encyclopedia of Abraham Savasorda" [above, n. 20, 263-4).

³² See above, n. 2.

mathematics and perhaps natural science. These readers, it seems likely, would have sought out first the sections of the encyclopedia dealing with mathematics, and these would have been the most copied. In any case, these parts of the encyclopedia on mathematics and geometry offered the Hebrew reader a knowledge of these subjects that was not available elsewhere and that, in some respects, was more than they could have attained had they been able to consult the available Latin translations of the mathematical writings. On the other hand, it is, at least, a possibility that the sudden appearance in the twelfth century of Latin translations of the works of Aristotle and others on logic and natural science could have reduced the need for the corresponding sections of Bar Ḥiyya's encyclopedia and thus diminished their popularity.

While there is no basis to say that Bar Ḥiyya completed his planned encyclopedia, it should be borne in mind that he had broader interests than those of a mere translator, and that these interests could well have moved him to complete the work. His description of the goals of the encyclopedia shows both his conviction that all sciences convene in one single truth, and his desire to transmit this comprehensive view to his contemporaries. Bar Ḥiyya's mind was certainly that of a scholar concerned about every single issue relevant to human knowledge. It was the mind of a true encyclopedist, whose fields of interest were as broad as human knowledge itself. It was through the study of all these sciences that man could attain his perfection. Thus, while Scripture, in the passage from Jeremiah interpreted by Bar Ḥiyya in his introduction, does not permit one to be praised for the qualities of the soul dealing with scientific knowledge, it was, nevertheless, unquestionably lawful for one to dedicate one's time to its study.³³

Abraham bar Ḥiyya was the first to undertake the task of writing a Hebrew encyclopedia of science. Regardless of whether or not he actually finished his encyclopedia, there is no doubt that the part of the text that has been preserved, particularly in light of the rest of his scientific works and translations, has secured for him an honored place in the history of encyclopedias of science in general, and in the history of Hebrew encyclopedias of science in particular.

³³ *Yesodei*, 8-9, 30-2.