

THE INCORPORATION OF PRE-MODERN SCIENTIFIC THEORIES INTO BIBLICAL LITERATURE: THE CASE OF INNATE HEAT

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INTRODUCTION

Rabbinic commentators throughout the ages utilized many disciplines of human knowledge for their exegetical enterprise in the hope of achieving optimal textual and legal clarification. For passages that explicitly refer or allude to anatomical or physiological notions, commentators often drew upon contemporaneous medical and scientific theories to enhance or supplement their understanding of a passage. While the methodology of employing scientific theories for rabbinic exegesis is ubiquitous throughout the centuries, the particular theories used are a product of the exegete's generation. Only a knowledge of medical history can assist the reader in understanding an author's application of scientific teachings in his commentary.

This essay deals with one unique pre-modern physiological notion, the doctrine of innate heat, which finds its expression throughout rabbinic literature. After providing a brief overview of this physiological principle, I will provide examples of rabbinic passages of biblical exegesis in which it has been employed. This exercise illustrates how an understanding of medical history can be a valuable supplement for the study of biblical literature.¹

THE DOCTRINE OF INNATE HEAT

Since the beginnings of scientific inquiry, research efforts have focused on defining the unique physiological properties of warm-blooded animals and, in particular, the human being. One such fundamental property is the ability of the human being to maintain core body temperature despite fluctuations in the outside environment. This principle, in conjunction with the movement of

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the blood and the passage of air during respiration, has always served as a cornerstone of physiology.

While a corpse soon accommodates its temperature to that of its surrounding environment, a living being succeeds in maintaining body temperature with only very slight variability. What accounts for this remarkable phenomenon? We now understand the origin of the body's heat on a molecular level, being generated by the interplay of multiple complex biochemical reactions. But how did the pre-modern scientist, unequipped with a microscope and ignorant of biochemistry, microbiology and cellular physiology, explain this phenomenon?

In order to account for the body's ability to maintain a temperature above its environment, scientists of antiquity postulated the presence of a heat source within the body. As the exact nature of this heat was elusive, intense debates regarding its identity, quantity, and regulation raged on for centuries.² It must be understood, however, that innate heat is but one piece of the complex puzzle of human cardiac and respiratory physiology as understood in antiquity.

While many theories evolved in early antiquity to explain the different aspects of innate heat,³ the formulation of Galen (second century C.E.), who incorporated aspects from, among others, Hippocrates⁴ and Aristotle, superseded those of his predecessors. Galen's theories of human physiology, including innate heat, remained prevalent, with only minor variations, into the eighteenth century. According to Galen, heat is the most important element in the body, facilitating the existence of life. Innate heat is housed within the heart⁵ where the heat is the greatest,⁶ and from where the heat is disseminated to the rest of the body.⁷ By means of this innate heat all the major physiological functions of the body are accomplished, including growth, digestion and production and regulation of the humors. Regarding the regulation of innate heat, Galen maintained that the heat must be cooled and contained by respiration if the source of life is to persist, for in the absence of this cooling mechanism, the heat will consume itself, and the person will die.⁸

BIBLICAL COMMENTARIES

The doctrine of innate heat, a physiological notion universally accepted until recent times, is mentioned in a number of areas of rabbinic literature, and is variously referred to as *hom ha-tiv'i*, *hom ha-toladi*, and *hom ha-lev*. In

INNATE HEAT

this essay, we focus, in a chronological fashion, on the doctrine of innate heat as found in biblical commentaries.

THE CREATION OF MAN

The second account of the creation of man reads, *And the Lord God formed man of the dust of the ground, and breathed into his nostrils the breath of life; and man became a living soul* (Gen. 2:7). While most commentaries on this verse focus on the process by which man received his soul, Abraham Ibn Ezra addresses the relationship between the nostrils and the creation of life: "The reason it says 'into his nostrils,' for it is by their virtue that man lives. They remove the warm air from the [innate] heat of the heart, and replace it with other air." As described above, respiration of air through the nostrils was thought to be essential for the cooling and regulation of the innate heat of the heart. If this cooling mechanism failed, it was believed that the innate heat would consume the body.

This comment of Ibn Ezra was cited by Zevi Ashkenazi (?1660-1718), known as Hakham Zevi, in his famous responsum on the halakhic status of a chicken that was found to be lacking a heart,⁹ and is an example of the application of homiletic exegesis to the realm of halakhah. In this responsum of Ashkenazi which emphasizes the physiological and halakhic importance of the heart, the understanding that the heart is the center of the innate heat figures prominently in the discussion, and many of Hakham Zevi's prooftexts regarding the centrality of the heart, including that of Ibn Ezra, rely on this physiological notion. This particular responsum has been applied to the contemporary halakhic debate regarding the definition of death,¹⁰ an area where a medical historical analysis of the rabbinic sources can be particularly helpful.¹¹ The aforementioned interpretation of Ibn Ezra, as quoted by Ashkenazi, also appears in other modern responsa.¹²

Returning to the homiletic realm, the aforementioned verse regarding the creation of man was adapted by the prophet Isaiah in the following statement: *Cease from man, though his breath be in his nostrils* [neshamah be-apo] *for in what is he to be accounted of?* (Isa. 2:22). In his commentary on this verse, David Kimhi explains it along the same vein as did Ibn Ezra: "and it says 'in his nostrils' because the spirit [*ruah*] of life depends on the nose. It is through

the nostrils that innate heat of the heart exits, and likewise it is through the nostrils that the cooling air enters."¹³

THE FAINTING OF JACOB

Upon hearing that his son Joseph was still alive, Jacob's response was dramatic:

And they told him, saying, Joseph is still alive, and he is governor over all the land of Egypt. Vayafag libo, for he believed them not. And they told him all the words of Joseph which he had said to them. And when he saw the wagons which Joseph had sent to carry him, the ruah of Jacob their father revived (Gen. 45:26-27).

Rashi explains the phrase "*vayafag libo*" to mean that Jacob turned his heart away in disbelief, but after seeing the wagons and realizing the truth, the power of prophecy, or the presence of the *Shekhinah* (i.e., *ruah*) was rekindled within him. According to *Siftei Hakhamim*, Rashi was compelled to interpret the phrase to mean that Jacob regained his powers of prophecy because the word *ruah* is used, and this word, in other contexts, refers to prophecy. Nachmanides, as we will see, does not feel bound by the same definitional constraints and interprets the term *ruah* differently.

This exegetical debate is an example of a larger problem regarding the ambiguous definition of the term "spirit," and its Hebrew analogue, "*ruah*." G.J. Goodfield notes that in the history of medicine the word "spirits" could at one and the same time mean a gas, a volatile fluid, a soul, an animating principle, something which was the cause of nervous energy in the animal, something which was the cause of its being alive, and something which when mixed with various other substances was the cause of heat in the animal.¹⁴

The term had material and immaterial, descriptive and explanatory implications. Goodfield further quotes Aristotle, who clearly acknowledges the ambiguous usage and nature of the word. A similar ambiguity exists with the usage of the analogous word "*ruah*" in Hebrew. For example, Maimonides details the multiple meanings of the word.¹⁵

Returning to the interpretation of the biblical passage, Nachmanides argues for a different etymology for the word "*vayafag*," meaning cessation or arrest, as well as for the word "*ruah*." With these different meanings, he advances the following novel interpretation:

INNATE HEAT

. . . likewise here *vayafag libo* means that his heart arrested and his breathing ceased, for the heartbeat stopped and he appeared as dead. . . . And it is mentioned in the medical books that the elderly and infirm often faint when confronted with a sudden surprise. The heart expands and suddenly opens, the natural heat [*hom ha-toladi*] escapes and dissipates, and the heart, thereby cooled, ceases activity. The aged man then collapses as if dead. And it says "for he believed them not," to indicate that he remained unconscious for a long time because he did not believe them. For it is known that the treatment for this type of fainting is to shout at him and accustom him to the surprise until he is calmed. This is why it says "and they told him all the words of Joseph, which he had said to them. And when he saw the wagons which Joseph had sent to carry him. . . ," for they were shouting into his ears the words of Joseph and bringing before him the wagons. Only then was his respiration [*ruah*] restored and he awoke and regained consciousness, as it says, "the *ruah* of Jacob their father revived."¹⁶

Here Nachmanides applies the physiological principle of innate, or natural, heat (i.e., *hom ha-toladi*) to provide what, in his opinion, is the most logical and literal interpretation of the passage.¹⁷ The sudden surprise caused the dissipation of innate heat, which resulted in Jacob's fainting. Only with the auditory and physical stimulation of his sons did Jacob regain consciousness. Nachmanides interprets the phrase, "*vatechi ruach Yaakov*" in a very literal sense – his breathing was restored and he was revived. Parenthetically, Maimonides, in his commentary on Galen entitled *Pirkei Mosheh*, devotes a section to the causes of fainting wherein he also notes that the surprise mention of good news can lead to the dissipation of innate heat.¹⁸

THE AGING AND ILLNESS OF KING DAVID

The Book of Kings opens with an account of the aging of King David, and states that, despite his layered clothing, *he could not become warm* (I Kg. 1:1). In his commentary, David Kimhi attempts to explain the nature of King David's deficiency of heat and makes the following comment: "In his old age he became infirm and bedridden. . . and as long as the aging process progresses, the innate heat [*hom ha-tiv'I*] continues to diminish, therefore,

and they covered him with clothes, but he could not become warm." This notion of the diminution of innate heat with age was a commonly held belief.

Mezudat David (eighteenth century) understands King David's illness in the same vein, and uses this to explain why Avishag the Shunammite was present in the King's quarters when Bathsheba paid him a visit. "Lest we think that she [Bathsheba] came to lie with the King, it says, 'and the king was very old.' His innate heat had diminished, and Avishag was serving the King by providing warmth."¹⁹

RESUSCITATION EPISODES OF ELIJAH AND ELISHA

There are two accounts of resuscitation in Tanakh, both performed by prophets, with the actual resuscitation procedures being similar. The first was performed by Elijah on the son of the widow of Zarephat: *And he stretched himself upon the child three times, and cried to the Lord and said, 'O Lord my God, I pray thee, let this child's soul return to him again,' and he revived* (I Kg. 17:21-22).²⁰

The second was performed by Elisha on the son of the Shunammite woman:

And he went up, and lay upon the child, and put his mouth upon his mouth, and his eyes upon his eyes, and his hands upon his hands and he stretched himself upon the child; and the flesh of the child was warmed. Then he returned, and walked in the house to and fro; and went up, and stretched himself upon him and the child sneezed seven times, and the child opened his eyes (II Kg. 4:34-35).

While many have drawn upon our modern understanding of physiology and resuscitation in order to shed light on these episodes,²¹ I would like to focus on how the pre-modern commentator understood the strange maneuvers of Elijah and Elisha. While the miraculous element of both resuscitations seems clear, David Kimhi suggests that the method of resuscitation was chosen so that these miracles, like others in Tanakh, would have some basis in the natural world order.²² He therefore posits, based on his contemporary understanding of nature, that the prophets positioned their mouths against those of the victims in order to transmit their innate heat, via respiration and exhalation, into the victims' lifeless bodies. The inspired air was thought to travel directly

INNATE HEAT

to the heart, where it came in contact with the innate heat. When the air was released during exhalation, it was now a higher temperature, having been warmed by the heat of the heart. As innate heat is required for the generation and preservation of life, the method employed by both Elijah and Elisha represents, according to Kimhi, a natural physiological basis for resuscitation upon which the miracle was based.

THE HEALING OF NA'AMAN FROM ZARA'AT

Na'aman, the military commander for the king of Aram, is one of a few specific people mentioned in Tanakh as being stricken with the disease of *zara'at*.²³ While *zara'at* is mentioned many times throughout Tanakh, there is one literary aspect of the story of Na'aman which attracted the attention of biblical commentaries. The discussions of *zara'at* in Leviticus focus largely on the diagnosis of the disease, while the story of Na'aman focuses on its treatment. Throughout the passage in II Kings, the enigmatic word *asaf* is consistently employed to refer to the cure for *zara'at*, [*va-asafto mi-zara'ato* (5:6), *le-esof ish mi-zara'ato* (5:7), *ve-asaf ha-mizora* (5:11)].

The usual term for healing is *le-rapot*, not *le-esof*. Both Rashi and Radak explain the usage of the verb *asaf* based on the unique social and halakhic dimensions of the disease of *zara'at*. The word *asaf* means to gather, or be gathered. When stricken with *zara'at*, a person is ostracized, both socially and physically, from the camp of Israel. Once cured, the person can now return to the camp, and again gather with his people.²⁴

Ralbag, in the fourteenth century, also contends that the cure for *zara'at* is unique, and therefore merits the use of a verb other than *le-rapot*. However, his justification for the use of the verb *asaf* is based on the physiological, rather than halakhic or social, uniqueness of the disease:

The cure for *zara'at* is called *asifah* because *zara'at* makes from one, many. The domination of the putrid fever or heat [*hom ha-ipushi*] weakens the innate heat, which is normally responsible for binding and unifying the limbs of the body. Consequently, in the *mezorah* [who lacks this unifying force] we often find that their limbs fall off. Therefore [Elisha] says, regarding the healing, that "thy flesh shall be restored to thee, and thou shalt be clean," for the

mezora lacks the substance or power which normally allows the flesh to adhere to the body.²⁵

Ralbag operates with the premise, which was widely accepted throughout history, that biblical *zara'at* was identified as leprosy. He therefore applies the principles of the pathology of leprosy, as understood in his time, to the explanation of this abnormal verb usage. The notion that leprosy was in part due to the decline of the unifying and adhesive force of the innate heat was already advanced by Galen.²⁶

CHEESE ANALOGY OF JOB

Nestled among the conversations of Job we find a number of metaphors for the creation of man: *Remember, I beseech thee, that thou hast made me like clay; and wilt thou bring me back to dust? Hast thou not poured me out like milk, and curdled me like cheese?* (Job 10:10). In his commentary on this verse, Ralbag applies the physiological principle of innate heat in order to explain the cheese analogy, stating that the innate heat found in the seed of the male congeals or solidifies the seed of the female with which it comes into contact.

This analogy of the formation of the human embryo to the process of making cheese was already advanced by Aristotle:

The action of the semen of the male in setting the female's secretion in the uterus is similar to that of rennet upon milk. Rennet is milk, which contains vital heat, as semen does. . . . As the nature of milk and the menstrual fluid is one and the same, the action of the semen upon the substance of the menstrual fluid is the same as that of rennet upon milk.²⁷

Isaac ben Sheshet, in the fourteenth century, is aware of the Greek origins of the cheese analogy, and, in fact, comments that this physiological understanding is in contradiction to rabbinic teachings which state that both the male and female contribute material to the fetus.²⁸ I therefore assume that Ralbag thought otherwise, else he would not have used it in his commentary.

CONCLUSION

The understanding of the use of the doctrine of innate heat enhances our understanding of rabbinic biblical interpretation in a number of ways. On the

microcosmic level, it helps explain passages that heretofore may not have been fully understood. On the macrocosmic level, it reveals the breadth of the biblical commentators in their integration of scientific theory into their works. The doctrine was consistently applied, in numerous cases, by the most prominent of exegetes. In addition, the thematic, literary and etymological ways in which the doctrine was applied is a testimony to rabbinic creativity.²⁹

This article illustrates the importance of medical history for the study of rabbinic literature and contributes to the continued discourse regarding the approach to passages in rabbinic literature where the scientific information differs from that of our modern understanding.

NOTES

1. This article is adapted from the author's "The Incorporation of Early Scientific Theories into Rabbinic Literature," *The Torah U-Madda Journal* 8 (1998-1999) pp. 181-199. For other studies by this author on the interface between medical history and rabbinic literature, see "The Halakhic Definition of Death in Light of Medical History," *The Torah U-Madda Journal* 4 (1993) pp. 148-74; E. Reichman and Fred Rosner, "The Bone Called Luz," *Journal of the History of Medicine and Allied Sciences* 51:1 (January, 1996) pp. 52-65; "The Rabbinic Conception of Conception: An Exercise in Fertility," *Tradition* 31:1 (Fall 1996) pp. 33-63; "A Tale of Two Stones," *BD'D* 5 (Summer 1997) pp. 33-40; "The Impact of Medieval Medicine on Medical Halakha: The Case of Mumia," in Fred Rosner, ed., *Pioneers in Jewish Medical Ethics* (Jason Aronson, 1997) pp. 27-52; "Ovarian Transplantation: The Halakhic Precursor to Surrogate Motherhood," *Tradition* 33:1 (1998) pp. 31-70.

2. For discussions on innate heat, see C. R. S. Harris, *The Heart and the Vascular System in Ancient Greek Medicine* (Oxford, 1973), esp. pp. 374-78; Margaret Tallmadge May, *Galen on the Usefulness of the Parts of the Body* (Ithaca, 1968) pp. 50-54; G. J. Goodfield, *The Growth of Scientific Physiology: Physiological Method and the Mechanist-Vitalist Controversy, Illustrated by the Problems of Respiration and Animal Heat* (London, 1960); David J. Furley and J. S. Wilkie, *Galen on Respiration and the Arteries* (Princeton, 1984) pp. 3-46. Regarding the relationship of innate heat to the understanding of fever, see Iain M. Lonie, "Fever Pathology in the Sixteenth Century: Tradition and Innovation," in W. F. Bynum and V. Nutton, eds., *Theories of Fever from Antiquity to the Enlightenment* (London, 1981) pp. 19-44.

3. D. J. Furley and J. S. Wilkey, pp. 3-40.

4. It is now accepted as fact that the Hippocratic corpus does not represent the work of one man, but is rather the collection of a group of disparate, and occasionally contradictory, works penned by multiple authors, but related in theme. As a result, since the works of Hippocrates are not unified, it is not always possible to say that there is one Hippocratic theory on a particular topic. D. J. Furley and J. S. Wilkey (pp. 11-14) grapple with this problem in their discussion of the Hippocratic theories of respiration and innate heat.

5. M. T. May, pp. 52-53. More specifically, the heat was thought to reside in the left ventricle. Galen accepted this notion from Hippocrates. See G. E. R. Lloyd, ed., *Hippocratic Writings* (Middlesex, 1978) p. 349.

6. The heart, in fact, does not have a higher temperature than the rest of the body, but this notion persisted until it was disproved by Alfonso Borelli in the seventeenth century with the use of a thermometer. See M. T. May, p. 53.
7. The mechanism of dissemination throughout the body is itself a matter of debate, as it depends upon how one understands the constitution of the blood vessels and arteries, and the interrelationship between respiration and circulation. As circulation was not clearly understood until the time of Harvey (seventeenth century), the function and identity of the veins, arteries and nerves was not agreed upon. Furthermore, many believed that air passed through the vessels, either in conjunction with or to the exclusion of blood. For extensive discussion of these issues see C. R. S. Harris, D. J. Furley and J. S. Wilkey.
8. M. T. May, p. 51.
9. *She'elot u-Teshuvot Hakham Zevi* #77.
10. See, for example, M. D. Tendler, *Responsa of Rav Moshe Feinstein: Care of the Critically Ill* (Hoboken, 1996) p. 75. R. Tendler is sensitive to the medical historical context of the responsum of R. Ashkenazi.
11. See E. Reichman, "The Halakhic Definition of Death in Light of Medical History," above, n. 3.
12. I. J. Weiss, *She'elot u-Teshuvot Minhat Yizhak* 9:120.
13. See also Radak to Jeremiah 2:24, where R. Kimhi applies the same physiological explanation to another verse similar to Genesis 2:7.
14. (above, n. 4), pp. 18-19.
15. *Guide for the Perplexed* 1:40. For the usage in rabbinic literature of the words *ruah*, *neshamah* and *nefesh*, which are plagued with ambiguity and often used interchangeably, see Samuel S. Kottke, "The Seat of the Soul: Contribution to the History of Jewish Medieval Psycho-Physiology," *Clio Medica* 13:3-4(1978) pp. 219-46.
16. *Commentary on the Torah*, Genesis 45:26. Rabbenu Bahya, *ad loc*, repeats the same interpretation as his teacher, Nachmanides, and uses this physiological explanation of the fainting associated with surprise to explain a passage in *Ketubot* 62b.
17. While our current understanding of the mechanism of fainting, or syncope, may differ from that of Nachmanides, this does not preclude acceptance of his basic interpretation that Jacob fainted and was revived.
18. See Suessmann Muntner, ed., *Rambam: Kitvei Refuah* 2 (Jerusalem, 1961). The section devoted to the causes of fainting begins on p. 92, and the relevant passage appears on p. 114, at n. 32. Maimonides makes no reference there to this story of Jacob, but, then again, there are few, if any, biblical or halakhic references in his medical works.
19. *Mezudat David* on 1 Kings 1:14-15.
20. There is debate amongst the commentaries whether the child had actually died, or whether his condition was so grave that he appeared to be dead but was, in fact, barely alive. See, for example, Radak, *ad loc*; Maimonides, *Guide for the Perplexed* 1:42; *She'elot u-Teshuvot Hatam Sofer*, *Yoreh De'ah* #338. *Targum Yonatan* implies that the child may not have died, and Josephus (*Antiquities* 8, 13:3.325) is explicit in saying that the child's illness was so severe that he "ceased to breath and seemed to be dead." This debate has a number of halakhic ramifications. According to rabbinic tradition, Elijah was thought to be the embodiment of Pinhas. As Pinhas was a *kohen*, it is logical to assume that this distinction would have likewise been conferred upon Elijah. If he was, in fact, a *kohen*, it would have been forbidden for him to come into contact

INNATE HEAT

with a corpse. How, then, could he have performed the resuscitation? This issue is addressed in *She'elot u-Teshuvot ha-Radbaz* #2203. Furthermore, this discussion impacts on the halakhic definition of death. See *She'elot u-Teshuvot Hatam Sofer*, cited above. For a discussion on how an understanding of medical history impacts on the halakhic definition of death, see my "The Halakhic Definition of Death," above, n. 1.

21. F. Rosner, "Artificial Respiration in Biblical Times," *New York State Journal of Medicine* 69:8 (April 15, 1969) pp. 1104-05; Z. Rosen, "Rhinological Aspects of Biblical Resuscitation," *Archives of Otolaryngology* 95:5(May, 1972) pp. 488-89; Z. Rosen and J. Davidson, "Respiratory Resuscitation in Ancient Hebrew Sources," *Anesthesia and Analgesia* 51:4 (July-August, 1972) pp. 502-05; L. Wislicki, "A Biblical Case of Hypothermia-Resuscitation by Rewarming (Elisha's Method)," *Clio Medica* 9:3 (September, 1974) pp. 213-14; R. B. Howard, ". . . And There is Nothing New Under the Sun," *Postgraduate Medicine* 65:3(March, 1979) p. 25; J. H. Comroe, Jr., ". . . In Comes the Good Air," *American Review of Respiratory Diseases* 119:6 (June, 1979) pp. 1025-31; A. S. Abraham, "Hanshamah Melakhutit bi-Tanakh," *Ha-Ma'ayan* 28:3 (Nisan, 5748) pp. 72-76; J. A. Paraskos, "Biblical Accounts of Resuscitation," *Journal of the History of Medicine and Allied Sciences* 47:3 (July, 1992) pp. 310-21.

22. See *Radak* on I Kings 17:21 and II Kings 4:34.

23. I intentionally do not identify *zara'at* with the disease known today as leprosy, or Hansen's disease, because the biblical *zara'at* is clearly a disease of a different nature. The bibliography on the exact medical definition of *zara'at* is extensive and continually growing. See A. D. Rabino-witz and Bezalel Naor, "The Medical Aspects of Zara'at: Selected Bibliography," *Orot* 1(1991) pp. 30-32, for a sampling.

24. See their commentaries to II Kings 5:6 and II Kings 5:3 respectively.

25. See his commentary to II Kings 5:6. Translation by the author.

26. See A. J. Brock, trans., *Galen: On the Natural Faculties* (London, 1916) p. 41.

27. A. L. Peck, trans., *Aristotle: Generation of Animals* (Cambridge, 1942) pp. 739b, 21-29. For more on the cheese analogy see J. Needham, *A History of Embryology* (New York, 1959) pp. 26, 50, 64, 66, 76, 82-85; C. R. S. Harris, (above, n. 4) p. 139.

28. *She'elot u-Teshuvot ha-Rivash* #447.

29. For other examples in biblical exegesis, see *Ralbag* on II Samuel 2:23 and 20:10, Proverbs 17:22 and 25:25, and Job 31:40; *Mezudat David* on Job 41:10-11.

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