Immovable Giants?

Rabbinic Approaches to Science and Jewish Law

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Contradictions abound between modern scientific discoveries and knowledge and the principles and laws of the Jewish tradition. Ranging from divergent views about the age of the universe, to the *halakhic* versus scientific definition of death and its impact upon the permissibility of organ donation, to the contentious issues of stem cell research, abortion and cloning, science and Jewish law often emerge at odds with one another. Are these issues reconcilable? Is there any precedent for dealing with contradictions of this nature? If so, what types of approaches and resolutions fall within the gamut of normative Jewish tradition?

These kinds of discrepancies and contradictions between science and Jewish tradition are nothing new. The history of interaction between the Jewish tradition and the natural world is, in fact, long and complex. From the rabbinic period, to Medieval Europe, and through the Early Modern and Modern eras, a wide variety of approaches has been championed by different Jewish figures to address the challenges that the scientific world poses to Judaism. Ranging from complete rejection of scientific knowledge to complete acceptance even in face of conflicting Jewish traditions, Jewish thinkers have adopted a wide range of views to cope with the apparent conflicts between science and religion.

One especially significant aspect of this multifaceted history is the impact that new scientific knowledge has on one of the foundations of Judaism, the *halakhic* (Jewish legal) system. How is scientific progress reconciled within the framework of Torah? What happens when Jewish law or rabbinic descriptions come in conflict with science? What happens, for example, to the law that one may kill lice on Shabbat because they spontaneously generate, in an age when spontaneous generation has been proven false? Or to the view that a baby born after eight months is an invalid and his life may not be saved if it involves desecration of the Sabbath, while a baby born after seven or nine is viable, in light of modern science and medicine in which this ancient biological theory has been rejected? In addressing these questions, four different approaches that characterize traditional rabbinic responses to this dilemma will be elucidated. In addition, when notable, the broader historical context will be considered in order to develop a better understanding of the issues that the rabbis faced and the context in which their responses developed.

The views of two important Jewish thinkers can serve as background to some of the issues underlying the relation between scientific progress and *Halakhah*. Maimonides, writing in Egypt in the thirteenth century, writes in his *Mishneh Torah Hilkhot Yesodei HaTorah* 9:1, "It is a clear and explicit matter in the Torah that it [the Torah] is a commandment that stands for all eternity, and is not subject to being changed, subtracted from or added to etc." Similarly, in *Hilkhot Melakhim* 11:3, he writes, "And the essence of the matter is as follows: This Torah, its laws and its statutes, are eternal." In these passages, he echoes the beliefs of Saadya Gaon, who in the tenth century described in his classic philosophical treatise *Emunot v'Deot* the impossibility of any part of the Torah ever being annulled.[1]

However, both Saadya and Maimonides go further than just postulating the permanence of the Torah corpus; they extend the argument to include the immutability of nature in general and of man in particular. Saadya, in the context of a discussion of miracles, writes, "We must believe that all that is in

existence the Creator will not change unless He first announces such."[2] In his philosophic work, *Moreh Nevuchim*, Maimonides expands upon this idea in reference to the nature of man, explaining:

> The nature of man is never changed by God by way of miracle… I do not say this because I believe that it is difficult for God to change the nature of an individual person; on the contrary, it is possible, and it is in His power. However, it has never been His will to do it, and it never will be, according to the principles taught in Scripture…[3]

Earlier in *Moreh Nevuchim*, he addressed the question of miracles and nature, writing:

> Our opinion…is clearly established, namely, that no prophet or sage has ever announced the destruction of the Universe, or a change of its present condition, or a permanent change of any of its properties…We have thus clearly stated and explained our opinion, that we agree with Aristotle in one half of his theory. For we believe that this *Universe remains perpetually with the same properties with which the Creator has endowed it, and that none of these will ever be changed* except by way of miracle in some individual instances.[4]

Thus, Maimonides and Saadya spell out very clearly their views that Torah and nature are rigidly fixed, with seemingly little flexibility. Thus, the question of the relationship between science and Torah—specifically the impact of scientific developments on *Halakhic* adjudication—is even more difficult. If neither Torah nor nature changes, what room is left for reconciliation when discrepancies do emerge between the two?

I. The Incontrovertibility of the Torah and the Sages

In light of the clear statements of Saadya and Maimonides, the simplest approach would seem to be to ascribe absolute truth to the words of Torah, both in its elucidation of laws and its presentation of scientific facts. Thus, when a conflict emerges between what scientific theories indicate and what

the Torah relates, it would seem that one must side with the Torah and uphold its pristine divinity. By extension, *Hazal*, the Rabbinical sages, who are considered to be in possession of traditions dating back to Sinai and thus the authoritative interpreters of Scripture, must likewise be considered infallible. Their incontrovertible authority is established by virtue of the dictate "*lo tasur min ha'davar asher yagidu lekha yamin u'semol*,"[5] which the fourth century C.E. *Midrash Halakhah Sifrei* (ad loc.) interprets as "even if it seems to you [that they say] that left is right and right is left, you shall listen to them." From this sweeping mandate of *Sifrei*, it would seem that the statements of *Hazal* must be taken as veridical even in face of contrary scientific knowledge.

This approach, negating scientific wisdom in the face of scriptural or rabbinic statements, is explicated clearly in writing as early as thirteenth century Spain. The *Mishnah* in *Chullin* 3:1 states, "The following are *tereifot* [unfit to eat] in animals…this is the rule, any animal the likes of which cannot live is a *tereifah*." The *Gemara* comments that the general rule of the *Mishnah* refers to an animal living twelve months, and Rashi, the famous eleventh-century Biblical and Talmudic commentator explains that if it lives longer, you know, perforce, that it is not a *tereifah*. In the mid-thirteenth century, Rashba (Rabbi Shlomo ben Aderet of Barcelona) was asked about the law in a case in which an animal with one of the signs of a *tereifah* was seen to live more than a year. In his *Responsa*, Rashba embarks on a sharp polemic against such a claim. He writes that one who claims that he has seen a *tereifah* living more than a year "casts aspersions on the words of the Sages" and we deny his testimony. "May the testifier and a thousand like him be nullified," Rashba writes, "and let not even a dot of that which has been agreed upon by the Sages of Israel, the holy ones, prophets and sons of prophets, and the things which were said to Moses at Sinai be nullified.[6] Rashba clearly rejects the ability of empirical facts contrary to *halakhic* conceptions to influence the law. Instead, he insists on upholding the integrity of *Hazal* and denying contravening facts.[7]

II. Nature has Changed

However, not all rabbis were willing to be so forceful in their dismissal or denial of science. Rabbi Yosef Bekhor Shor,[8] writing in Northern France in the late twelfth century, was willing to concede that certain scientific statements of *Hazal*, specifically in regard to *tereifot*, were proven wrong by more recent scientific knowledge. However, still wishing to uphold the infallibility of *Hazal*, he took a median pathway; he invoked the concept of *hishtanut ha'tevaim*, changes in nature. This second approach postulates that nature has changed between the time that the Torah was written and interpreted by *Hazal* and the current generations. Thus, *Hazal* were correct at the time in which they wrote, but the empirical facts have changed since their time to yield the world that contemporary science now perceives. Indeed, Bekhor Shor asserts here what is the most widespread approach taken by classical rabbinic authorities throughout the generations, and one first popularized by his teachers, the Tosafists, in the early twelfth century.[9]

Three hundred years later, in the fifteenth century, Rashbash (R. Shlomo ben Shimon Duran of Algiers) took the approach of the Tosafists one step further; he wrote that their approach can be taken in any instance of a contradiction between science and *halakhic* precedent and applied to *halakhah l'maaseh*, i.e. as a basis for changing the preexisting law. The *Gemara* in *Niddah* 27a[10] posits that under normal circumstances a woman gives birth to children after either 271, 272 or 273 days (i.e. end of the ninth month.) Alternatively, the *Gemara* indicates, there is a seven-month track for gestation after which a woman could also give birth to a viable baby. Any baby born between the end of the seventh and the end of the ninth month, however, is considered an invalid, a designation with many *Halakhic* ramifications.[11] This view was a widely believed phenomenon in the times of *Hazal*, reflected already in the works of Aristotle and Galen.[12] Rashbash, seeing in his own time that this was clearly a scientifically flawed view, wrote:

> Many have wondered about this because the senses contradict this and experiments have shown the opposite to be true. Many women that enter [even] one day into the ninth month give birth to valid offspring, and also, not all women complete nine months…and the Tosafists wrote that this was in earlier generations but nowadays matters have changed[13]…and likewise many matters that *Hazal* discuss that we find to be different…[therefore] if we find a different reality nowadays, should we not change the law accordingly?![14]

He thus acknowledges the array of discrepancies that emerge between the writings of *Hazal* and those of contemporary scientists, and utilizes the approach of *hishtanut ha'tevaim,* changes in nature, as a general precedent.[15]

Although change in nature represents a widespread solution to the problem of science contradicting *Hazal*, this approach engenders its own set of difficulties. Fundamentally, it is difficult to accept the theory that large-scale changes in nature occurred in such a short time span. Geologically, a thousand years is like the blink of an eye, and changes of the magnitude considered would require a speed of evolution never observed by scientists. These intellectual difficulties may have been an important factor that led many rabbis to reject this approach, or to limit its application as much as possible. Rabbi Yaakov Emden, an eighteenth-century German rabbi, rejects the approach of the Tosafists and suggests an alternative to resolve the contradiction in question. He writes:

> We may resolve the question of Tosafot…who answered in a strained manner that the generations have changed…For I say that we do not have to conclude this; in truth, nature has not changed in this matter. Rather, because it is uncommon [for cows to give birth under the age of 3] and we follow the majority etc.[16]

At least in this matter, Emden avoids relying on this "strained" approach and finds an alternative, case-specific solution.

III. The Sages are Fallible in their Scientific Knowledge

However, the question remains: how would Emden respond to cases that truly present irreconcilable differences? In addressing this question, a third general approach can be seen that is offered in a number of different contexts. Emden's father, Zvi Ashkenazi, better known as Hakham Zvi, was widely considered one of the leading authorities of his generation in the Ashkenazi world. He received *halakhic* questions from Jews all over, and published his responses to the queries. On one occasion, he was asked by a young woman about the *kashrut* status of the chicken that she was preparing—was it, or was it not, kosher according to *halakha*? The woman had been cleaning the innards of the chicken when she realized that the chicken lacked a heart. Fearing that this would qualify the animal as a *tereifah*, she consulted Hakham Zvi as to the chicken's *halakhic* status. Apparently, by the time he published his responsum the question had already stirred up some controversy because he begins by arguing against those who "errantly" forbid the chicken. He claims:

> All those that say so [that the chicken is forbidden] are in error. For it is clear to anyone that has a wise heart in his innards or a brain in his skull that it is impossible for any creature in the world to live even a short time without a heart…[17]

In effect, Hakham Zvi is taking what he knows to be a scientific reality and imposing its dictates upon the *halakhic* system. He refuses to admit to the possibility of such an animal's survival, especially in the perfect health to which the woman attested, and goes so far as to say "even if witnesses come and testify that it did not have a heart, we say they are false witnesses, and we view them as if they were not scrupulously watching through the entire duration."[18]

A look at the broader historical context may shed light on Hakham Zvi's repeated insistence, through an ongoing exchange and multiple *responsa*, on permitting the chicken, adamant that no animal could live without a heart. Although his *responsum* is written in very traditional style and he quotes numerous rabbinic predecessors about the centrality of the heart as the center of

the *ruach hiyuni*, the force of vitality, an important historical development must be noted. Years before Hakham Zvi published his response in the early 1700's in Amsterdam, William Harvey, a famous scientist in London, had proved the role of the heart in blood circulation in 1628.[19] Hakham Zvi had spent time in London in the course of his many travels,[20] and thus was likely aware of the new scientific developments. Thus, although it is possible that he is merely revisiting the ancient debate between Aristotle and Galen about the primacy of the heart and siding with Aristotle according to whom the heart was the seat of intelligence, his rigid insistence on the matter seems to indicate otherwise. It may be for this reason that he writes in a follow-up *responsum*:

> I reasoned that no man who is called wise would so much as doubt the fact that every living physical creature is dependent upon his heart, without which he could not survive, and therefore I wrote in brief in my first responsum. However, I have seen that some of the wise men of this land are doubtful of the matter and I have thus seen it fitting to elaborate on my intention and to remove all doubt that has been expressed against my responsum by a certain wise man…[21]

What emerges from the ruling of the Hakham Zvi is a willingness to use scientific observation in the determination of *halakhah.* It is not clear, however, if he thought that he was adjudicating in blatant contradiction to the dominant rabbinic opinion as he was accused of doing. What is clear, however, is that precedent for such a bold approach exists and dates back at least to the twelfth century to the writings of Maimonides. Maimonides clearly adopts this third approach of dealing with contradictions that arise between scientific observations and rabbinic statements. Thus, in a now famous passage in *Moreh Nevuchim*, Maimonides writes:

> Do not ask me to harmonize everything that they [*Hazal*] said regarding matters of astronomy with true reality, because the sciences in that time were lacking and their [*Hazal's*] statements were not based on the authority of the Prophets, but on their own understanding as knowledgeable men of the generation or on knowledge that they heard from contemporary scientists.[22]

Maimonides clearly concedes that the Rabbinic sages had no divine traditions in scientific matters and their science could be ignored in light of newer discoveries.[23] While Maimonides in this passage refers specifically to questions of astronomy, his son, Rabbi Abraham, elaborates upon the opinion of his father and explains:

> We are not obligated by virtue of the greatness of stature of the Talmudic Sages and their wisdom in explicating the Torah in all its exactitudes and explicating all of its rules and details to rely upon them and uphold their opinions regarding medicine, the natural sciences and astronomy, and to believe them like we do in matters of Torah, the wisdom of which is in their hands and was given to them to transmit to mankind.[24]

While Rabbi Abraham expands the words of Maimonides to include medical advice and the sciences in general, in his conclusion he reaffirms the infallibility of *Hazal* in explicating the Torah as a divinely received tradition. Maimonides, as shown, also clearly rejected both of the first two approaches, namely, the denial of scientific knowledge and postulating a change in nature. However, for both Maimonides and his son who describe the immutability of Torah, the question then remains: although *Hazal*'s *scientific* statements could, according to this approach, be ignored, what about *halakhot* that they establish based on scientific realities that they perceived? Do these fall under the realm of scientific fallibility or Torah-related infallibility? In answering this question, the three general approaches laid out until now—denial of scientific knowledge, change in nature, and *Hazal*'s scientific fallibility—can be further refined and a fourth approach revealed.

A passage in *Shabbat* 107b records a dispute between Rabbi Eliezer and the Sages regarding killing certain insects on the Sabbath. While killing on the Sabbath would normally constitute transgression of a forbidden labor, the Sages rule that there is no prohibition to kill a louse because "it does not reproduce." This ruling is accepted as the normative *halakhah* and codified by Karo in the *Shulkhan Arukh*, "A flea…is forbidden to kill, but a louse it is permissible to kill."[25] While Karo finished publication of his *Shulkhan Arukh* in the late 1500s,

it was not until a hundred years later in 1668 that Franscesco Redi demonstrated that maggots do not spontaneously generate from rotting meat.[26] By the time Rabbi Yitzhak Lampronti was writing in the early eighteenth century, however, this was already accepted knowledge. Confronted with scientific proof against spontaneous generation on one hand, and a *halakhic* tradition about lice on the other, Lampronti was forced to grapple with the status of lice on the Sabbath. In a bold entry in his encyclopedic work *Pahad Yitzhak*, Lampronti writes:

> Were I not afraid, I would say that in our times, when the experts of reproduction have studied, watched, discovered and written that every single living creature emerged from an egg, and this they proved with clear proofs, that therefore one who wishes to guard his soul will distance himself and not kill neither a flea nor a louse [on Shabbat]…And in this matter I will say that if the Sages of Israel had heard the proofs of the Gentile Sages they would retract and accept their words…[for] the Sages of Israel spoke occasionally from their own intellect and human investigations and not from transmission…[27]

In what is thus one of the clearest formulations of the approach which concede *Hazal*'s fallibility in scientific matters, Lampronti makes an explicit *halakhic* determination based upon the theoretical position first advanced by Maimonides without leaving the same ambiguity as Maimonides and his older contemporary Hakham Zvi.[28]

IV. Bifurcation of Science and Halakhah

This radical approach adopted by figures like Maimonides, Hakham Zvi and Lampronti, was not tenable in the eyes of other rabbinical figures. As science became increasingly systematic and reliable, however, beginning in 1543 with the revolutionary works of Galileo and Vesalius, through 1687 with the publishing of Newton's *Principia Mathematica* and beyond, a large number of rabbis recognized the escalating difficulties in adhering to the literal truth of *Hazal*'s scientific writing.[29] While some, as we have seen, rejected

the statements of *Hazal* altogether as outdated science, a fourth approach to the conflicts emerged that hoped to uphold the integrity of both science and *Hazal*. The Maharal of Prague, writing in the mid and late sixteenth century, developed a unique approach that posited the existence of two distinct realms of existence: the natural and the supernatural. In one place he writes that the knowledge of scientists is limited to the natural realm, stating:

> We should pay attention to what the scholars of the nations have said about what is below the sphere of the moon because they were scholars of the natural world…but we should not pay any attention to what they say regarding what is beyond nature.[30]

In another, he clearly distinguishes between the realm of the scientists and the supernatural one, writing:

> Since man, who is natural, can only understand the natural, the supernatural will always be hidden from him. He cannot conceive it on the basis of his knowledge. Thus all miracles are impossible from [the vantage point] of nature, but from [the vantage point of the separate [that is, miraculous] world beyond nature, they are possible.[31]

Thus, in conclusion, according to the Maharal, one should judge "the words of Torah alone and the words of their science alone."[32] The Maharal established a paradigm through which one could maintain the views of scientists in explaining natural phenomena, but also those of *Hazal* in seeing the deeper meaning behind it. As David Ruderman summarizes, "The Maharal's most important clarification was to disentangle natural philosophy from the assumptions and restraints of Jewish theology and Aristotelian metaphysics, and in doing so to provide an autonomous realm in which scientific pursuit could legitimately flourish."[33]

This mystical approach was adopted by kabbalistic schools since the Maharal and in the modern era it was reformulated and even gained explicit *halakhic* applicability. In the early twentieth century, the prominent Lithuanian rabbi, Rabbi Eliyahu Dessler, a known adherent of the Maharal, used a similar

approach to resolve *halakhic* questions. In response to a number of science versus *halakhah* contradictions, Rabbi Dessler writes:

> *Hazal* knew the *Halakhah* from the transmission of many generations…but in regards to the natural explanations, it is not the explanation which precipitates the law but on the contrary, the law precipitates an explanation. [As such,] the reason given in the Gemara is not the sole possible explanation of the matter. And if, upon occasion, they gave explanations according to the knowledge of nature that they possessed, it is incumbent upon us to find alternative explanations through which we can uphold the law properly according to our contemporary scientific knowledge.[34]

In a slightly modified way, Rabbi Dessler presents a unique view, positing that normative *halakhah* as presented by *Hazal* has independent credibility as a transmission dating back to Sinai, but the reason that *Hazal* gave for the *halakhah* was sometimes based on the science of their day. Or as the Maharal explains, it is a deeper meaning that *Hazal* are presenting, and should not be taken as a superficial explanation of natural phenomena. Using this approach, Rabbi Dessler addresses the question of killing lice on the Sabbath and upholds the ruling, explaining that a new explanation for the distinction between lice and other insects must be crafted, but the *halakhah* as recorded still stands.

Finally, Rabbi Abraham Isaac Kook, the luminary of Israel in the early twentieth century, also a close follower of the Maharal, elucidates a similar view. He explains,

> Regarding the opinions that are formulated by modern scientists, many of which contradict the simple meaning of the Torah: My opinion in these matters is that anyone whose opinions are straight should know that even though there is no guaranteed truth in all of the discoveries, even so, we are not obliged in the least to contradict them explicitly and take a stand against them, because *this is not the essence of the Torah at all to relate to us simple facts and events that occurred.* The essence is the inside, the inner explanation of the matters etc.[35]

Thus Rabbi Kook reaffirms from a Jewish perspective a quote which Galileo

cited in a letter to the Duchess Tuscany in 1615, before being forced by the Inquisition to rescind his position about the Copernican system of the universe. Galileo explains, "That the intention of the Holy Ghost is to teach us how one goes to heaven, not how heaven goes."[36]

Jews throughout history have dealt with the complex question of how to integrate their religious tradition with the secular world in general and with the natural, scientific world in particular. The interaction becomes all the more difficult when considering questions of legal, *halakhic* precedent, and what impact, if any, new scientific discoveries should have upon them. In dealing with these challenges and in hope of resolving the clashes, rabbinic authorities throughout the ages have developed a range of innovative approaches. By tracing the history and application of these approaches, and by understanding the context in which they developed, a greater understanding of and appreciation for the complexities of the world of Jews and science can be attained.

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Notes

1. *Emunot V'Deot Maamar* 3:7
2. *Emunot V'Deot Maamar* 3:4
3. *Moreh Nevuchim* 3:22
4. *Moreh Nevuchim* 2:29 [emphasis added] Maimonides uses phrases such as "המציאות הזו היא נצחית לעד כפי הטבע הזה אשר רצהו יתעלה, לא ישתנה ממנו מאומה כלל", and "ולא ישתנה בו טבע" the significance of which will become apparent in the continuation.
5. Deuteronomy 17:11
6. Rashba Responsa 1:98. For another clear example of the denial approach see Rabbi Yaakov Reisler's (1670-1733) *Shevut Yaakov* 3:20.
7. Cf. Rivash, Isaac ben Sheshet (1326-1408), Responsum 447 whose language, "we trust our Sages of blessed memory, even if they tell us that right is left," reflects the *Sifri* on Deut. 17:11.
8. Bekhor Shor on *Chullin* 58a. See Yael Haviva Nisan. *Medieval Ashkenazi Bible Interpretation: A Textual Analysis of Rabbi Joseph Bekhor Shor's Torah Commentary* (M.A. thesis, McGill University, 1997) 8-10 for summary of the conflicts over Bekhor Shor's identity and his relationship to the Tosafists.
9. See Mishnah Bekhorot 3:1 and Tosafot on *Masekhet Avodah Zarah* 24b
10. Cf. *Niddah* 38a-b, *Rosh Hashana* 11a, *Yevamot* 42a

11. E.g. A widow whose only child is an eight-month baby is considered childless in regard to the levirate marriage (*Yevamot* 80a-b). Additionally, it is forbidden to desecrate the Sabbath to attend to the needs of an eight-month baby (*Shabbat* 136a).

12. Julius Preuss. *Biblical and Talmudic Medicine*. trans. Fred Rosner. (New York: Sanhedrin Press, 1978) 14:4, 14 (p. 383-4, 393-4)

13. As this comment of the Tosafists does not appear in their current commentary, he seemingly refers to their commentary in *Avodah Zarah*, by the cow, and extends it here.

14. Rashbash Responsa 513

15. See Rema *Even HaEzer* 156:4 who codifies this ruling, writing that despite the *Gemara*, "we must say that nowadays the matter has changed, and so too with a number of matters." It is also worth noting that the denial approach persisted even in face of Rema's ruling. See, for example, Rabbi Chaim Halberstam in his *Divrei Chayim Even HaEzer* 1:95 where he writes that Rema did not personally adopt this approach nor intended it to be practiced.

16. *She'elat Ya'avetz* 1:81

17. *Shut Hakham Zvi* 74

18. ibid.

19. Lois N Magner. *A History of the Life Sciences*. (New York: Marcel Dekker, 2002), 106-108

20. The Jewish Encyclopedia, s.v. Ashkenazi, Zebi Hirsch

21. The wise man to whom Hakham Zvi refers here, is no doubt the great German Rabbi, Rabbi Yonatan Eybeschutz. See Eybeschutz's *Kereti u'Feleti* 40:4, and his attack on Hakham Zvi.

22. ibid. 77

23. *Moreh Nevuchim* 3:14

24. See *Pesahim* 94b for a classic case in which a *Talmudic* sage concedes to a Gentile one on a scientific question. See Rabbenu Tam (1100-1171) cited in *Shittah Mekubetzet* to *Ketubot* 13b who denies that the *Talmudic* sages actually conceded. Also see Rabbi Yitzchak Arama (1420-1494) in his *Akeidat Yitzhak Parshat Bo*, Gate 37, Rabbi Isaac Israeli (d. 1326) in *Sefer Yesod Olam* 1:1, and Rema (1520-1572) *Torat Ha'Olah* 1:82 who all give explanations why it was that *Hazal* conceded to the Gentile scientists.

25. Dissertation on *Derashot Hazal*

26. *Shulkhan Arukh* 316:9. See, however, Maimonides' *Mishneh Torah Hilkhot Shabbat* 11:2 where he changes the formulation of the *Gemara* and, based on the science of his day, distinguishes between insects born through sexual reproduction or generated from dust, which are forbidden to kill, versus insects generated from excrement or rotten fruit, which are permitted to kill.

27. See A. Rupert Hall. *The Scientific Revolution: The Formation of the Modern Scientific Attitude*. (Boston: Beacon Press, 1966) 156-8 for a summary of Redi's experiments.

28. *Pahad Yitzhak* v. *Tzedah Asurah*. See David Margalit. *Hakhme Yiśra'el ke-rof'im*. (Jerusalem: Mosad ha-Rav Kook 1962) 152-74 for background on Lampronti as a doctor and for other entries in *Pahad Yitzhak* that deal with medical issues.

29. See, however, Lampronti's quotation of his Rabbi, Rabbi Yehuda Briel who disagreed and denied the scientific evidence in favor of siding with *Hazal*.

30. See A. Rupert Hall 35-51 for the impact of Vesalius' discoveries, 105-116 for Galileo's advances in astronomy, and 244-76 for the impact of Newton's work, the pinnacle of which was the *Principia.*

31. *Netivot Olam, Netiv ha-Torah* 14 (p. 59)

32. *Sefer Gevurot Hashem* (p. 16)

33. *Be'er HaGolah* (p. 118)

34. David B. Ruderman. *Jewish Thought and Scientific Discovery in Early Modern Europe*. (New Haven, Connecticut: Yale University Press, 1995) 77

35. *Mikhtav MiEleyahu Ma'amar* 4 p. 355 footnote 4. This was an oral teaching of Rabbi Dessler appended to his book by Rabbi Carmell, the volume's editor.

36. *Iggrot HaRaAYaH* 1:134

37. Stillman Drake, ed. *Discoveries and Opinions of Galileo*. (New York: Random House, 1957)