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Yashar Books is a new venture in Jewish scholarship. It was founded by Gil Student and Moshe Schapiro, two young Orthodox rabbis with a mission: to give Open Access to the world of Jewish inquiry.

The Orthodox community has spent many years becoming comfortable with the methods and findings of modern scholarship, while rejecting certain aspects that contradict our basic beliefs. There have been many debates over the years over the propriety of using academic tools and both sides have voiced their views repeatedly. It is time to move on from that debate and, as one prominent scholar has advocated, instead of discussing modern scholarship *and* Torah study to discuss modern scholarship *in* Torah study – to integrate the techniques of scholarship into how we view ourselves, Torah and the world around us.

We need to retell the story of Jewish history, this time with the rigorous use of historical methodologies. What did Jewish leaders of various eras say, as opposed to what we *want* them to have said? What did our holy texts mean to their original readers, in light of archaeology, history and linguistics? How do we apply the eternal truths of the Torah to our daily lives, using systematic approaches that are fully aware of the competing systems of beliefs and laws we encounter in the world? The Orthodox world, the community of devout, committed Jews, has much to say in these matters.

Sages and scholars have been plumbing these depths for some time. It is now time for "the rest of us" to share the bounty and gain access to the insights of current Torah scholarship. Yashar Books is dedicated to a program its founders call "Open Access": introducing quality scholarship to popular readership.

Intellectual trends change over time. There are currently many innovative pockets of cutting-edge Orthodox scholarship throughout the world. Yashar intends to globalize that knowledge and provide Open Access to serious Jewish books to students — and the simply curious — around the world. Fresh scholarly developments, and even new fields of study, have opened up in recent years and the explorations of these new areas can take place in a much wider arena than they currently are. These works need to be taken off dusty library shelves and made available to everyone, not just the readers of scholarly journals.

Yashar Books wants to bring together scholars and laypeople in a new virtual learning community. That is why Yashar is launching this campaign to share in the advances in other specialties, thus creating a cross-pollination — adding insight onto insight and further developing the ideas in entirely unforeseen directions. Yashar Books wants to encourage people to *ask* and to think, to re-evaluate what they may take for granted and pursue promising ideas in creative — perhaps revolutionary — ways.

Many of the most difficult questions people have about Judaism vis-à-vis the modern world are still being addressed based on the methods of thirty or forty

years ago. There are more relevant answers, consistent with current scholarly trends. However, these responses have yet to be widely disseminated in a convincing and understandable format. By disseminating current scholarship that honestly grapples with these issues, we will be buttressing the Orthodox faith as well as demonstrating to the entire world – Jewish and non-Jewish – that we are both honestly and fearlessly members of contemporary intellectual society.

Yashar intends to be a force in the contemporary Orthodox world, bringing the ideas of our brightest minds to the wider world through extensive distribution and creative marketing, integrating old and new technologies, as well as old and new distribution channels. Yashar will nurture a new literature and new lines of communication that will inform, inspire and, hopefully, change the world one book at a time.

The Open Access Project is an experimental new way of disseminating Torah scholarship. Yashar Books searches the community of Torah thinkers for innovative insights that break new ground or take old topics and reshape them from novel perspectives. These essays, or sometimes even whole books, are made available to the public on the Open Access website and then our ambassadors disseminate the information throughout the community. Using the Open Access website as the research center, anyone with internet access can download the Open Access contributions and then pose questions and offer further insights to the online community.

This contribution to the Open Access Project is an essay by Rabbi Gil Student, previously published online on the *Torat Emet* website (www.aishdas.org/toratemet), on the issue of what to do when contemporary science contradicts accepted *halakhah*. Should we ignore science, revise Jewish law or creatively reconcile the two?



Gil Student

Judaism is a very practical religion. It is concerned largely, but not solely, with actions. For this reason, the rabbis have always been concerned with reality. How must one act in this situation? What does one do in that case? Both actual and theoretical scenarios have been and continue to be lengthily discussed to clarify how one must act in those cases. But what happens when later investigation informs us that the reality discussed in those situations is incorrect? What if the discussion of reality assumed a scientific fact that we now know is mistaken?

Sages and Science

Tradition and Science

Before we ask these questions, we must first ask whether it is possible for rabbis to make a mistake. This question is particularly important if we assume that they received all of their knowledge from God at Sinai, as transmitted throughout the ages. Even if we believe that this is not the case, but that the sages of every generation, particularly those of the Talmud, were divinely inspired, then mistakes should be impossible. Can these holy and inspired rabbis err? Would God let them make mistakes?

First, we must make clear that Moshe did not receive scientific knowledge at Sinai and that science was not transmitted throughout the ages to the great rabbis. The first *Mish*-

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nah in Avot says, "Moshe received Torah from Sinai." Torah, not science. Rashi (Exodus 12:2), quoting the Mekhilta, says that Moshe showed the Jews pictures of a moon and said that they should sanctify the new month when the moon looks like that. He did not explain to them the monthly orbit of the moon around the earth rather he showed them what a new moon looks like. Would anyone suggest that during Moshe's stay on Mt. Sinai he studied geometry and physics? Certainly not. He studied Torah directly from God and that is what he transmitted to Yehoshua, who transmitted it to the elders...

If the sages did not receive all of science from Sinai, then from where did they gain their scientific knowledge? As we have discussed elsewhere, the talmudic rabbis were keen observers of the world and performed experiments to better understand reality (e.g. Hullin 45b, 57b). Additionally, they consulted with scientists of their time. Aside from explicit mentions of consultations with doctors in the Talmud (e.g. Hullin 77a), there are many striking similarities between Greek and Roman science on the one hand and talmudic science on the other. While it is certainly possible that Aristotle and the rabbis arrived at certain identical conclusions independently, it is very likely that some rabbis were either familiar themselves with Greek and Roman science or consulted with doctors who were. For example, the Mishnah (Hullin 9:10) mentions the existence of a mouse that was half animal and half dirt. Since the sages obviously did not witness this imaginary creature themselves, they probably either read about it (perhaps in Plinius' History of Nature 9:58) or heard about it from others. Similarly, the Gemara in Hullin 45b seems to accept that hearts have two chambers. This is in accordance with how Hippocrates and Galen understood the heart (see The Kosher Code Of The Orthodox Jew, section 40 n. 2). The many parallels between talmudic and ancient medicine, some of

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which may be merely coincidental, are discussed extensively by Julius Preuss in his Tal-

mudic and Biblical Medicine.

Sages and Errors

The answer to whether God would allow the sages to err is, based on classical

sources, a resounding yes. The Torah (Leviticus 4:13-21) informs us that when the entire

congregation sins based on a mistaken ruling, the leaders must bring the sin-sacrifices

because it is their fault. Clearly, the halakhic deciders of the community can make mis-

takes. The Sifra (9:9,10) learns from the verse (Leviticus 23:2) "Which you shall pro-

claim as holy assemblies" that the rabbinical court decides when the new month begins

(and therefore determines when holidays occur) even if they err in determining the astro-

nomical reality of the lunar cycle. "You, even accidentally. You, even mistakenly. You,

even against your will." Clearly, it is possible for rabbis to make mistakes about when the

new month begins. Indeed, the talmudic tractate *Horivot* is dedicated to what must be

done when rabbis rule in error. The only conclusion can be, as one scholar eloquently put

it, inspiration does not imply infallibility. Only God is infallible.

R. Yosef Karo, in his Kessef Mishneh (Hilkhos Mamrim 2:2) asks why scholars of

the Gemara era, *Amoraim*, may not dispute the rulings of scholars from the Mishnaic era,

Tannaim and, similarly, why post-Talmudic scholars may not argue with Talmudic

scholars. Rabbi Karo's answer is not that past scholars were all correct and, therefore,

they must be right. Rather, he invokes a technical reason involving the authority of their

halakhic rulings even if we believe them to be incorrect (see below for more on this).

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Rambam says outright in his Moreh Nevukhim (3:14) that Talmudic sages can be

incorrect on scientific matters:

Do not ask me to reconcile everything that they (the sages) stated about astronomy with the actual reality, for the science of those days was deficient, and they did not speak out of traditions from the prophets regarding these matters.

Similarly, Rav Sherira Gaon (or possibly his son, Rav Hai Gaon) wrote the following regarding the medical cures suggested in the Talmud (*Teshuvot Ha-Geonim*, ed. Harkaby, no. 394):

Our sages were not doctors and said what they did based on experience with the diseases of their time. Therefore, there is no commandment to listen to the sages [regarding medical advice] because they only spoke from their opinion based on what they saw in their day.

There is nothing heretical in respectfully saying that some sages were incorrect in regard to some scientific facts. The key, however, is to say it respectfully. It is easy to be arrogant and compare a rabbi's scientific knowledge to a schoolchild's. But it must be remembered that a schoolchild today is informed from two thousand years' worth of scientific breakthroughs that the sages of the Talmud did not have. You are not comparing a rabbi with a child. You are comparing a rabbi with a schoolchild standing on the shoulders of Newton, Galileo, Harvey, Einstein, and thousands of others. The rabbi is not to blamed for his misunderstanding nor to be pitied. He was a valiant and pious person who dedicated his life to knowledge. While historical circumstances may have led him to err on a few issues, on 99 percent of relevant topics he knew more than even the greatest Torah scholar of our day.

Centralized *Halakhah*

But the fallibility of halakhic decisors does not mean that each person should make his own halakhic rulings. If that were the case, there would be no organized relig-

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ion because every person's worship would be different. Even more importantly, very few people are knowledgeable enough to make educated decisions based on a robust knowledge of the entire Torah. Is it not better for there to be a possible few mistakes of an organized religion than millions of mistakes of a disunified people? The *Sefer HaHinukh* (496) makes this very point:

The views of people are different and it is impossible to get many opinions to agree on matters. The Master Of All, blessed be He, knows that if the intent of the written Torah was given to each person to determine according to his judgment, everyone would explain the words of the Torah as they see fit and the disagreements in Israel about the commandments would be numerous. The Torah would be made into many different Torahs... Therefore, God, who is the Master of all wisdoms, completed our Torah - the true Torah - with this commandment: that we are obligated to follow the true explanation that was transmitted to our early sages, of blessed memory... Even if they say that the right is left and the left is right, we cannot depart from their rulings. Meaning, even if they err in an issue we should not dispute them but follow their error. It is better to withstand one mistake with everyone relying on one authority than to have each person follow his own halakhic opinion because this would disrupt the religion, cause disunity of the people, and destroy the nation entirely.

Even if the sages were mistaken on certain scientific facts, the overall corpus of rabbinic literature must still remain the basis of Judaism. It is better to tolerate a few errors than to encourage religious chaos. As we will see, some take this approach in regard to every single *halakhah* and will never allow changing an *halakhah* based on modern science. Others are more willing to change some *halakhot*. However, the suggestion that since the rabbis did not have access to modern science we must reject their entire world view is both over-reactive and impractical. That would destroy the Jewish religion and the Jewish people.

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Types of Responses

What do we do when an halakhah seems to be based on incorrect science? For

example, the Gemara (Shabbat 135a) states that a baby born in its eighth month from

conception cannot survive and, therefore, the Sabbath should not be violated to try to

save it. However, a baby born in its seventh or ninth month is viable and the Sabbath

must be violated for its sake. Doctors today tell us that a baby born in its eighth month is

viable. How do we, as an halakhic community, react?

1. Do Not Change Halakhah

1a. Skeptical

There are three main responses, with different nuances among them. The first possi-

ble response is not to change anything. From one perspective, this is due to a profound

skepticism about science. Over the past 200 years, indeed over the past 20 years, scientific

theory after theory has been recognized as truth and then rejected as incorrect. Medical stud-

ies are touted as proving a fact that is later disproved by more studies. Practical medical ad-

vice, such as whether eating fish is healthful, changes almost annually. Why, skeptics ask,

should we change an established halakhah based on a constantly changing science? If doctors

next year change their minds and tell us that they were mistaken and that babies born in their

eighth month are not viable, much desecration of Shabbat will have been caused.

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1b. Fixed *Halakhah*

Others, perhaps less skeptical, offer a different reason for not changing *halakhah*. There was a time in history when *halakhah* was more fluid and changes in reality caused changes in *halakhah*. However, there was a point in history, approximately coincident with the closing of the *Mishnah*, when reality as it relates to *halakhah* became fixed. At that point, halakhic assumptions were finalized. Any new information we have subsequently gained, any changes that have occurred in reality or our understanding of it, are irrelevant to halakhic conclusions (*Hazon Ish*, *Yevamot* 57:3).

1c. Closed Talmud

Another similar approach is based on the answers to a different question. Why were Amoraim, sages of the Gemara, unable to argue with Tannaim, sages of the Mishnah? Furthermore, why are post-Talmudic rabbis unable to argue with either Tannaim or Amoraim? The Kessef Mishneh (Hilkhot Mamrim 2:2) says that both the Mishnah and the Gemara were closed by a meeting of the leading rabbis of the time who finalized its contents. At those points, the contents of the Mishnah and later of the Gemara were considered to be acts of a central court, Sanhedrin, that can only be changed by a later Sanhedrin of greater authority. R. Tzvi Hirsch (Maharatz) Chajes in his Torat Nevi'im, Ma'amar Lo Tasur (Kol Sifrei Maharatz Chajes, vol. 1 pp. 97-104) expands on this point as does R. Elhanan Wasserman in his Kovetz Shiurim, Kuntres Divrei Sofrim ch. 2 (see also his exchanges with the Hazon Ish printed in the back of Kovetz Inyanim). The final rulings of the Talmud cannot be reversed by anyone except a great Sanhedrin, which does not cur-

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rently exist. Therefore, even if science implies that halakhah as decided in the Talmud

should change, only a Sanhedrin can make that change.

While all of this seems to imply the horrific conclusion that a baby born on the

Sabbath in its eighth month from conception will not be cared for, in practice there are

other considerations, as we shall see.

2. Change Halakhah

2a. Incorrect Knowledge

Another possible response is to advocate changing *halakhah* whenever it seems to

contradict science. This can come from two different understandings. The first is simply

that the sages of different generations did not have any special understanding of science.

Rather, they knew the science of their times and occasionally erred alongside the leading

scientists of their generations.

2b. Nature Changed

Others would argue the exact opposite. The rabbis had divine assistance in under-

standing scientific reality. If so, how can contemporary science disagree with he sages'

perception of reality? Evidently, reality has changed. Whether it is due to changes in cli-

mate, diet, exercise patterns, or even what some term "micro-evolution", nature has

changed and the scientific facts of 1500 to 2000 years ago are sometimes different from

what we observe today. Therefore, it is not that halakhah changes but that it must relate

to a new reality.

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An example of these different attitudes exists in regard to talmudic cures for dis-

eases. The Talmud contains many suggested remedies for various medical symptoms

(e.g. Gittin 67b). Rav Sherira Gaon wrote in a responsum quoted above that people

should not try the medical cures in the Talmud because they do not work. Tosafot (Moed

Katan 11a), however, say that the cures do not work because nature has changed. The

cures that worked in the time of the Talmud no longer work today. Both agree that the

cures should not be used because they do not work. However, they disagree over why

they do not work.

3. Case-By-Case Response

A third response is much more nuanced. According to this view, science is used by

the sages in two ways. One is as a basis for making halakhic rulings. For example, the Mish-

nah (Yevamot 16:4) rules regarding a man who falls into the sea and whose leg is recovered

that if the leg was cut off from above the knee then the man has certainly died and his wife

may remarry. According to the sages' medical understanding, a man whose leg is cut off

from above the knee will definitely die within twelve months. Based on this understanding,

the rabbis ruled that his wife may marry another man.

Another way the sages used science is to explain a received tradition or an ob-

served phenomenon. For example, there is an established halakhah that lice may be killed

on the Sabbath while fleas and other animals may not (Shabbat 107b). What is the reason

for this distinction? Based on their understanding of the world, the rabbis of the Talmud

explained that lice do not sexually reproduce and it the prohibition to kill animals on the

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Sabbath only applies to those that sexually reproduce. Indeed, until Louis Pasteur in the

late seventeenth century proved it impossible, scientists believed almost unanimously that

lice and many other animals were produced spontaneously and not through sexual repro-

duction. The sages used this scientific "fact" to explain the halakhah that they had re-

ceived as a tradition.

These two uses of science by the talmudic rabbis lead to different reactions when

the science is revised. In the first case, when the *halakhah* is based on the science, once

the understanding of reality is changed the halakhah must be as well. And so the Ram-

bam ruled in *Hilkhot Gerushin* (13:16) that what is necessary for a woman to remarry is a

wound from which a man cannot recover. Rambam never mentions the Mishnah's exam-

ple of a man whose leg was cut off from above the knee. Even more telling is how Ram-

bam defines a deadly wound in Hilkhot Rotzeah 2:8 - "Every person is considered

whole... until we know for certain that he is a tereifah and the doctors say that this wound

can not be cured in a person..." Contemporary medicine defines which wounds are

deadly.

However, in the second type, science was only used to explain the halakhah. If

the science is shown to be incorrect, the halakhah should not be changed. Rather, a new

explanation should be sought to explain the halakhah. Thus, while in the time of the Tal-

mud it was sufficient to say that lice can be killed on the Sabbath because they do not re-

produce, in the Rambam's time that was not a satisfactory explanation. To the Rambam,

fleas also do not sexually reproduce and, therefore, the talmudic distinction that permitted

killing lice on the Sabbath but not fleas had to be explained differently. The Rambam

wrote in Hilkhot Shabbat 11:2-3:

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Insects which reproduce sexually or which are generated from dust like fleas - he who kills them [on the Sabbath] is as liable as if he had killed an animal. But insects generated from excrement or rotting fruit... he who kills them is exempt... It is permitted to kill lice on Sabbath because they are [generated] from sweat.

The Rambam explained that the prohibition against killing animals on the Sabbath does not depend on whether the animal is sexually reproduced but on from what it was generated. We are not prohibited from killing on Sabbath animals that are generated from sweat, such as lice. He knew the *halakhah* and tried to find an acceptable explanation of it based on the science of his times.

We will discuss this topic at greater length later in this essay. Now, however, let us address a number of topics and see how different halakhic authorities reacted to scientific changes that affect *halakhah*.

Sunrise and Sunset

The determination of the times for the rising and setting of the sun, and therefore the beginning and end of the day, is one that depends greatly on an understanding of the astronomy of the earth's movement around the sun. In *Pesahim* 94a, R. Yehudah is quoted as saying that the time between sunset and the appearance of stars is the time it takes to walk four *mil*. However, R. Yehudah is quoted in *Shabbat* 34b as saying that *bein hashmashot*, the time between sunset and dusk, is the time it takes to walk three quarters of a *mil*. This apparent contradiction, whether it is three quarters of a *mil* or four *mil*, is explained in different ways.

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Three Explanations

According to R. Avraham Ibn Ezra (Exodus 18:13) and R. Eliezer of Metz (*Yere'im*, 274), the period of *bein hashmashot* begins three quarters of a *mil* before sunset and concludes with sunset. Sunset is when *bein hashmashot* ends and night definitely begins. The four *mil* represent the time from sunset until all of the stars appear, the whole time being definite night.

The Geonim (Otzar Ha-Geonim, Pesahim 94), whose view was essentially championed by the Vilna Gaon (Orah Hayim 261:12), explain that bein hashmashot begins with sunset and lasts for three quarters of a mil until tzeit hakokhavim, the appearance of three average-sized stars, when night definitely begins. While some, most notably R. Yechiel Michel Tukaczinsky in his Bein Ha-Shmashot, argue that in Jerusalem stars cannot be seen at the time the Geonim established for tzeit hakokhavim, R. Yehudah (Leo) Levi has verified that a trained observer can indeed spot three medium stars at this time (Jewish Chrononomy, Hebrew section, section 3, chapter 2, answer 2). The Vilna Gaon further explained that the four mil mentioned in Pesahim begin with sunset and end with the appearance of many stars at a point that has already been night for a long time.

Rabbeinu Tam (*Tosafot*, *Shabbat* 35a) explains that the four *mil* begin with sunset and end with *tzeit hakokhavim*. Bein hashmashot does not begin with sunset but begins with three quarters of a *mil* before *tzeit hakokhavim*. According to Rabbeinu Tam, definite night is not until 4 *mil* after sunset. This diagram shows the three different views.

		Sunset			
	3/4 mil	3/4 mil	2 1/2 mil	3/4 mil	
R. Eliezer of Metz	Bein Hashmashot	Definite night begins			Appearance of many stars
Geonim/ Vilna Gaon		Bein Hashmashot	Definite night begins		Appearance of many stars
Rabbeinu Tam				Bein Hashmashot	Definite night begins

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Rabbeinu Tam and the Sun's Motion

Rabbeinu Tam further explains what bein hashmashot represents. According to R. Ye-

hudah, who gave us these timeframes, the sun travels back and forth across the earth, during

the day below the firmament (sky) and during the night above the firmament. Bein hashmashot

is the time it takes for the sun to travel through the firmament (from below to above) so that

it can begin its trek back over the earth, above the firmament.

Clearly, R. Yehudah according to Rabbeinu Tam is basing the halakhic definition of

night on a pre-Ptolemaic understanding of the sun's travel above the earth. R. Yehudah

thought that the sun travels back and forth above the earth. However, science has told us for

centuries that the sun does not move back and forth above the earth. Rather, the earth ro-

tates daily so that, from the perspective of someone on earth, the sun goes around the world,

rising and setting on its approximately circular path. The sun does not need time to travel

through the firmament, what Rabbeinu Tam called bein hashmashot. Since Rabbeinu Tam's

explanation of this topic is contradicted by science, how should the halakhic community re-

spond?

1a. Skeptical

It is hard to imagine anyone today being skeptical of the established fact that the

earth rotates on its axis while the sun remains relatively motionless or claiming that this

aspect of nature has changed since the time of the Talmud. There are those, however,

who are skeptical that Rabbeinu Tam ever intended to contradict science. R. David Luria

(Radal), at the end of his long introduction to Pirkei De-Rabbi Eliezer, quotes R. Moshe

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Hayim Lutakes that position. Rabbeinu Tam was speaking mystically when he referred to

the sun's motion above the earth and through the sky.

2a. Incorrect Knowledge

Others, such as Rav Hai Gaon, argue that this view contradicts reality and must

therefore be rejected (Rav Hai Gaon lived well before Rabbeinu Tam but still rejected the

view that Rabbeinu Tam later accepted).

3. Case-By-Case Response

A third approach, what we have termed a "Case-By-Case Response", was offered by

the Minhat Cohen (1:10). He asked this very question and answered that Rabbeinu Tam chose

a certain observable time and decided, based on the Gemara, that it marked the beginning of

definite night. His explanation of this ruling, which is incorrect, is irrelevant. The position of

the sun in its descent that corresponds to Rabbeinu Tam's tzeit hakokhavim remains an ap-

propriate time regardless of how Rabbeinu Tam explained his choice. The Minhat Cohen

added that the author of Maggid Mishneh, a 13th century talmudic scholar and astronomer,

agreed with Rabbeinu Tam's time despite the pre-Ptolemaic explanation.

Tereifot

Another area where Torah must sometimes react to scientific developments is that

of tereifot. The Gemara (Hullin 42a) records a debate over whether an animal with an injury

that renders it a tereifah can live for more than twelve months. While Tannaim and Amoraim

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dispute this point, all agree that the animal will eventually die from this injury. The clear conclusion of the Talmud is that a *tereifah* will not live beyond a year. However, our understanding of animal medicine has progressed dramatically since the time of the *Gemara*. What happens when veterinary science contradicts the Talmud? Moreover, what happens when we

observe a tereifah living beyond 12 months? Do we revise the halakhot of tereifot?

For example, one of the types of *tereifah* is a *derusah*, an animal that has been pierced by the nails of a predator. The *Gemara* (*Hullin* 53a) explains that a *derusah* is considered a *tereifah* because the predator secretes a venom into its prey as it retracts its nails. However, we now know that this is not correct and that the predators mentioned in the Talmud do not secrete venom. Should we therefore permit a *derusah* against the ruling of the *Gemara*?

The Gemara in Hullin 46a has a debate over how much of an animal's liver can be removed without causing the animal to die. The conclusion is that as long as there are two olive-sized pieces of liver, one near the gall-bladder and the other near the "the most vital place" (either the diaphragm or the right kidney), then the animal can live and is not rendered a tereifah. This is how the Shulhan Arukh (Yoreh Deah 41:1) ruled. As the Rivash (Responsa, 447) pointed out, medicine tells us that such an animal cannot survive. Experiments have demonstrated that an animal can only regenerate its liver if at least one quarter of its original size remains (The Kosher Code of the Orthodox Jew, section 41 n. 2). However, one quarter of an average animal's liver is much larger than two olives.

On the other hand, the *Mishnah* in *Hullin* 54a says that an animal is kosher if its skull is diminished as long as the brain is intact. On 54b, Rav Nahman qualifies this that only up to a *sela*'s worth of the skull can be removed. If a *sela* or more is removed then the animal is a *tereifah* and so the *Shulhan Arukh* (*Yoreh Deah* 30:2) ruled. However, it is common for birds to

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live with more than a sela of their skull removed. For example, the Tzemah Tzedek pointed out

that clefts can be found in the skull of geese that are covered by a membrane. Yet the geese

live with this.

We see that sometimes the Talmud permitted an animal that we now observe cannot

live and sometimes forbade an animal that we now observe can live. How should halakhah

respond to this information?

This is particularly troublesome because the Gemara in Hullin 42a says that the laws

of tereifot were given to Moshe on Sinai. If so, how can they be wrong?

Skeptical

The Rashba (Responsa, 1:98) was skeptical that science could prove the laws of tereifah

to be incorrect. Anyone, he claimed, who has observed a tereifah living more than twelve

months is either lying or witnessing a minor miracle. Similarly, Rivash (Responsa, 447) wrote:

We will not believe Greek or Arabic philosophers who only spoke out of their own theories or on the basis of some experiment or other without paying atten-

tion to all the possible errors that can befall such an experiment.

While the Rashba and Rivash were referring to medieval medicine, R. Shlomo Heiman fol-

lowed the same line of reasoning in regard to twentieth century medicine. He argues in Hid-

dushei Rav Shlomo (Hullin, ch. 11) that if scientists contradict the laws of tereifot, the scientists

must be wrong.

Alternate Solution

The Maharshal in his Yam Shel Shlomo on Hullin (3:80) suggested that the laws of terei-

fot were formulated regarding the overwhelming majority (ruba deruba) of animals. However,

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there can be the rare exception of a tereifah that lives longer than a year. The Shakh (Yoreh Deah 57:48) uses this to explain why if we observe an animal that suffered an injury that rendered it a tereifah live for more than a year we do not determine that this injury does not make any animal a tereifah. This animal can be an exception. The Rashba in the above cited responsum argued against this theory but the Kereiti U-Peleiti (57:) tried to defend the Maharshal and Shakh against the Rashba's arguments. However, this does not necessarily answer all of the questions. If there are a few animals that survive a tereifah injury then this explanation suffices. But if it can be demonstrated that every animal that has a particular injury will sur-

1b & 2b. Fixed *Halakhah* & Nature Changed

vive, this explanation does not help.

The *Bekhor Shor* on *Hullin* 58a agrees that science can demonstrate that certain statements of the Talmud regarding *tereifot* are no longer correct. However, that does not mean that at the time they were said they were incorrect. It only means that now they are incorrect. If nature has changed since the time of the Talmud then both the Talmud's statements about animals and current scientific statements are correct. The *Hazon Ish* (*Yevamot* 57:3) follows this approach as well. It is not that science has disproved the Talmud. Rather, science has demonstrated what is correct today. While it may sound controversial to suggest that animals have changed over the past 1500-2000 years, it is actually to a degree an observed fact upon which all agree. Charles Darwin made this knowledge famous based on his observations in the Gallapagos Islands. Animals adapt and change over time based on their environment. While many will question whether evolution applies to the **origin** of animals, no one will disagree that fully developed animals will evolve from that point.

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Should the laws of tereifot then change to fit the current reality? The Hazon Ish ex-

plains, based on the Gemara in Avodah Zarah 9a, that the world was divided into three periods

- two thousand years of tohu, two thousand years of Torah, and two thousand years of

Mashiah. The full explanation of this passage is fascinating but will take us well off topic.

However, the Hazon Ish explained that the laws of tereifot were based on nature as it was dur-

ing the time of Torah, the two thousand years between Avraham and approximately the

close of the Mishnah. Since at that time the tereifot as described in the Talmud caused an ani-

mal to die within a year, we are still forbidden to eat such animals even if they can now sur-

vive for over a year.

1c. Closed Talmud

The Yad Yehudah (30:3) takes another approach. To answer this, he turns to the

Rambam. The Rambam writes in Hilkhot Shechitah 10:12-13:

One must not add to these laws at all. For anything that happens to an animal or a bird outside of those [tereifot] that were listed by the early sages and were agreed upon by Jewish courts, there is a possibility that it will survive, even if we know from medicine that it will not survive. Similarly, those that were listed and were called tereifah, even if it seems from the medical methods we have that some are not fatal and it is possible to survive - you only have what was listed by the sages, as it says "According to the law that they will teach

you."

The general rules of tereifot were given at Sinai and their details were debated in the Tal-

mud and agreed upon by the scholars of the time. When the Talmud was closed, the final

rulings of the Talmud were given the status of a ruling issued by a high court that cannot

be overruled. Even if we now believe the rulings to be incorrect, we do not have the ca-

pability of changing them.

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3. Case-By-Case Response

R. Dessler only discusses derusah but offers an approach that can be extended to all

tereifot. He suggests that, as the Gemara says, derusah is one of the tereifot that was given at Si-

nai. However, the details of exactly what is prohibited was a matter of debate. The sages ob-

served that, for example, animals scratched by wildcats had a higher fatality rate than those

scratched by dogs and concluded that it was due to venom secreted from the predatory wild-

cats. In other words, the scientific explanation came after the halakhah. Looking back, we

know that the higher fatality rate cannot be due to venom because wildcats do not secrete

venom. However, there must still be an explanation to the phenomenon that underlies the

halakhah. R. Dessler suggested that the explanation was that a wildcats' nails penetrate farther

into its prey than a dog's and therefore allow more dirt from the nails to enter the prey's

body and cause infection.

From this we can elicit a general response to medical questions that raise doubt re-

garding the laws of tereifot. The general rules were given at Sinai and the details were put in

place by the sages based on observations. These halakhot were then given explanations.

When science tells us that these explanations are wrong, we need to focus on the original

observations that prompted the explanations and try to offer alternative explanations.

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Premature Babies

Fetal Development

As we already mentioned, the Talmud claims that babies born in their eighth month

from conception are not viable. The Hazon Ish (Yoreh Deah 155:4) explains that the sages ob-

served that babies born in their seventh month rarely survived. However, a small but signifi-

cant percentage lived. In the eighth month, the survival rate dropped even lower. But in the

ninth month, the survival rate rose sharply. This phenomenon is reflected in other ancient

medical works such as those by Hippocrates and Galen (see J. Preuss, Biblical and Talmudic

Medicine, 14:14). Keep in mind that until recently infant mortality was very high. Many new-

borns never lived past their first month. Indeed, this is reflected in *halakhah* in that parents

do not fully mourn a baby that dies in its first month alive. Before the month passed, there

was a strong likelihood that the baby would not survive.

To explain this drop in infant survival in the eighth month, the sages adopted the

medical explanation that babies develop along two paths - a seven month path and a nine-

month path. Babies in the seven-month path progress at a rate so that they are fully devel-

oped after seven months while babies in the nine-month path are only fully developed after

nine months. A nine-month baby born in its seventh or eighth month cannot survive be-

cause it is not sufficiently developed. However, the rabbis observed that there were still

some very few babies born in their eighth month who survived. These babies, it was ex-

plained, were seven-month babies who were born late.

With all this in mind, we can understand the following from *Tosefta*, *Shabbat* 16:4.

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Who is an eight-month [baby]? Any [baby] who has not completed his months. Rebbe says: His signs identify him - his hair and fingernails... Rabban Shimon

ben Gamliel says: Whoever has lasted thirty days is not a stillborn...

According to the first anonymous opinion, any baby born in its eighth month, i.e. who has

not completed its nine-month development period, is considered to be an eight-month baby

that will not survive. According to Rebbe, only a baby that is born in its eighth month and is

not developed enough to have fingernails and hair is considered to be an eight-month baby.

Even if a baby is born in its eighth month, if it is fully developed it is deemed viable and

treated appropriately. According to R. Shimon ben Gamliel, any baby that survives its first

thirty days is deemed viable. In Shabbat 136a, Shmuel rules like R. Shimon ben Gamliel.

Whether R. Shimon ben Gamliel is coming to add to Rebbe's criteria, so that even a partially

developed eight-month baby is deemed viable if it survives thirty days, or he is coming to

subtract from Rebbe's criteria, or a number of other possibilities is discussed by the com-

mentaries. For summaries of these discussions see R. Aharon Yaffen's footnotes to Mossad

HaRav Kook's edition of the Ritva's novellae to Yevamot 80b and Minhat Yitzhak 4:123:3.

Regardless, the Shulhan Arukh (Orah Hayim 330:7-8, Yoreh Deah 266:11) rules that a baby born

in its eighth month that has fingernails and hair is considered viable in regard to the laws of

Shabbat. What is significant is that the rabbis recognized that a baby born in its eighth month

can live a full and long life. However, based on their observations and medical knowledge,

they said that the overwhelming majority does not.

Halakhic Ramifications

The non-viability of an eight-month baby has halakhic ramifications. A widow whose

only child is a non-viable eight-month baby is considered childless in regard to the levirate

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marriage. If she had given birth to a viable child she would not be obligated to perform the

levirate marriage or halitzah ceremony. However, since her child's chances of living are so

remote she is considered childless and is prohibited from remarrying until she fulfills the

necessary biblical requirements (Yevamot 80a-b).

Additionally, the needs of a seriously ill person may be cared for even if they require

violating the laws of the Sabbath. A newborn baby, in particular, requires great care. While

most of those needs do not require violating the Sabbath, if they did the Sabbath could be

violated. However, for a non-viable baby that has essentially no chance of survival, the Sab-

bath may not be violated. The concerns of an eight-month baby that does not have fully

grown fingernails and hair do not override the Sabbath (Shabbat 136a).

Today, modern science gives us a different understanding of a fetus' development

than that of the sages. Babies develop steadily until their last month. Those born in their

seventh month are less likely to survive than those born in their eighth month. Premature

babies can suffer from difficulty in modulating temperature and underdeveloped capillaries

and lungs which can be alleviated with respirators and incubators. Today, babies born in

their eighth month routinely survive. How should halakhah respond to this change?

Defining an Eight-Month Baby

Before we address this question, let us first discuss an often overlooked issue – a

definition of terms. What is an eight-month baby?

The Talmud says that a normal (nine-month) gestation period is approximately 271

days from conception. Modern medicine places the due date of a baby at approximately 280

days from the mother's last menstrual cycle. Since a religious woman may only have marital

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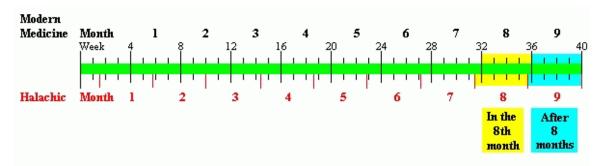
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relations beginning with 12 days after starting to menstruate (after she immerses in a *mikvah*), the 271 days translate into approximately 283 days, which is essentially equal to modern medicine's 280.

Modern medicine divides the 280 days into ten months of 28 days. What is generally called the ninth and final month is really the tenth month - from weeks 36 to 40. The eighth month is from weeks 32 to 36 and the seventh month is from weeks 28 to 32.

Halakhah divides the 271 days into nine months of about 30 days each (Responsa Rashbash 513). Translating that into the weeks we used above (from the last menstruation), the ninth month is from weeks 35.7 to 40. The eighth month is from weeks 31.4 to 35.7 and the seventh month is from 27.1 to 31.4.

Additionally, the simple understanding of the Talmud is that an eight-month baby is one born after eight full months, i.e. after 35.7 weeks. This is the understanding of most commentators with only the Ramban dissenting (*Responsa Rivash* 446).



It is a daily occurrence for babies to be born at 36 weeks and survive without the assistance of respirators or incubators. With their assistance, the survival rate is greater than 95%. How should the halakhic community react to this undeniable reality?

The first point that needs to be made is that *halakhah* only needs to address those babies born without fully grown fingernails and hair. Only those born between 35.7 and 40 weeks who are under-developed are an issue. Nevertheless, the problem remains.

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2b. Nature Changed

The Rashbash (R. Shlomo ben Shimon Duran; early 15th century) quotes the authors of *Tosafot* as saying that already by their time nature had changed. While in the days of the Talmud babies' months were determined by how many months had been completed, they are now calculated by which month the baby is in. While for the Talmud a baby born in weeks 35.7 to 40 (after eight months) was premature, this baby would now be considered full-term (a nine-month baby). Now, only babies born in weeks 31.4 to 35.7 (in their eighth month) are considered premature (*Responsa Rashbash* 513). This is how the Rama ruled in *Shulhan Arukh* (*Even Ha-Ezer* 156:4). The *Hazon Ish* (*Yoreh Deah* 155:4) continued along this line and noted that today a significant number of babies born in their eighth month are viable on their own. This must mean that nature has changed, although he does not speculate as to whether it is due to better prenatal care, healthier diets, or other causes. Since nature has changed and eight-month babies are no longer inherently at risk, the *halakhah* as it relates to current nature is different than it is in regard to Talmudic nature. Since eight-month babies are deemed viable, the Sabbath may be violated for their needs and women who give birth to such a baby are not considered childless.

There were two issues that we pointed out above. One is that babies born after eight months are not only viable but are more viable than those born after seventh months. The other is that with modern medical care even premature babies can survive. The *Hazon Ish* solved both issues by ruling that nature has changed and that eight-month babies are no longer born non-viable. Any baby that can survive, whether on its own or with medical help, is considered a viable baby.

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Alternate Solution

The *Minhat Yitzhak* (4:123:19-20) refused to go that far. He was not ready to say that the Talmudic understanding of the development of babies is no longer true. Of the two issues above, he only addressed the second. Even though eight-month babies are inherently less viable than others, modern medical care can help those babies survive. Since these babies become viable through medical assistance they are therefore viable. It is not that nature has changed. Rather, modern medicine has found techniques to help the non-viable survive.

Spontaneous Generation

Lice on Shabbat

As mentioned earlier, the Talmud in *Shabbat* 107b asserts that it is permissible to kill lice on *Shabbat* because they are not generated from sexual reproduction. The passage reads as follows:

Mishnah: Other insects - one who injures them is exempt... Gemara: Who taught this? R. Yirmiyah says: This is R. Eliezer as it is taught: R. Eliezer says: One who kills a louse on Shabbat is like one who kills a camel on Shabbat. Rav Yosef attacked this: R. Eliezer and the rabbis only argue regarding [killing] a louse that does not sexually reproduce (lit.: that is not fruitful and does not multiply) but regarding other insects that sexually reproduce they do not disagree.

According to R. Eliezer, it is forbidden to kill a louse on the Sabbath. The anonymous majority of rabbis, however, permit killing a louse on the Sabbath because it does not sexually reproduce. As the continuation of this passage makes clear, the dispute between R. Eliezer and the rabbis is not over whether lice are spontaneously generated but over the significance Page 25

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of this fact to the laws of the Sabbath. According to the rabbis, it renders lice permissible to

be killed on the Sabbath and this is how almost all halakhic codes rules. (Interestingly, the

important eighth century work Halakhot Pesukot ch. 136 rules that it is forbidden to kill lice

on Shabbat. But this, along with Responsa Geonim Shaarei Teshuvah no. 225, is a clear minority

view. According to them, however, there is no halakhic implication from this scientific dis-

cussion.)

As already mentioned, it is a well established fact that lice reproduce. With the aid of

a magnifying glass, their eggs can be seen. While prior to the 17th century science claimed

that lice and many other animals are generated spontaneously, science now considers it to be

a strongly established fact that no animals are generated spontaneously. How does halakhah

respond to this radical scientific change?

2. Change *Halakhah*

This was first raised in a now-famous passage in the early 18th century Talmudic en-

cyclopedia Pahad Yitzchak. Its author, R. Yitzhak Lampronti, had an exchange with R. Yehu-

dah Brill of Montoba on this topic. R. Lampronti recommended revising the halakhah based

on the new scientific understanding and prohibiting killing lice on the Sabbath. While he was

quite hesitant to do this and only did so because he was being stricter based on science and

not more lenient, we need to keep in mind that he was living at a time when science was in

flux. It was an exciting time of advances when accepted theories were being overturned. He

had no way of knowing with certainty that this particular theory would remain standing. This

ruling of the Pahad Yitzhak has been recently confirmed in Responsa Shevet Ha-Kehati 3:126,

who claims that nature has changed, and Piskei Teshuvot 314:6. Rav Yosef Qafih in his com-

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mentary to Mishneh Torah (Hilkhot Shabbat ch. 11 n. 4) also prohibits killing lice on the Sab-

bath based on modern science.

1a. Skeptical

However, R. Lampronti's correspondent, R. Yehudah Brill, was more skeptical of

scientific advances. Science, he claims, has limits and its methodology does not give its prac-

titioners enough information to understand the inner workings of the world. Therefore, this

halakhah cannot be changed.

1b. Fixed *Halakhah*

R. Menahem Kasher argued against changing the halakhah for a different reason. If

we forbid something that was previously permitted, we are implying that all of the previous

generations inadvertently sinned. R. Kasher garnered a host of sources, as is his way, that use

this reasoning not to change halakhah. See, for example, Gittin 5b. (Torah Shelemah, vol. 1 no.

710; Mefane'ah Tzefunot, vol. 17 ch. 7 n. 2; Ha-Adam Al HaYare'ah p. 50).

3. Case-By-Case Response

As we explained above, R. Eliyahu Dessler considered this to be a case where the ha-

lakhah preceded the science. Knowing already that one is permitted to kill lice on the Sab-

bath, the sages tried to explain this based on the then-established reality of spontaneous gen-

eration. Later, when science had changed a little, Rambam explained it based on spontane-

ous generation from sweat or excrement. Today, when science has changed dramatically, we

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must find a more suitable explanation. R. Dessler suggested that halakhah is intended for

people to observe and therefore only recognizes items that are visible to the unaided eye.

God does not expect us to rule halakhically based on information we cannot naturally gather.

Since lice eggs are too small to be seen unaided, lice look as if they grow from the item in

which they appear and are given the same halakhic status as their apparent origin. Since hair

and fruit are not living animals that we are prohibited from killing on the Sabbath (picking

fruit off a tree is a separate prohibition), lice are given that same status. Incidentally, this

logic has ramifications regarding microscopic insects found in fruit, but this is not the place

for that discussion.

Conclusion

We have seen that halakhic authorities have been keenly aware of scientific advances

and their relation to Torah. No rabbi should be surprised when told that lice reproduce be-

cause this has been discussed widely in halakhic literature. However, how halakhah should

react to changes in scientific understanding was never discussed explicitly in the Talmud and

modern authorities need to deduce their approaches from the classical texts. This leaves

room for different reactions to scientific changes. Some believe that the proper approach is

to revise halakhah. Others believe that they do not have the right to do so. And, as we dis-

cussed, others argue that only some halakhot may be changed. Who is correct? This is a mat-

ter that requires not just knowledge of certain areas of halakhah but a firm grasp of all halak-

hot and the entire halakhic process. This is an area where one need to have a feel for how

halakhah develops and is decided. In other words, only the greatest of experts can even offer

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an opinion and, while even the experts may disagree, we do not believe that we have mastered the entire halakhic process well enough to merit having an opinion. May God send us Eliyahu speedily to clarify the *halakhah*.

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