

Derech HaTeva

A Journal of Torah and Science

Volume 27

2022-2023



A Publication of Yeshiva University Stern College for Women

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Acknowledgment

Over a quarter of a century ago, the concept for an undergraduate Torah-science publication was born at Stern College for Women (SCW), with the realization that science majors at the college have two unique strengths—a comprehensive secular education and a strong Torah foundation. Only at SCW could these two worlds meld into one—that of Torah U’*madda*. It is a common misconception that Torah and science are at odds with each other, but this approach is simplistic and unsophisticated. With a deeper understanding of both biblical texts and scientific principles, conflicts between the two can be dissolved, leading to greater unity and understanding.

Derech HaTeva, the journal that embodies Torah U’*madda*, is a perfect representation of this unity, as is Dr. Harvey Babich, who has provided guidance and support in publishing volume 27 of Derech Hateva. Without his constant assistance and encouragement, this publication would not have been possible. Dr. Babich's passion for Torah and science is evident to anyone who knows him, and his dedication to his students and the success of the biology department is inspiring. He goes above and beyond the standard responsibilities of the head of the department, ensuring that each individual is set up for success not only academically and professionally, but also personally.

Much appreciation is expressed to Dr. Fred Grunseid, M.D., and to Dr. Sheri Rosenfeld, M.D., Allied Medical Associates, Brooklyn, NY, for their continued support towards the publication of *Derech HaTeva*.

Sincerely,

Editors

Taliah Soleymani, Eden Hariri, and Avivit Nsiri

Co-Editors

Aliza Kass and Allison Warren

Dedication

This past year we mourned the tragic loss of Adira Koffsky, who was killed in a car accident while on her gap year at Amudim. Adira Koffsky's sudden passing has left a deep sense of loss for all those who knew her. At the young age of eighteen, Adira had already made an indelible impact with her sharp intellect, artistic talent, and unreserved warmth and friendship. Her passion for the performing arts was matched only by her subtle leadership in other areas. Adira's passion for writing and her voracious reading habits hinted at a future of great potential, but it is her human contribution that will be



missed the most. Like her ability to live life on her own terms while expressing warmth and support to those around her. Her vibrant personality and unwavering commitment to her beliefs made her an extraordinary person, and her absence will be deeply felt.

In honor of Adira Koffsky and her insightful musings on the intersection of intellectual curiosity and religion, we dedicate this journal to exploring the complexities and nuances of these two fields. Adira's writing reminds us that doubt can be a powerful tool in our search for understanding and that questioning our beliefs should not be feared, but rather embraced. Her journey toward finding practicality and grounding in her faith serves as an inspiration for all of us to continue exploring the depths of our own beliefs. May her words continue to guide us as we seek to bridge the gap between science and religion.

Sincerely,

Editors

Taliah Soleymani, Eden Hariri, and Avivit Nsiri

Co-Editors

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Adira Koffsky's Essay for an Israeli Seminary

I never liked the word 'faith'. It implies blindness, following or believing in something simply because you were told to. When I was younger, I thought it was faith that made you religious, that if you just believe in Hashem and the Torah everything will be perfect. Then middle school arrived and with it came the very thing that shaped my entire Jewish development till this very day. Doubt.

'Doubt' is another word I never really liked, or to be more accurate, I never liked the connotations that came with it. Doubt is seen as a bad thing, something that must be shunned and persuaded against. After all, how can you doubt G-d? How can you doubt what He gave us, everything that our religion and community is built on? How can you question everything you've ever known? And to that I say *how can you not?*

How can you live, taking everything at face value, and never even once considering that there could be more to it? I used to fall victim to this as well, taking every story from the Torah as literal, but it never felt right. It was almost too miraculous. My Jewish identity has always been a practical one, it never felt complete with miracles and prophecies. The direct presence of G-d was hard to relate to or even believe at times. I love fantasy, and that's what it felt like, a fantasy novel, not the history book I was told it was.

It went further than that. Halacha, the rules that shape our daily lives as Jews, the structure of our communities and religion. Too many people follow the rules because they are rules, they don't stop and wonder why we have them in the first place. Some even try to discourage it, claiming that questioning such things is dangerous and can lead people off the derech. I find that to

be more harmful than curiosity ever could. Questions shouldn't be brushed off, they should be treated with the proper time and respect they deserve.

My questions led to answers, some I found satisfying, many did not. But this prodding for knowledge is what made me realize just how complex and truly breathtaking Judaism was. An unlikely mix of faith and law, where religious beliefs are backed by legal systems established by both G-d and man. It's truly a marvel, and I think that if more people looked past the face value, they would see that too.

They would see the story of creation, not as an argument against evolution, but as beautiful poetry about the world we live in. And the people of the Torah, what they did and what was done to them, shouldn't only be seen as chapters in one long history textbook. Rather, moral lessons and cautionary tales, highlighting both midot and flaws, so we can learn to improve ourselves and the world around us. It was through this logic and practicality that I saw a way to make the Torah not a fantasy, but truly grounding and part of reality.

This realization doesn't mean I'm done searching, far from it. I have just begun this journey, and I do not plan on stopping anytime soon. Some like to claim that doubt can ruin religion, tear down what we have spent centuries and centuries building. I disagree. Because of doubt, my faith has never been stronger.

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A Synesthetic Perspective on Jewish Mysticism and the Revelation at Sinai

By: Taliah Soleymani

There is a biblical text which describes an extraordinary event at Mount Sinai, where the Jewish people "saw the voices (of G-d), the lightning, and the sound of the shofar" (וּבְלִי-הַקְּעָם רָאִים אֶת-הַקּוֹלֹת וְאֶת-הַחַלְפִידִם וְאֶת קוֹל הַשּׁוֹפָר) (Exodus 20:15). This pasuk raises the question of how to interpret this statement, which suggests that the Jewish people perceived a non-visual experience through their sense of sight.

The concept of "seeing sounds" at Mount Sinai has been the subject of much discussion among biblical commentators. Sforno, a 16th-century medieval commentator, provides one interpretation of this phenomenon. He suggests that the word "ראים", which is commonly translated as "seeing," should be understood similarly to its usage in *Kohelet 1:16*, where it is used to describe the phrase "and my heart 'saw.'" Drawing a comparison between the heart's inability to physically see and an individual's inability to truly "see" sounds, Sforno proposes that "seeing" in this context means attaining a deep understanding.[1] This opinion suggests that there was a profound sense of knowing that occurred during the revelation. According to Kli Yakar, a prominent 16th-century commentator, the words spoken by G-d at Mount Sinai were so tangible that they took on physical form and could be seen as floating letters in the air as if they were being written in front of the Jewish people. [2] However, this interpretation appears to contradict the account of this event in *Deuteronomy*. In *Deuteronomy 4:12*, Moshe

recounts G-d's speech to the Jewish People at Mount Sinai, emphasizing that they heard the words, but did not see any images: "You heard the sound of the words, but saw no image, just a voice." (קוֹל דְּבָרִים אָתָּם שָׁמְעִים) (קוֹל דְּבָרִים אָתָּם שָׁמְעִים וְלֹא רָאִיתִי קוֹל וְיִתְמוּנָה אֵינְכֶם רָאִים זוּלָתִי קוֹל). Ibn Ezra, a 12th-century Spanish commentator, provided a more fitting explanation for the phenomenon. He suggested that at that time, all sensations were perceived and processed at a single point, allowing for the voice of G-d to be processed visually.[3] This idea is echoed in contemporary science, suggesting that Ibn Ezra's commentary could be seen as a precursor to the phenomenon now identified as synesthesia.

Synesthesia is a perceptual condition where multiple sensory pathways are activated, resulting in an intertwined interpretation.[4] For example, a synesthete—one who is born with synesthesia—may experience a variety of sensory integrations such as grapheme-color or sound-color. Grapheme-color synesthesia is when a person experiences visual stimuli of letters or digits, which simultaneously stimulate color perception, without the color being present. As well, sound-color synesthesia occurs when an individual perceives color from sound stimuli without receiving visual stimuli. Scientists currently have two prominent theories to explain synesthesia. The first approach, the disinhibited feedback theory, suggests there is a functional abnormality in the brain in which a pathway that is usually suppressed to prevent crosstalk between different regions of the

brain becomes active. A second approach, the cross-activation theory, centers on a structural difference in the brain resulting in excessive neural connectivity between regions that process different types of information, such as numbers and colors in grapheme-color synesthesia.[4] However, the empirical support for these theories is not well established and further research is needed to elucidate the neurobiological underpinnings of the phenomenon.

Apart from those born with synesthesia, the perceptual phenomenon can be triggered by means of meditation or through the administration of drugs.[5] Recently, there has been a resurgence in psychedelic research, and David Luke, Ph.D., an associate professor of psychology at the University of Greenwich, has been investigating the intersection of psychopharmacology and parapsychology, particularly in relation to synesthesia. In a recent study, he conducted a survey of recreational drug users about their use of 28 psychoactive drugs from 12 different drug classes and whether they had experienced synesthesia while under the influence of these substances. The findings indicate that sound-color synesthesia is the most common form of drug-induced synesthesia. Furthermore, the study revealed that tryptamines had the highest incidence rates in inducing synesthesia. [5] Tryptamines are serotonergic hallucinogens, with the most commonly known ones being lysergic acid diethylamide (LSD) and dimethyltryptamine (DMT), which is a molecule most notable for being an active ingredient in Ayahuasca—a plant-based psychedelic.[6]

DMT has been regarded as a spiritual molecule for centuries by various indigenous cultures in South America.[7] In addition to its exogenous presence in psychedelics like Ayahuasca, DMT has also been discovered endogenously.[8] The first identification of DMT in mammalian brain tissue was made by Nobel Prize laureate Julius Axelrod. Subsequent studies have provided further evidence supporting his discovery.[9] In the 1990s, Dr. Rick Strassman, a medical doctor and psychiatrist, conducted pioneering research on the administration of DMT in humans. He later wrote a book called "DMT and the Soul Prophecy," in which he proposed that prophetic and psychedelic states may share biological mechanisms.[7] Throughout the book, Strassman explores medieval commentaries on the biblical text and presents a model he calls "theoneurology," which bridges biology and spirituality by suggesting that the Divine communicates with us using the brain and that endogenous DMT is a critical factor in visionary experiences. This model provides an alternative to "neurotheology," which suggests that altered brain function only creates the impression of a Divine-human encounter. Nevertheless, Strassman emphasizes that meeting criteria beyond the mere release of DMT are necessary to have a genuine prophetic experience.[7] While the administration of exogenous DMT does not replicate the prophetic experience, it can serve as a framework to enhance our comprehension of this neurological phenomenon.

According to Strassman, during a revelation, G-d intervenes by triggering the body to produce endogenous DMT, which enables a higher level of consciousness required for a prophetic experience.[7] Since DMT is known to induce synesthesia, which is thought to have occurred during the events at Mount Sinai, the release of endogenous DMT may be related to the Jewish People being able to experience the revelation.[7] Furthermore, Luke's research demonstrates that DMT specifically induces sound-color synesthesia [5], which aligns with the description of the "seeing sounds" experience at Mount Sinai. Given this evidence, it is possible that DMT contributed to the synesthetic encounter at Sinai, or at the very least can be utilized as a template to comprehend a comparable experience.

Although chemically induced synesthesia could be proposed as a factor in the Jewish People's ability to see the voice of G-d, it fails to account for the significance and purpose of this experience. The Sefat Emet, the late 19th-century prominent Hasidic leader, offers a compelling analysis of this question, prompting readers to contemplate the intricate relationship between the processing of sight and sound.

“We still have to understand, though, what the need is for this miracle. What do I care if they just heard the sounds, without a miracle? And we may answer: because Seeing and Hearing are two distinct experiences, one unlike the other. And each one has an advantage and a disadvantage.

For the Seer looks at a thing in its completeness, exactly as it is. But for the Hearer, the sound changes as it enters his ears, and it isn't exactly the same sound that was originally made. That's the advantage of Seeing. But with Hearing, there is an advantage that the sound truly enters inside of him through the ear, whereas the sight remains outside. With this in mind, the verse teaches us that the Children of Israel had both advantages. They received the words in the manner of “seeing sounds,” such that even though they truly entered inside of them, nevertheless they “saw” the sounds, without any distortion.”(Sefat Emet, Numbers, Shavuot 4:5)

Here the Sefat Emet stresses that Seeing and Hearing are two distinct experiences, each with its own advantages and disadvantages. However, the miracle of "seeing sounds" provided the Jewish People with both advantages simultaneously without any distortion allowing for the complete experience. Rav Kook, a late 19th-century Jewish philosopher, and thinker, further emphasizes the importance of this unique experience:

"The prophetic vision at Mount Sinai...granted the people a unique perspective as if they were standing near the source of Creation. From that vantage point, they were able to witness the underlying unity of the universe. They were able to see

sounds and hear sights. G-d's revelation at Sinai was registered by all their senses simultaneously, as a single, undivided perception." [12]

Rav Kook emphasizes in his writings that G-d's *Oneness* transcends the limitations of physical perception. Our senses are compartmentalized in order to help us navigate and comprehend the physical world, as it would be overwhelming to constantly experience multiple stimuli simultaneously. However, when one reaches a higher level of consciousness, they are removed from physicality and there is no longer a need for the separation of senses. To experience *Oneness*, one must transcend the limitations of their physical senses, as highlighted by both the Sefat Emet and Rav Kook.

It is noteworthy that David Luke and Rick Strassman's research indicates that individuals who have undergone psychedelic experiences, specifically DMT, often report profound realizations about the interconnectedness of all things, the dissolution of the ego, spiritual awakenings, and the perception of truth.[7][13] The teachings of mystics, as elucidated by Rabbis such as Sefat Emet and Rav Kook, reveal that the concept of universal *Oneness* was a crucial component of the revelation at Sinai.[11-12] Isaiah's portrayal of the Meshiach provides another reference to the concept of oneness and synesthesia. The verse states, "*And the glory of the Lord shall be revealed, and all flesh, as one, shall see—for the G-d Himself has spoken*" ("וְנִגְלָה וְרָאוּ כָּל-בָּשָׂר יְהוָה וְאֵין כָּל-בָּשָׂר יִתְדָו כִּי פִי יְהוָה דַּבֵּר")

(Isaiah 40:5). The use of the phrase "as one" highlights the emphasis on unity.

Furthermore, similar to the phrasing used during the revelation at Sinai, the word "וְרָאוּ" is used to emphasize the visualization of G-d's words. These connections suggest that the experience of synesthesia is associated with profound revelations of universal *Oneness*.

In addition to psychedelics, meditation can also bring us to higher levels of consciousness. In his book "Jewish Meditation: A Practical Guide," Rav Aryeh Kaplan, a 20th-century Orthodox Rabbi and Physicist at the National Science Foundation, explains that although certain drugs can alter a person's state of consciousness, he chooses to explore self-induced states.[14] Kaplan delves into Jewish mystical teachings on meditation and how higher consciousness can be achieved. He notes that in advanced meditation, one may even begin to see colors implying a synesthesia-like experience: "There are sources that indicate that in more advanced meditative techniques, it is possible actually to see visions in this blue field (see Sefer Yetzirah 1:12)." While psychedelic experiences may induce a revelation of *Oneness*, Kaplan suggests that higher levels of meditation are achieved through becoming aware of G-d's *Oneness* and Universal unity. From here it is suggested that the relationship between higher consciousness and the revelation of *Oneness* can be bidirectional, and implies that achieving such a state is possible without the use of external substances. Additionally, based on Strassman's hypothesis, it is

possible to suggest that meditation may also lead to the endogenous release of DMT. Thus, meditation may provide a safe and feasible means for individuals to attain higher levels of consciousness.

By combining biblical accounts of our ancestors' extraordinary sensory experiences with modern scientific explanations of similar neurological phenomena, it is plausible that our ancestors experienced mass synesthesia at Mount Sinai.

Additionally, by employing scientific insights, we can validate traditional teachings and interpret our forebears' perceptions of intermingled senses as an indication of their profound spiritual awareness during the revelation. This observation highlights the potential of scientific investigation to uncover a deeper significance behind these experiences.

While the renewed interest in psychedelic substances offers new avenues for studying higher consciousness, it's important to acknowledge that many questions remain unanswered and that these substances can only serve as a limited model or conceptualization of a larger process. The drug-induced model of higher consciousness suggests that this state is attainable, but in Judaism, there is a strong emphasis on being present in the physical world, which is further reinforced by the brief nature of Bnei Yisrael's revelatory experience. The Jewish perspective maintains that it is humanity's responsibility to strive towards unity and wholeness, but the great sin of the golden calf underscores the fact that experiencing Oneness is not enough—one must continually work to develop a relationship with G-d.

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Infertility is a taboo subject, commonly addressed in hushed tones and sympathetic whispers. It's a topic "not discussed" or considered "rude" to discuss in a public setting. This mentality only perpetuates shame and secrecy surrounding this extremely common and devastating reality.

Infertility is a complication that plagued three of the four matriarchs, causing great suffering for each of them. Sarah was resigned to not having children since she had reached the age of 90 without conceiving. Rebecca had similar struggles with infertility and asked her husband Isaac to pray on her behalf. Rachel Imeinu not only struggled to conceive but had to watch as her sister and both their midwives conceived before she did. Rachel was driven to such desperation, she tells her husband Yaakov "Give me children, or I am dead" [1]. These are three widely known cases of infertility in Judaism from centuries ago, a condition that persists in modern times. According to studies in 2022, approximately 6% of women face infertility, and 12% of women have complications carrying a pregnancy full-term [2]. In the United States alone, roughly 1 in 5 women are unable to conceive naturally even after a full year of trying— the definition of infertility— and the CDC claims fertility issues continued to rise in 2022.

Infertility is a complex medical topic and can vary from patient to patient in both minor and major ways. Since it is such a complex topic, there have been multiple Halachic papers written discussing the matter and answering questions from struggling couples. The most common infertility treatments are Intrauterine Insemination (IUI) and In-vitro Fertilization (IVF). These procedures involve artificial insemination with a man's sperm inside the woman's uterus, or in a petri dish.

The subjects of IVF and IUI are broad topics with endless possibilities for discussion and debate regarding ethical and halachic matters. One question regarding fertility treatment was posed to Rabbi Elan Segelman (the rabbinic director for PUAH in America) [3]. The case is as follows: shortly before engagement, Chaya was diagnosed with cervical cancer, and the couple decided to wait to perform the necessary hysterectomy until after their wedding. They intended to first create an embryo and eventually transfer the embryo to a surrogate. However, due to the Covid-19 pandemic outbreak, their wedding was postponed, but the scheduled date for the embryo creation was maintained and approaching. Since it was necessary to remove Chaya's genetic material prior to chemotherapy and the hysterectomy, she asked PUAH if she and her groom were still allowed to medically create an embryo together prior to their marriage. There are three main Halachic issues that PUAH had to deal with in order to answer this question. First, determine if a hysterectomy is halachically permissible at all. Second, the method of sperm procurement. Lastly, dealing with the premarital embryo creation prior to delving into the halachic background and considerations, we must first understand the medical background necessary for this case study.

The cervix is what connects the vaginal canal to the uterus, which is where fetal development occurs during pregnancy. Each year "13,000 new cases of cervical cancer are diagnosed and about 4,000 women die of this cancer" [4]. Depending on the location of cervical cancer, a hysterectomy might be necessary. A hysterectomy is a surgical procedure to remove the womb (uterus), resulting in the patient being unable to carry a pregnancy after the operation. The

discussion of castration is brought up in *Parshat Vayikra 22:24* regarding animals. In *Gemara Shabbos 110b*, it is discussed that castration applies to human sterilization as well. However, regarding saving a life (*pikuach nefesh*), the Sages (*Chazal*) teach us that we are obligated to preserve life, even if we must violate a Torah prohibition (except for the three cardinal sins). Therefore, *Halacha* would fully allow and obligate Chaya to get the hysterectomy since her life is in danger, regardless of the operation causing infertility.

The next subject to understand is fertility preservation. A newborn female is born with millions of oocytes (eggs) in her ovaries, and this number is significantly reduced to 300,000 by the time she reaches puberty. Unlike men, who are constantly reproducing sperm, women are born with all the oocytes they will ever have. This is why in 2018, the American Society of Reproductive Medicine (ASRM) recommended that single women in their mid-thirties to freeze their eggs to “prevent the consequences of their biological clock’s inevitable fertility decline.” reference #? Then, when a woman is married, she can unfreeze her eggs, fertilize them with her husband’s sperm, and create embryos to be implanted into her uterus via IVF. This procedure is also common in cancer patients, referred to as oncofertility. An unmarried woman undergoing the procedure of egg retrieval, has her oocytes immediately cryopreserved (stored at very low temperatures). According to Dr. Eli Ryback and many other fertility professionals, “embryo cryopreservation remains roughly 15% more efficient than egg freezing.”[3] Meaning, there is a 15% higher chance of having a baby using a frozen, fertilized oocyte (embryo) than a frozen oocyte (unfertilized egg).

Now that the medical background is understood, let's delve into the Halachic

debate and decisions surrounding this case. Chaya wants to take advantage of the benefits of frozen embryos versus frozen oocytes and wants to know if it's halachically permissible.

One major Halachic issue to address is procuring the sperm for fertilization. Typically, when a couple is undergoing fertility treatment, they use what's called a collection condom. Rabbi Moshe Feinstein [5] states that couples undergoing fertility treatment must use a collection condom. He also mentions the possibility of alternatively utilizing *coitus interruptus* [6]. Unfortunately, in this case study, a collection condom would be impossible since the procedure is occurring prior to marriage. The only route available would be masturbation, which is very controversial according to Halacha. The Shulchan Aruch [7] holds that causing semen to spill with one's hand is *like* committing adultery on a lesser level and violates “*Lo Tinaf*” (“Do not commit adultery”[8]). Rabbi Waldenburg addressed this conundrum and ruled, when no other option is available, masturbation is permitted for fertility purposes. The consensus amongst most Rabbanim states, that masturbation is permissible with the intention of fulfilling “*peru urvu*”, since the semen is not being wasted. As such, for married couples this justifies semen collection for IVF treatment since it fulfills the commandment of “*peru urvu*”. This reasoning might pose an issue for Chaya’s case study since prior to marriage, there is seemingly no obligation to fulfill “*peru urvu*,” because premarital relations are prohibited. However, Chaya’s scenario is unique, since the intention of the semen collection would be for the mitzvah of “*peru urvu*” after marriage, starting IVF treatment now. Even though the mitzvah isn’t immediately relevant, in Chaya’s scenario it would be ultimately fulfilling the purpose of “*peru urvu*”.

Another consideration for embryo creation surrounds the concept of *Niddah*. *Niddah* is defined as “a woman who has menstruated and not completed the purification process afterwards”[9]. This Halacha is first cited in *Vayikra* 18:19 it states: “וְלֹא-לִאִשָּׁה בְּיָמֵי טְמֵאֹתָהּ לָא תִקְרַב לְגִלּוֹת עִרְוַתָּהּ” meaning, “Do not come near a woman during her menstrual period of impurity to uncover her nakedness.” An unmarried woman is considered perpetually in *Niddah*, from the time she begins menstruation until she completes the purification process prior to marriage. The Sages (*Chazal*) teach that a child born during this period of impurity (*Niddah*) is called a *Ben Niddah*. There is a question raised about the status of a *Ben Niddah*, however, the consensus states a *Ben Niddah* is a completely legitimate individual [10]. Regardless, in the Halachic discussion regarding appropriate behavior during this *Niddah* period, the Bach quotes Rabbeinu Peretz, stating that a woman in *Niddah* is allowed to lay on her husband's sheets. Despite the risk of the woman in *Niddah* conceiving from residual sperm on his bed, the child would not be a *Ben Niddah* since the label is “a direct function of the prohibited act of intercourse.” Based on this understanding and following Rabbinic discourses, the majority Halachic opinion maintains that conception during *Niddah* is permitted. Since single women do not immerse in the *Mikvah*, Chaya is allowed to proceed with her scheduled egg retrieval prior to marriage. Additionally, a medically conceived child would not be considered a *Ben Niddah*, since medical conception violated no *Niddah* Laws as there was no sexual act between the couple during this process.

Upon thorough analysis and debate, the final Halachic conclusion was that Chaya and her *chasson* could proceed with premarital embryo creation in a Halachic manner. The full study and discussion can be read in

Rabbi Elan Segelman’s Halachic discourse on “Premarital Embryo Creation” [3].

This is, of course, a complex and specific scenario, but as mentioned initially, this is a common issue that is being addressed by thousands around us daily. PUAH receives 400+ calls a day and there are 10,300+ fertility cases supervised by PUAH alone. Understanding and awareness are of the utmost importance in order to support our community and fellow Jews.

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As science has determined, human beings are composed of cells, and each one of these cells contain our genes, the necessary information required to make us who we are. As one delves into the study of genetics, it is natural to wonder if we control ourselves or if our genes control who we are. It is understood that we look the way we look because of our genetic makeup, but is this makeup also responsible for how we act? This question really addresses an age-old question of free will; do we control ourselves, or are we being controlled? With the emerging research on epigenetics, this question may now be answered using science.

As we know, a person's genes are the combination of the genetic information from their mother and from their father. This information is divided and distributed at random, or is predetermined by God. These genes code for the way we look and how our bodies function. However, it is up to epigenetics to control the way our genes are expressed. The analogy that is commonly used to help understand epigenetics is that of a sentence; the words are the genetic code, and the punctuation represents epigenetic expression. Punctuation can change the way the sentence is read and understood. Similarly, Epigenetics has the power to control how much certain genes are expressed or whether they are expressed at all. These epigenetic controls vary between people and have the potential to be passed on to offspring. Epigenetics works by processes called methylation and acetylation. Chromosomes consist of DNA wrapped around proteins called histones. Chemical changes to the DNA and histones can affect whether a gene will be expressed or not. Methylation, or the addition of a methyl group to DNA base pairs, "turns off" a gene, and acetylation, or the addition of an

acetyl group, to histones "turns on" a gene. Inactivation and activation of gene activity is the basis of epigenetics. These processes are controlled largely by our environment or lifestyle, and they have major effects on the expression of our genes [1].

To fully understand the ramification of epigenetics, it is important to understand exactly what our genes control. We know that our genes code for our physical makeup and for the various biological processes in our bodies. However, as the study of epigenetics has shown, it is possible to change the expression of our genes through various environmental factors. This can affect physical or biological factors in our bodies. For example, a diet including blueberries has shown to reduce environmentally induced or spontaneous DNA damage through epigenetic processes. This can protect someone against certain cancers. Additionally, limited fasting has shown to promote longevity due to epigenetic processes [1].

As established, genes code for our physical and biological makeup, and the expression of these genes is controlled through epigenetics. However, the next step is to understand if genes control how we feel and act. Rabbi Dr. Moshe David Tendler says very clearly, "There is a scientific basis for the existence of behavioral genes in our genome" [2]. Our genes code for certain natural behaviors or traits. However, Dr. Gerald Schroeder adds that, "Genes present a tendency. They do not dictate our actions." Genes control our desires and tendencies, but they do not control our ultimate behaviors [3]. Similarly, Rabbi Dr. Tendler further explains that we have genetic predispositions toward certain traits or emotional reactions, however, we have the ability to control ourselves and change our

genetic predispositions [2]. How is this possible? The answer is epigenetics. Epigenetics is the process that allows lifestyle habits and changes to affect the way our genes would otherwise guide us to act and react [1]. This means that even if someone has a genetic predisposition toward certain traits, he still has the ability to change those traits by changing the way that he expresses those genes.

This research on epigenetics and behavior seems to address the question of how we can be expected to act “against our genes”, and more broadly, the question of free will. If a person is born to two criminals, and is shown to have certain violent tendencies, how can he be expected to be anything but a criminal? The answer to this is that he can control the expression of his genes. He does not have to be a criminal. He can be a kind and gentle person if he works on his traits and behaviors.

This idea, that we can control who we are and who we become, is greatly supported in Judaism. The Ramban makes it clear that the Torah believes that human beings have free will, “This following subject is very apparent from Scripture: Since the time of Creation, man has had the power to do as he pleases, to be righteous or wicked.” (Ramban on Devarim 30:6). We have control over our behaviors. Additionally, Rabbi Dr. Tendler points out the relationship between epigenetics and free will using the story of Cain and Abel. Cain was angry after his sacrifice was not accepted by God, and God told him, “Sin crouches at the door; Its urge is toward you, yet you can be its master (Genesis 4:7).” Rabbi Dr. Tendler explains that, “G-d’s instruction to Cain was: I did give you a genetic disposition to quick temper... But I also gave you free will to master your more violent tendencies...” [2].

So how exactly do we use epigenetics to change our traits? The Rambam addresses this in his Mishneh Torah: Hilchot Deot, saying that repeating the same behavior over and over will cause a person to acquire the positive trait that is associated with that behavior. “He should do this constantly, until these acts are easy for him and do not present any difficulty. Then, these temperaments will become a fixed part of his personality” [5]. Repetitive behaviors can trigger epigenetic changes, which will change the expressions of our genes, thereby changing our traits or “natural” tendencies. Rav Eliyahu Dessler gives similar advice in his book *Strive for Truth*; he recommends that people who are struggling with loving someone, should purposely give to the person, and eventually they will come to love him. This type of behavior can cause actual feelings and tendencies to change [4]. This idea is famously summarized by a quote from the *Sefer Hachinuch*, “after the actions, come the feelings” [6].

Dr. Schroeder explains that God's commandments serve to change the expression of our genes so that we can change our traits. We have a natural tendency towards certain things, but we are commanded to act against these tendencies. In this way, we can become the moral and ethical people that the Torah intends for us. The Torah commands us to regulate and shape our traits [3].

As was mentioned previously, epigenetic changes can be passed down to children and even to grandchildren. This information is interesting and important because it validates the idea that angry people can have angry children, but it also tells us that people who work on certain traits can have children who will genetically possess those positive traits. The traits and behaviors that a parent has at the time of conception is what matters most [1]. And furthermore, the way that a

mother feels and acts when she is pregnant can have significant effects on her child. “The mother’s emotions, such as fear, love and hope, can biochemically alter the genetic expression of the offspring” [1] Our genes aren't the only things we pass on to our children, we also give them our epigenome.

Ultimately, we have control over our behaviors and traits. Although a person may have certain natural tendencies, he has the ability to overcome these tendencies and change his behaviors. The development of epigenetic research has proven this concept. Science shows that our genes might present us with certain inclinations, but our epigenetics control those inclinations, and we have control over our epigenetics.

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Accountability in the Celestial Court, Free Choice, and the Prefrontal Cortex

By: Hannah Pollak

Modern medicine suggests that teenagers are highly sensitive to minimal amounts of any addictive substance. Consequently, they are more prone to addiction and suffering from neurological damage than adults.

Furthermore, the predisposition to addiction and resulting brain damage stems from the fact that the prefrontal cortex (PFC) is not fully developed until around twenty years old [1]. The PFC is the cerebral cortex that covers the frontal lobe of the brain. Research has shown that the PFC is mostly responsible for, what neuroscientists call, “executive function” [2]. The executive function allows the individual to accomplish and make “smart” choices. Executive functioning skills involve social cueing, higher-level reasoning, anticipation, working memory (specifically, short-term memory that allows a person to have more than one thought in mind), and decision-making. In fact, it has been demonstrated that patients with PFC damage tend to have poorer judgment and decision-making [3].

It is known today that several significant morphological and functional changes happen to the brain during adolescence, ages ten to twenty four years. [4]. PFC development is no exception. In fact, since, as MRI studies have shown, the brain develops in a back-to-front pattern, the PFC develops last [5]. Research has also discovered that myelin in the frontal lobes increases throughout adolescence. Myelin increase translates into neurocircuitry increase –more effective communication between the brain regions. These processes are called “frontalization,” the maturation of the PFC in order to regulate behavior and give the individual access to a full array of creative and analytical skills [6].

At first glance, it would seem that the Torah view on adulthood is not consistent with the discoveries of modern science. In fact, according to Jewish law, girls and boys cease to be children at the age of twelve and thirteen, respectively. Thus, starting from *bar* or *bas mitzvah*, the individual is bound to all *mitzvos* and consequently liable to penalty in a *beis din* (Jewish court) [7]. Nevertheless, this is difficult to understand, since as we presented above, it is known that even when an individual officially reaches the age of adulthood, he still has to mature considerably, and thus, how can we expect a child to be held to the same standards as a full-fledged adult? In any case, there are *aggadic* statements that provide perspective to what it means to be an adult and an adolescent according to the Torah. *Chazal* learn that a person is not held accountable in the Celestial Court, i.e., subject to divine punishment, until he or she is twenty years old. Elsewhere, the Talmud notes that those from the generation of the desert that was under twenty years when the sin of the spies happened, were not part of the death sentence [8]. The Rambam quotes this in his Commentary to the Mishnah, stating that *kares* [excision] is not binding until the person turns twenty years [9]. The *Nodah BiYehuda* argues that while we do give legal validity to this principle, we still cannot say that a person has a free pass to sin for eight or seven years. Rather, he assumes that G-d will not execute the corresponding retribution until he/she is twenty years old [10]. However, the *Chasam Sofer* writes that since this principle is derived from *aggadic* contexts, we do not accept it as actual *halacha*, and therefore we assume that a person is held accountable in a human *beis din* and in the *Beis Din Shel Maalah*, from his or her *bar* or *bas mitzvah* [11].

In any case, these *Aggadatta*, as any other vignette or statement in *Chazal*, cannot be disregarded completely. Even if we assume that we do not take *Aggadatta* at face value nor use them as sources for *halacha*, it is crucial to understand that there is still a message or a concept being conveyed [12]. In this case, one can take advantage of the scientific discoveries available to us today to find insight into the Talmudic passages quoted above and to show, one of the many examples, where science can enrich our understanding of Torah.

An adolescent brain is more prone to make “stupid” decisions because the PFC is not yet mature enough to warn the person of the long-term effects of his/her actions. And at the same time, when the person is vulnerable and makes the wrong decisions, substances like drugs can compromise the healthy development of the PFC (and other parts of the brain, as well), creating long-lasting neurological damage [13]. It is ironic and even tragic that when a person is most affected by allure of alcohol and drugs is when he/she is mentally the least qualified to think straight and avoid them. Therefore, on a parenthetical note, it goes without saying that parents, educators and community leaders are extremely responsible for creating awareness of this issue and should protect those more vulnerable to the corrosive effects and abuse of addictive substances. In fact, there is a famous responsum by Rav Moshe Feinstein, where he outlines around seven different reasons why consumption of cannabis should be prohibited according to *halacha* [14]. It is clear that Rav Moshe was using his common sense and the scientific knowledge available at his time to apply timeless Jewish principles. Today, some want to say that some of his reasons are not up-to-date with the research and thus perhaps no longer applicable. Either way, most of his rationale is still valid. Moreover,

having in mind the additional factor of the immature PFC, the *teshuva* becomes even more severe and binding with respect to drug consumption for adolescents.

Back to the original theme of accountability in the Celestial Court vis-à-vis accountability in a human court. Even though there is no medical consensus regarding when exactly the PFC matures fully, it seems clear that a normally developed person is around twenty years old. Around that time, the brain is already in an adult stage, allowing the individual to be a citizen, vote, run for governmental positions, marry and consume alcohol. Since the Torah was aware of the complex and gradual process of mental maturation, it also defined that while in this world, in our fact-based *halachic* reality, if a person sins, he will receive retribution once he is a legal adult from bar or bas mitzvah. However, the *aggadic* passages come to embrace a meta-*halachic* reality; a broader perspective on justice and the development of the human mind. When *Chazal* claim, via a narrative, that Divine judgment would not be executed until the person is twenty years, perhaps they are implying that according to the Torah, adulthood is not a black-or-white status, or that an individual becomes a full-fledged grown-up, the day she or he turns twelve or thirteen years. The potential leniencies a minor might have before the Celestial Court suggest that *Chazal* acknowledge that even if a person is an adult before the law, he/she can still not be fully capable of weighing the value and effect of his actions [15].

It is explained in Jewish thought, that human justice and Divine justice are different in the sense of how precise they are. A human judge does not take into account how that punishment will affect the person’s relatives or others who depend on him. However,

G-d's justice is absolutely just. When G-d executes punishment, more than the isolated sinful action is considered. G-d considers if and how the person should be penalized without ignoring factors beyond that crime [16]. In this sense, we can explain why a human court will execute punishment, even when the person's brain, or moral consciousness, might not yet have fully matured. The judge has "before his eyes" an adult who made a mistake, and thus, for that he deserves a proper penalty. However, G-d can factor in other components. Beyond the particular crime, G-d's perfect, all-encompassing justice, can consider developmental factors that might lead a person to make the wrong decision.

On a slightly different note, we can also distinguish between the purpose of human and Divine justice. A human *beis din* acts not only to punish the individual who sinned but also to educate the masses and create awareness of the severity of sin. However, the Celestial Court has only justice in mind [17]. Thus, we can argue that a human *beis din* can execute punishment to that person who desensitized others regarding the seriousness of violating G-d's will. However, when it comes to Divine punishment, the sociological effect of crime and its punishment is not taken into account. And therefore, the Celestial Court will only consider the individual's conditions and perhaps wait until he/she is mature enough to weigh the value of their actions and the potential consequences.

One can argue that the Oral Torah recognizes that someone might look like an adult, have the lustful drives and sensations of an adult but at the same time not yet have a fully developed adult brain. Before the days of MRIs, it was hard to demonstrate how and why this happened. How can someone who looks and seems like an adult

have poor judgment? Therefore, perhaps for pragmatic reasons, every adult is judged by the same standards. In any case, the Jewish justice system was not oblivious to the complexities of human development and the struggles of adolescence, and thus, via the overarching messages of the *Aggadatta*, *Chazal* revealed that legal adulthood and brain adulthood are not the same. This does not imply that G-d defined His justice system in a certain way because He had an insight into developmental psychology and neuroscience. *Halacha* and *Aggadatta* do not necessarily always depict exactly our conception of scientific reality. Yet often, our understanding of science can nourish our understanding of Torah and vice versa. On a broader note, one can hold on to neuroscience to strengthen one's conviction in *bechira* (and not undermine it, as has been the trend lately...). If one's brain is programmed to develop into a conscious and intelligent mind, how can one say that a person is unable to make the right choices and pursue their own destiny [18]?

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In many countries, such as Canada, when one gets injured or suffers from an illness, they can seek medical attention without hesitation. No individual ever questions going to the doctor for something that is bothering them physically. However, if the pain being experienced is not a physical one, but a psychological one, would it be given the same importance? Would people be as quick and confident to go to their doctor's office and get the proper care needed? There has always been a stigma around the concept of mental health, which causes people to avoid seeking help. Until recently, society's view of mental health was that it was essentially non-existent. People did not talk about their anxiety, depression, or a variety of other issues they may have been experiencing. As a result, people in the past suffered in silence unnecessarily with devastating consequences. Fortunately, with the help of prominent people in society talking about their own personal struggles with mental health, others are now starting to feel more comfortable seeking the help they need. As a result of breaking the stigma, more treatments and medications are being developed to help alleviate some of the symptoms caused by mental illnesses. Mental health in the Torah is not a foreign topic. Considering the Torah's inauguration thousands of years ago proves how old this illness really is. The new prominence simply reflects a change in the paradigm surrounding the topic, propelling it to the forefront of treatment and trampling the stigma.

Among the many different mental illnesses that people suffer from, a relatively common one is depression. Depression negatively affects how a person feels, the way they think and how they act. It can cause feelings of sadness or a loss of interest in things one once enjoyed. Depression leads to a variety

of emotional and physical problems and can decrease the ability to function in day-to-day life. Symptoms can vary from mild to severe ranging in things like "Changes in appetite — weight loss or gain unrelated to dieting, trouble sleeping or sleeping too much, loss of energy or increased fatigue, increase in purposeless physical activity, feeling worthless or guilty, difficulty thinking, concentrating or making decisions, thoughts of death or suicide. Symptoms must last at least two weeks and must represent a change in your previous level of functioning for a diagnosis of depression." [1]. The National Institute of Mental Health reports that in 2020, 8.4% of the US population had at least one major depressive episode. Clearly, depression is pretty common and shouldn't be stigmatized. While there is no real cure for depression, there are multiple ways for it to be treated, all of which can improve symptoms and improve everyday life. Treatments ordinarily include therapy, medication, or medical procedures. According to the Mayo Clinic, the most common and effective treatments are medications and psychotherapy, with people usually opting for one of the two or both [2].

Another way to help alleviate the symptoms of depression is using rTMS treatments. rTMS (Repetitive Transcranial Magnetic Stimulation) is a non-invasive treatment that stimulates the brain's nerve cells by using magnetic fields. The therapy involves delivering repetitive magnetic pulses. rTMS is usually used when all other treatments for depression have failed. The FDA

approved the use of rTMS in 2008 for major depression and expanded the use to treat pain associated with certain migraine headaches in 2013 [3]. During an rTMS

session, an electromagnetic coil is applied to the scalp close to your forehead. A magnetic pulse is painlessly delivered by the electromagnet, which stimulates the nerve cells in the part of the brain that is responsible for mood control and depression. According to studies, depression is linked to a reduced activity in the prefrontal cortex. The prefrontal cortex is involved with depression symptoms [4]. Therefore, it is helpful to activate regions of the brain that have decreased activity in depression. A study done on cognitive control in healthy human patients using ERP (event-related potential) after multiple rTMS sessions. They found that after the sessions, there was an increase in neural activity in prefrontal areas [5]. Other studies were done on rTMS and many of them found that rTMS increases activity in prefrontal areas. The full biology of how rTMS works to alleviate symptoms isn't fully understood. However, the stimulation from the sessions appears to impact how the brain works and alleviates depression symptoms and improves mood. It is an effective way to treat depression and can help many people. rTMS is a great option for people who don't respond to more mainstream depression treatments [6]

Despite rTMS's effectiveness, there can be some side effects of using rTMS. The most common ones are transient headaches, local discomfort in the stimulation area, dizziness, ipsilateral lacrimation, and very rarely generalized seizure. A study was done on the side effects of rTMS. They tested a patient who had no history of autonomic headaches. After rTMS was done, the patient started reporting a development of sudden headaches with "characteristics of trigeminal autonomic cephalalgia on the stimulated side"[7]. This is showing another potential side effect of rTMS treatment. In regards to long term side effects, none have

been reported and patients who need rTMS shouldn't be worried about any long-term effects, only immediate side effects. After reviewing around 12 different studies on rTMS, overall, they showed there was an antidepressant effect from continuous rTMS sessions. Each study focused on a different effect of rTMS and it did show different results depending on what or where they focused their study. However, overall rTMS is seen as a safe way to treat depression when no other treatments work.

As mentioned, contrary to popular opinion, mental health and treatment is actually a concept that is included in the Torah. There are a few different examples of this. In Samuel I Chapter 16, King Shaul felt depressed when the spirit of G-d left him. He called David to play music to help treat his depression. This is a direct example of someone with depression in the torah and how they treated it [8]. As stated above, there are several different types of possible treatments for depression. So what is the Torah's perspective on treating mental illnesses? The Mishnah Shabbat 2, 5 says a story, "one who extinguishes the lamp because he is afraid of non-Jews, robbers, or an evil spirit, or so that a sick person may sleep, he is exempt " [9]. This Mishnah is explaining that usually putting out a fire is not allowed on Shabbat, but saving someone's life always takes precedence over the laws of Shabbat. The question is what type of sick person is the Mishnah talking about. The sick person is someone with a potentially life-threatening disease which was further clarified as depression. Based on this mishnah, it is seen that one should treat depression like any other physical sickness [10]. This is observable with how Rambam decided to treat one of his patients. He had a Muslim patient who was depressed and he recommended he should consume some wine to feel better. His explanation to this is

that “ saving a life is itself a religious duty that supersedes virtually all other religious obligations.” This is why he permits his Muslim patient who suffers from depression to drink wine, despite this not being allowed in Islam [11]. There are more commentators who also talk about depression. Rabbi Yonah of Gerona said that one shouldn’t ever be in a constant stage of sadness since it is a physical disease. Rabbi Yehuda Halevi wrote in the Kuzari “It is not in accordance with the spirit of the Torah to worry and feel anguish throughout one’s life; one who does so transgresses the Almighty’s commandment to be content with what he has been given.” Overall it is seen in Judaism that a person should not stay in a state of depression and should get the proper treatment to feel better [7].

Mental health is a topic that needs to be talked about. Countless people struggle with it, and even though the issue is finally entering the public eye, it is still not enough. As stated above, depression was discussed in the torah. If someone is struggling with depression, the Mishnah and other commentators clearly state that the person should seek help and get the proper treatment. Whether that be the more common treatments such as medication, or a treatment like rTMS. rTMS is a great option to help alleviate the symptoms of depression. Many studies were done on rTMS and are still being done and all are showing a positive effect to help patients with depression. Mental health should be treated the same way as a person’s physical health and seeking treatment shouldn’t be any different. This concept aligns with what the Torah says about mental health.

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Before embarking on a discussion of the ethics of CRISPR, we will clarify how the process works on a technical level. CRISPR [1] technology has been called a “molecular scissors” for its ability to locate a specific DNA sequence and slice the DNA at that site. With CRISPR, researchers have figured out how to repurpose the bacterial immune system into a gene editing tool that has a wide range of applications in science and medicine. How does it work? Bacteria have developed a system to protect themselves against infections by viruses—phages—that infect them that involves “slicing” the phage genome. When first infected by a phage, bacteria store a portion of the phage genome in their own DNA, demarcated with CRISPR array spacer sequences [2]. They then create corresponding CRISPR RNAs [3,2]. Upon phage reinfection, this RNA matches up with the phage DNA, a process that drives a type of bacterial enzyme—an endonuclease, termed Cas9, [4]—to slice the phage DNA, thereby destroying the phage [2]. By synthetically changing the spacer sequence into any other RNA sequence, researchers can use this tool to target and slice almost any DNA sequence [2]. This technique has greater ease of use than previous gene-engineering techniques and therefore serves as a great benefit to the research process [2]. Using these bacterial defense system components to edit genes in the lab, researchers even can target multiple genes simultaneously, which enables them to study diseases whose cause stems from multiple genes [2].

Researchers have classified six types of CRISPR systems. The most commonly studied and used is type II-A from the bacterium *Streptococcus pyogenes* [2]. More research is needed to understand how the endonuclease Cas9 so accurately targets its DNA target and avoids errors [2]. Further research also needs to examine how

eukaryotic chromatin—the structure by which DNA arranges itself—impacts Cas9 binding and activity [2]. Likewise, more studies need to determine how DNA unwinding impacts Cas9 activity [2]. A better understanding of how CRISPR/Cas 9 works will further enhance future scientific research, which in turn will lead to better therapeutics and healthcare outcomes.

One recent example of CRISPR lab research involved researchers who genetically modified hamsters to study social behavior. Since vasopressin, a hormone produced by the brain, plays a role in sociability, researchers knocked out the gene for the vasopressin receptor and looked at the effect on social behavior [5]. The hamsters as a result became more sociable, though researchers had expected the opposite [5]. With the greater ease of genetic modification afforded by CRISPR, researchers can more readily find new discoveries such as this one.

Ethical Questions

Gene editing raises many ethical questions. This paper will focus on those questions that relate to when and how to use gene editing, namely which types of traits should undergo editing and which might be better left alone. This paper will focus on a few of those questions. While editing out diseases would obviously present a positive outcome, what about the question of “designer babies,” as the technique could also edit traits such as eye and hair color? As another question, about more of a gray area, what about editing for traits such as skills or neurotypicality? On the one hand, these traits do not present a medical necessity but on the other hand they present changes more beneficial than simple cosmetic traits. There are additional questions that arise that are beyond the scope of this paper. These include the fact that editing the human

genome could create errors (including those caused by binding to similar off-target sites) [6] and potentially other mutations [7]. There is also concern that those mistakes might pass down permanently [8]. In the future, as the technology evolves, more questions will emerge.

Although CRISPR emerged recently, the question of “designer babies” has remained an ongoing question ever since preimplantation genetic diagnosis (PGD) was introduced in 1990, [9] as PGD allows parents to select embryos with certain traits and was intended to prevent disease, but the PGD process also enables the selection of preferred traits such as hair or eye color. Like PGD, in addition to preventing widespread disease, CRISPR gene-editing technology could also open the door to editing the genome for any number of preferred traits, which raises the same ethical dilemma as does PGD, namely the ethics of selecting certain traits over others.

One additional concern is that of editing genes to manipulate intelligence. According to Daley *et al* in a New England Journal of Medicine editorial, editing for traits such as intelligence remains an unlikely occurrence and therefore only a theoretical concern [10]. “In the long run, our greatest protection against inappropriate genome editing may be the implausibility of influencing traits such as intelligence, which emerge from complex interactions among multiple genes and environmental factors. Our ignorance regarding such complexity may ultimately save us from the hazards of humanity’s hubris” [10]. Public opinion thus far seems to agree with this perspective: “Opinion polls show that most people are okay with using it [CRISPR] to wipe out disease mutations. But only about 20% think using it for ‘enhancement’—specifically, trying to increase the intelligence of

offspring—is a good idea. Luckily for scientists, they don’t have to tell us whether they think increasing intelligence is good or bad. It’s not possible, they say, so don’t worry about it” [11]. The limitations of CRISPR alleviate the need to make difficult decisions about intelligence.

Jewish Primary Sources

Although clearly no early Rabbinic sources mention gene editing, it might be possible to extrapolate from the early sources by considering a parallel case that can provide guidance on our modern technology. Modern Jewish sources, discussed below, address the topic, but I would like to add mention of a primary source that could bear weight on the issue. A source in the Babylonian Talmud addresses an issue relevant to CRISPR, that of intervening in the development of an embryo. When the Mishna (Berachot 54a) discourages vain prayer, namely praying for something already determined, and includes mention of praying for the gender of an unborn child, the gemara there (Berachot 60a) limits this prohibition to after forty days of gestation, the point at which the rabbis believed the gender of a child to become determined.

Mishna: **”And one who cries out over the past** in an attempt to change that which has already occurred, **it is a vain prayer**. For example, **one whose wife was pregnant and he says: May it be God’s will that my wife will give birth to a male child, it is a vain prayer”** [12]. Gemara: **“From the third day until the fortieth, one should pray that it will be male. From the fortieth day until three months, one should pray that it will not be deformed, in the shape of a flat fish”** [13].

The Shulchan Aruch (Orach Chayim 230) echoes this ruling—one can pray for the gender of the child prior to forty days. For an in-depth discussion of how Chazal view determination of the gender of an embryo, see Niddah 30b and Poltorak, “On the Embryological Foresight of the Talmud” [14]. The gemara in Brachot also suggests that from the fortieth day until three months, one should pray that the fetus does not become deformed. Perhaps here we see a precedent for altering the outcome of an unborn child through CRISPR rather than through prayer.

Traditional sources might also provide a philosophical perspective on our modern technology. For example, Taanit 2a states:

Rabbi Yoḥanan said: There are **three keys maintained in the hand of the Holy One, Blessed be He, which were not transmitted to an intermediary**, i.e., God tends to these matters Himself. **And they are: The key of rain, the key of birthing, and the key of the resurrection of the dead** [15].

This list leaves out the outcome of the child—how the child will turn out—which suggests that humans as intermediaries can intervene.

Modern Jewish Responses

Now that we have considered traditional sources that pertain to CRISPR, how have modern sources evaluated the issue? As current Jewish thinkers have addressed other medical ethical issues in the past, they likewise seek to address the ethical concerns raised by CRISPR, looking toward traditional Jewish texts for guidance. In the past, Jewish ethicists have addressed similar issues such as assisted reproduction technology and PGD. Likewise, Jewish ethics now face the challenge of discerning how an ancient tradition might view the

modern technology of CRISPR, with all of its implications. Several Jewish ethicists, scientists, and physicians have written on the topic. Again, the question remains in its infancy.

On the question of “playing G-d,” which arises in a religious context, Drs. Loike and Kadish suggest that “[w]e propose that a Divine directive is for human society to embrace science by actively supporting the research of natural law and *applying it wisely* (emphasis added)” [16]. The imperative to “apply it wisely” suggests that society must establish careful guidelines before embarking on CRISPR use but that the technology itself does not go against any Divine imperative. Cohen points to a medieval source on the idea of interfering with nature, a comment by the Meiri [17] on the topic of sorcery, who implies that Judaism presents no prohibition against manipulating nature, only against doing so using sorcery [18].

Regarding the superficial traits question, Drs. Loike and Kalish ask: “The ethical concerns regarding these biotechnologies are many. Will society limit their use to curing disease, or will also people begin to use technology for non-medical purposes?” From a practical perspective, Loike and Kadish maintain that Judaism would support therapeutic uses for the CRISPR technology but for the most part would not endorse the practice of “designer babies”:

The general rule in Judaism is that gene editing for non-medical applications is ethically wrong and should not be routinely acceptable. In the case of gene-editing a human embryo, we believe it is moral and ethical to genetically edit not only an embryo carrying lethal genes (*e.g.* Tay–Sachs) but also in cases where

the child would be born and burdened with serious health issues (e.g. cystic fibrosis) [16].

It remains unclear whether the language of “routinely acceptable” hypothetically could open the door for a case-by-case basis scenario. Cohen argues that the decision on whether to choose characteristics of a child is a moral one and, using traditional sources, posits that we face a *halachic* imperative to use our moral judgment [18].

Rabbi Dr. Tendler pointed out two concerns, the concern that errors will persist perpetually and the concern for genetic enhancement [19]. “Despite these concerns, *halakhah* would favor continued research with its potential to cure genetic diseases, even if a modicum of risk exists” [19]. Further, Rabbi Dr. Tendler maintained that creating changes in the child does not go against Judaism, which considers children as blank slates and gives parents the right to educate/shape them [19]. He left as a question, “Parents can now demand babies who will be seven feet tall or who will have perfect pitch. Can gene-editing designer babies lead to eugenics?” [19]. Again, how the technology develops remains as of yet undetermined and will impact the outcome of these questions.

In an article written shortly after the inception of CRISPR, Dr. Loike and Rabbi Dr. Tendler discuss editing genes for behavior—which falls in the gray area of not quite disease but not quite superficial—and point out how that question might end up changing over time. “We therefore propose that *Halakha* would prohibit, at this point in time, the utilization of gene editing to alter behavioral characteristics because of their unknown, far-reaching consequences on the personality of the individual. As science gains further knowledge regarding these

issues, the *halakhic* prohibition may be revisited in the future” [20]. Glick, in contrast, argues in favor of enhancement, given completely ideal conditions (technical, socio-economic, etc.), currently relegated to the realm of the hypothetical [21, 22].

Dr. Milner and Rabbi Cherlow invoke an issue that is raised regarding genetic testing and is relevant to CRISPR as well, the concept of *tamim tihiye im Hashem elokecha*—“you should be complete with G-d” [23] (Deuteronomy 18:13) [24]. According to this logic, one should not interfere with the future but rather leave it as G-d created it. Since PGD and CRISPR involve preventing disease before it occurs, the *halachic* issue does not relate to healing as much as to preventing a future danger [25]. However, Rav Moshe Feinstein compared the genetic testing process to “opening one’s eyes” and seeing, namely that genetic testing serves as an extension of our ability to see [24]. Analogously, one can view the process as comparable to moving out of the way of an oncoming truck [25]. Dr. Loike and Rabbi Tendler additionally recognize use of PGD even to avoid carrying genetic risk for common diseases such as Alzheimer’s and diabetes [26].

Halachic Analogy

The concept of plastic surgery can serve as an analogy for gene editing in Jewish law, in that both involve risk and both involve changes to the natural order of things. Rabbi Chaim Jachter has written an article that summarizes the four main *halachic* positions on plastic surgery from four leading Rabbis and from this summary, one can see that *halachic* approaches to plastic surgery vary. Rav Moshe, based on Rambam and inferred from other sources, allowed one to wound oneself for one’s benefit [27]. Rabbi Jachter comments that he is unsure whether Rav Moshe meant this ruling to apply in the

specific situation asked of him from someone in great need or whether Rav Moshe Feinstein extends this ruling to general situations for anyone who wants plastic surgery [27]. Rabbi Breich on the topic of risk maintains that one may take something considered a tolerable risk by society, such as driving a car or flying on a plane and maintains that in our times this premise also applies to surgery [27]. Rabbi Waldenberg, in contrast, presents a blanket ruling against plastic surgery, while Dayan Wiesz remains unsure [27]. Rabbi Jachter offers a philosophical approach, one also relevant to CRISPR: “One could argue that perhaps plastic surgery does not insult the work of the ‘Craftsman’ because He also revealed to mankind the knowledge and ability to perform cosmetic surgery“ [27]. Furthermore, “Cosmetic surgery might be viewed as part of our role as ‘junior partners’ with Hashem in the ongoing creation of the world (see Shabbat 10a and Ramban to Bereshit 1:28)” [27]. From this perspective, we have received the knowledge and tools to use CRISPR but must use it responsibly.

Conclusion

The above sources point to the fact that while traditional religious sources offer some guidance toward how halacha might view CRISPR, the CRISPR technology itself remains too new to reach a full conclusion. As the technology evolves, time will tell how ethicists and halachicists will respond accordingly. A Jewish aphorism states that upon meeting a new person, we judge them in the manner of *k'vodo v'chashdo*, both with honor and with suspicion. This aphorism seems apt for how we could approach a new technology such as CRISPR—with some suspicion as to its potential pitfalls but also with honor for the vast potential that it offers.

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The Fourth Partner: Examining the Halachic Conundrum of Surrogacy in Jewish Law

By: Eden Elkayam

"There are three partners in man - *Hashem*, his father, and his mother [1]." The famous verse from the Talmud tells us that these three entities are involved in the creation of a child. The introduction of new reproductive technologies, such as surrogacy, raises *halachic* questions about whether there can be four partners, two of which are women, in the creation of a child. If so, which woman is considered the third partner and the actual mother? These questions have complex *halachic* consequences, including the *mitzvah of Kibbud Em*, the question of a child's Jewish identity, and the potential for *mamzerut* status. Although there is no definitive *halachic* answer among *Poskim*, this discussion can be divided into different perspectives which will be explored in this article.

One perspective on the surrogacy issue examines it in terms of genetic material. Scientifically, a child born to a surrogate mother also termed the gestational mother, is biologically composed of the genetic material from his father's sperm and his mother's egg, therefore making the egg donor the child's genetic mother. If we were to define motherhood by genetic composition, the genetic mother would be considered the child's parent over the surrogate mother. However, recent scientific studies have shown that, in pregnancy, there is an exchange of stem cells between the host mother and the fetus [2]. This means that the host mother, or surrogate, contributes cells to the developing fetus through a process called cell trafficking, resulting in microchimerism. Stem cells from the surrogate migrate to, and establish in, various tissues and organs in the fetus and persist in the child's body for many years after birth. Cell trafficking is a two-way migration, as cells from the fetus migrate to, and establish themselves in the tissues of the surrogate. This exchange of stem cells between the host mother and the fetus

suggests that the host mother may have a more profound biological connection to the child than previously thought. It raises questions about the definition of motherhood and whether the host mother should be considered the child's *halachic* mother.

Although the surrogate mother is not considered the child's genetic mother, that fact does not determine motherhood in Judaism. We must look at other factors that define us as human beings which will help us understand how to define who our parents are. This concept can be applied not only to human beings but also to any of God's creations. The Talmud discusses a situation in which an older fruit is fertilized by a tree that is less than three years old [3]. Although fruit from trees younger than three years are considered *Orla* and are forbidden to eat, the sages rule that the fruit that grows on the older tree is permitted to eat. This ruling demonstrates that when determining the origin of a fruit, *halacha* takes into account various factors related to its development and growth, not just its initial DNA. This understanding that *halacha* considers more than just biological origin can be applied to other areas, such as determining parenthood.

Our *Neshama* is the essence of how we define ourselves as human beings and God's part in us. The question of when one receives their *Neshama* can be a defining factor in determining who the *halachic* mother is. In the Talmud, we find a debate between Rabbi Yehuda HaNasi and Antoninus regarding when a person receives his soul [4]. Antoninus convinced Rabbi Yehuda HaNasi that a man receives his soul when he is born rather than when he is conceived. This Talmudic discussion suggests that the surrogate is considered the mother since it is only through her that the child establishes his *Neshama*. Another Talmudic discussion in

this regard defines a forty days old fetus as "*Maya B'alma*"—"just water", and only afterward can it be considered a *Nefesh*, again proving that the child only transforms into a *Neshama* upon being carried by the surrogate mother [5].

Determining who is the mother of a child has significant implications, particularly when determining the child's Jewish identity. The Talmud addresses a case where a woman converted to Judaism while carrying twins [6]. According to the *Giyur* process, a convert is no longer considered related to his biological family. Even though the twins are considered Jewish, a question arises regarding their relationship with each other. The Talmud concludes that despite the conversion, the twins are considered siblings. Giving birth creates a bond between the mother and child and establishes the child's identity. This illustrates that in Judaism, the act of giving birth is a crucial factor in determining the maternal relationship.

There is no definitive answer among Rabbinic authorities regarding the determination of the mother of a child carried in surrogacy. There are three prominent opinions: the genetic mother is considered the *halachic* mother, the surrogate mother is considered the *halachic* mother, and both mothers should be considered *halachic* mothers. The Talmud also warns about the potential issues that can arise from having relationships with multiple partners [7]. Such issues include *mamzerut* (a child born from a prohibited relationship) and potential incest [8]. These warnings also apply to a surrogate child's complex and debated status, raising questions such as whether the surrogate mother can be a married woman, whether she must be Jewish, and more. Israeli law takes these considerations into account with a *halachic* approach. In 2010, the 'egg donation law' was passed, requiring the surrogate mother to be

single and of the same religion as the genetic parents [9]. This is done to avoid Jewish identity and *mamzerut* issues and to set an example for responsible *halachic* compliance, despite the lack of a clear *halachic* definition of the mother.

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Mitochondrial Replacement Therapy: A Halachic Perspective on Multiple Mothers

By: Allison Warren

With the rise of the success of fertility treatments such as *in vitro* fertilization (IVF), opportunities to further explore more specific niches within the realm of reproductive health are made available. Female carriers for mitochondrial DNA (mtDNA) diseases, a source of metabolic disorders, led to the development of Mitochondrial Replacement Therapy (MRT), an IVF technique. In contrast to nuclear chromosomal DNA, mtDNA is circular and contains only 37 genes. Genes associated with mtDNA include those for encoding for transfer RNA, ribosomal RNA, and enzymes involved in oxidative phosphorylation. Mitochondrial DNA diseases affect at least 1 in 5,000 individuals. While these diseases are incurable, treatments exist that aid in managing symptoms or delaying the disease's progression. The number of mitochondria per cell can range from tens to hundreds depending upon the energy needs of the specific organ or tissue. During meiosis and mitosis, the mitochondria within the cell segregate randomly, allowing for a potential significant disparity in the number of wild-type mitochondria and mutant mitochondria each new daughter cell receives. A woman can be unaware that she is a carrier for a mtDNA disease if her somatic cells contain a predominance of functional wild-type mitochondria. Yet, when the woman undergoes oogenesis, due to random segregation, oocytes can be produced with a high frequency of mutant mitochondria [1].

Currently, MRT is the only technique available to allow women with mtDNA diseases to bear a healthy child. Two MRT methods exist: spindle nuclear transfer and

pronuclear transfer. Both techniques involve two females: the woman with the mtDNA disease whose cytoplasm has defective mitochondria (*i.e.*, the female desiring a mtDNA disease-free offspring) and a healthy woman (*i.e.*, the donor of a cell with functional mitochondria in the cytoplasm). In the spindle nuclear transfer procedure, meiotic chromosomal DNA from a secondary oocyte is transferred from the woman with the health issue to the healthy woman's secondary oocyte, whose meiotic chromosomes were removed. In essence, a hybrid cell is created – a secondary oocyte with healthy mitochondria from one female but with chromosomal DNA from the woman with the defective mtDNA. This hybrid cell is fertilized with the sperm of the male desiring to be the father. The initial growth of the subsequent embryo is in a culture dish; within a few days, the multicellular embryo is implanted into the woman desiring the child. The other technique, pronuclear transfer, utilizes two fertilized zygotes, the zygote from the woman with the mtDNA disease and a zygote from a healthy woman. Both zygotes were formed using sperm from the male desiring to be the father. Prior to the fusion of the male and female pronuclei in the two cells, the pronuclei are enucleated from the cell with the functional mitochondria and are replaced with the pronuclei from the cell with the defective mitochondria. Fusion of the pronuclei occurs, with the resulting zygote free of a mtDNA disease. Early embryonic growth occurs in a culture dish and subsequently, the multicellular embryo is implanted into the mother. [1]. Some religions

prefer spindle nuclear transfer as it does not result in destroying a zygote [2].

MRT provides hope to many couples. When studying 92 female mtDNA carriers the researchers found that 78% of women felt the risk of transmitting their disease to their offspring was enough to consider not having offspring. At present, both technologies are banned in the United States, however, as of 2015, MRT has been approved in the United Kingdom for high-risk pregnancies. The Congress of the United States claimed that MRT is a form of “heritable genetic modification,” resulting in their insistence that funding for further research must be banned. However, in a survey of 139 genetic counselors, 75% disagreed with Congress and did not believe MRT to be a heritable genetic modification [1]. One counterclaim is that being the recipient of healthy mitochondria is not a case of genetic engineering rather it is equivalent to receiving any other type of organ donation. The gene sequence is not altered as is the case with genetic engineering. MRT will minimize the prevalence of future mtDNA diseases by terminating transmission from mother to offspring [3].

In countries that allow MRT, success has been found. In 2015 the world experienced the first reported live birth of a healthy baby boy born via the spindle nuclear transfer method. The procedure was performed by American doctors at a clinic in Mexico due to the ban in the United States. Previously the mother suffered four miscarriages and lost two children to Leigh Syndrome, a mtDNA disorder. When testing the baby’s tissue, the results demonstrated inheritance of less than 2% of the mother’s

defective mtDNA [4]. As of 2016, the world’s second child was born via pronuclear transfer in Ukraine without suffering any clinical complications. By 2018, 7 healthy babies were born in Ukraine with MRT technology [3].

The *halachic* challenge presented with MRT technology focuses on the identity of the *halachic* mother. There are several opinions, one of which is that perhaps there are two *halachic* mothers. Can a child possibly have multiple mothers according to *halacha*? Rav J. David Bleich addressed this question by referencing the Talmud *Sotah* (42B). In scriptures, the giant Goliath is referred to as “*ish ha-beinayim*” (Samuel 17:23). Rav Yochanan taught that “*ish ha-beinayim*” means “a man from among many,” suggesting that Goliath resulted from a case of polyspermy. *Tosafot* understands Rav Yochanan’s words to mean that Goliath’s mother was impregnated by many men, each being an identifiable father. Rav Bleich suggested that if *Tosafot* stated the possibility of multiple fathers, then there is no reason why this same concept cannot be applied to multiple mothers [5]. Rav Moshe Sternbuch agreed with this interpretation stating that a child born via MRT has two mothers [6]. Contrasting, Rav Asher Weiss disagreed, claiming it is not *halachically* possible to have two mothers, nor two fathers. Scripture clearly condemned this immoral conduct as it led to confusion about parental identity. The Talmud in *Kiddushin* (70B) stated, “When the Holy One, Blessed be He, rests His Divine Presence, He rests it only upon families of unflawed lineage among Israel”. Rav Bleich inferred from Talmudic sources like these that

“the Divine wish is that parental identity be established with certitude” [5].

One may question whether there is a halachic implication regarding causing potential harm to an unborn child. Halachically man has been commanded to procreate. Isaiah taught that G-d created the world to be inhabited (Isaiah 45:18). Yet, in terms of procreation, it is not a human concern as to whether non-satisfactory offspring will be produced. Talmud *Berakhot* (10A) recorded a dialogue between King Hezekiah and Isaiah. Hezekiah was informed that he would not merit a portion in the world to come as a result of his failure to procreate. Hezekiah protested and claimed that he feared his offspring would not follow in the ways of G-d. Isaiah replied that the secrets of G-d are not of our concern. However, there are instances in which the Talmud listed exceptions to this rule. Talmud *Yevamot* (64B) stated, “a person should not marry a woman from a family of *nikhpin* or a family of *mezora'im*.” We learn from this statement that the Talmudic sages were familiar with the concept of genetically transmitted disorders and discouraged people from potentially further propagating such disorders. Rav Bleich derived from here that, “man simply does not have the right to burden the human condition, when such burden can be avoided.” While it remains important for us as a community to empathize with the infertile individual or couple, no mental anguish justifies placing the unborn in a high-risk category. Any risk against an unborn child must remain in nature alone, not as the result of human intervention [5].

Nonetheless, if one were to undergo MRT, who is the *halachic* mother? The *halachic* principle of “*rov*”, when the majority component of a mixture nullifies the minority component, would not be applicable in this scenario. For one to take the approach that the donor mtDNA (with its 37 genes) can be nullified as it remains so minor in comparison to nuclear chromosomal DNA (with its >20,000 genes), the mtDNA must not be discernible in the mixture. However, the donated mtDNA is not suppressed within the mixture. The mtDNA would be under the status of *davar ha-ma'amid*, a substance that holds up. Meaning, if not for this donor the child would not exist. Therefore, the mtDNA cannot be subject to nullification. Yet if one were to argue that the act of giving birth is what determines maternity then the biological question of who the mother is becomes a moot point. A frequent source to prove this point is from a Mishnah discussed in Talmud *Yevamot* (97B). The Mishnah described the case of a woman pregnant, with twin sons, who converted to Judaism when pregnant. While typically *halacha* does not recognize converts to have parents or siblings, in the case of this pregnant mother who converted, her twin sons were recognized as brothers. This indicated that in conjunction with their mother's conversion, a filial relationship was formed between the sons and their mother. This Mishnah claimed that the acts of gestation and birthing a child dictate motherhood. If so, this would solve all questions pertaining to the number of mothers of a child born from MRT. An opposing *halachic* view stated a possibility that the birth mother is “*a*” mother rather than “*the*” mother. When determining the identity of an animal's offspring, there is a *halachic*

question as to whether the gamete of the father is to be considered or ignored: *hosheshin le-zera ha-av*. If one were to hold that the father's gamete is considered, one can deduce that parturition does not exclude other means of parenthood. Similar to how the father is classified as a parent due to passing his genetic information, so too a woman can be classified as a mother through the same means. However, *hosheshin le-zera ha-av* remains an unresolved *halachic* issue and cannot be used in this case to determine motherhood. Rav Bleich concluded that the motherhood of a child born through MRT remained a dispute [5].

Although MRT remains illegal in the United States, there are other countries offering the procedure under strict guidelines. When pursuing this treatment as a means of conception, one must do so under Rabbinic consultation, as this topic still remains heavily debated by the *poskim*.

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Chicken soup, renowned for its delicious taste and healing qualities, is coined the “Jewish penicillin” or “bubbymycin” [1]. Jewish grandmothers throughout history have administered chicken soup as soon as signs of illness developed and prayed for immediate recovery. Does science substantiate the curative features of chicken soup or is this belief, in chicken’s soup therapeutic powers, so engrained in our heritage that we respond from force of habit and placebo effect?

Scholars of *Torah* and the *Talmud*, were clued into the medicinal traits of chicken soup early on. Moses Maimonides, a world famous rabbinical scholar and physician to Egyptian royalty in the 12th century, wrote extensively on chicken soup in *The Medical Aphorisms of Moses Maimonides*. In this book, he discussed chicken soup’s suitability and aptness in treating ailments, such as leprosy, emaciation, as well as coughing incurred by asthma [2]. Much earlier, in the Babylonian Talmud, Rabbi Abba (290 CE-320 CE) was known for his “fowl” (*Shabbos* 145b). Rashi, a revered biblical commentator who lived in France in the 11th century, pointed out that Rabbi Abba would boil the chicken in water and ultimately consume it as a remedy (Rashi, *Shabbos* 145b). This notion of chicken soup acting as a medicine, was apparent in Judaic literature and has been passed down for generations [2].

A small study in 1978 provided evidence for the potency of chicken soup in the treatment of cold symptoms. Scientists tested and determined the effects of various fluids on nasal mucus velocity [1]. Studies have shown that sugars in mucus play an important role in disabling bacteria [3]. An increase in nasal mucus velocity can facilitate the elimination of pathogens from the body and reduce their ability to penetrate cells and spread. The results of the study corroborated the ability of hot liquids, including chicken

soup, to transiently magnify nasal mucus velocity. However, when chicken soup was drunk by straw it demonstrated superiority over regular hot liquids drunk by straw. This suggested that chicken soup possessed unique properties (over and above its being a hot liquid) possibly related to the aroma or taste, as exhibited by its persistence in efficacy, despite the omission of vapors produced by the soup [1].

In an *in vitro* study, chicken soup was further proven as beneficial in the treatment of upper-respiratory infections.[4] The authors of the study, Rennard and colleagues, elucidated that respiratory infections stimulate what is called a “cytokine cascade” or “cytokine storm.” If this sounds familiar, it has been implicated in the major cause of death early in the COVID-19 viral pandemic. [5] This means that when the body becomes infected with a pathogen, such as a virus, it produces excessive amounts of white blood cells as a defense mechanism. While the production of white blood cells assists in the elimination of the pathogen, Rennard and colleagues suggested that a surplus of white blood cells can be harmful and spur an inflammatory response; resulting in the symptoms of the common cold. In this study the propensity for chicken soup to inhibit neutrophil chemotaxis, the ability of white blood cells called neutrophils to migrate towards a chemoattractant, was evaluated. When migration of immune cells are restricted, inflammation can be lessened. The results of the study demonstrated the effectiveness of 13 market brand chicken soups in inhibiting neutrophil activity. They observed that all the individual ingredients had inhibitory activity, and when prepared together they displayed maximal results. Chicken soup’s ability to inhibit neutrophil migration and reduce anti-inflammatory activity *in vitro*, points to a possible

mechanism by which it can alleviate symptoms caused by respiratory infections [4].

The Talmud writes on fever, a symptom of the common cold. Rava, one of the great *amoraim* of the *Talmud* (280-352 CE), lived in Mahoza, Persia. He stated the following regarding a fever, “were it not for the fact that it is an agent of the Angel of Death, it would be beneficial for a person as a prickly foliage is for palm trees, if it is experienced once every thirty days...” (*Nedarim* 41a, b). While fever is seemingly detrimental, Rava, with the support of science, claimed that it was actually beneficial! A fever is the body’s response to a bacteria or viral infection. Moderate fever indicates an underlying malady, but it itself is not harmful in most cases. The reason that infection causes the body to mount a fever is because the immune system is more effective when body temperature is slightly elevated. For instance, macrophages, which are cells that fight infection, function better at warmer temperatures. Some doctors advise the avoidance of those medicines that reduce fever, because it will hinder the body’s ability to fight the lurking infection. On the other hand, the consumption of chicken soup is encouraged. One becomes increasingly dehydrated as the body temperatures rise in response to infection. Chicken soup is a great way to keep hydrated while allowing the fever to create ideal conditions for the body to fight off infection! [6]

In conclusion, we can surmise that chicken soup indeed has medicinal powers. We draw this conclusion from our ancient sources as well as common sense and science. So did Bubby really know best? It’s up to you to decide!

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Halitosis, commonly referred to as bad breath, is an unpleasant odor emanating from the mouth. It is a common problem that leads to social anxiety and embarrassment. Medical causes of chronic bad breath include certain medications, chronic sinus infections, acid reflux, respiratory tract infections, diabetes, liver or kidney problems, and dry mouth. Depending on the underlying cause, the medical treatment may involve prescription medications, lifestyle changes, and possibly even surgery.

Today bad breath is a manageable diagnosis, yet its victims are linked to general social anxiety disorder (social phobia), an intense fear of interacting or talking with strangers. It is one of the most unattractive issues during social interactions, with the potential to cause considerable personal discomfort and social embarrassment [1]. A 2011 study regarding genuine halitosis patients concluded that anxiety exhibited prior to oral malodor treatment did not dissipate after treatment due to their general social anxiety disorder [2]. An additional study investigated the relationship between the degree of general social anxiety disorder and the amount of improvement of anxiety contingent on oral malodor in patients with halitosis. Results showed that 22.9% of genuine halitosis patients had a tendency for general social anxiety disorder [3]. Furthermore, anxiety about the oral malodor in genuine halitosis patients was only improved by treating the general social anxiety disorder in addition to treating the oral malodor. Some treatment regimens for social anxiety disorder include cognitive-behavioral therapy. Dentists in oral malodor clinics cooperate with staff from other departments and test for social anxiety disorder in addition to performing regular oral malodor treatment.

In contrast to the current society zeitgeist, Talmudic scholars recorded bad breath as a “major disability” citing Torah scripture [4]. Most concern falls within marriage and the laws of the priests (*kohanim*). Marriage, both a holy and a social bond, can be adversely affected by bad breath in either spouse. In the Talmud (Ketubot 72b, 77a) bad breath is considered a serious disability regarding spouses and priests. In a Jewish marriage, if the husband detects a serious disability in his wife that was not disclosed prior to the wedding, he can annul the marriage and summarily void the marriage contract. These disabilities include ungainly breasts, a thick voice, non-obvious lesions of the head and neck, sweat, and oral malodor (Ketubot 75a). The Rambam later added that both nasal and oral bad breath are considered equally valid grounds for divorce. Even more so, a widow is able to overlook *yibum* if halitosis runs in the family of her deceased husband (Maimonides, Hilchot Ishut 25:13). Furthermore, halitosis is also seen as a disability prohibiting *kohanim* with bad breath to work in the Temple [5]. Interestingly, the Rabbinic Authorities provide a solution for the *kohanim*, “to place a pepper in his mouth” (Ketubot 75a), suggesting this is a reversible condition.

There are many remedies the Talmud discusses to help manage and treat severe bad breath. The two with the most notoriety have antibacterial properties. The first is mastic gum, a hard gum resin from the *Pistacia lentiscus* tree. *Tosefta Shabbat* (8:7) states: “It is forbidden to chew mastic on *Shabbat*, yet it is permitted for the prevention of oral malodor.” This emphasizes the importance of maintaining good oral hygiene, and how its importance overrides the keeping of *Shabbat*. The second remedy is an oil-water mouthwash [5]. The story of Rabbi Yohanan and his readily bleeding gum offers insight. Rav Yohanan was advised to use a mixture of

leavening water (possibly the water left over after kneading dough), salt, and olive oil (Avodah Zara 28a). The mixture has emulsifying tendencies, and when the mouthwash was used it subsided the bad odors present in the oral cavity. In addition to these remedies, it was common to use ginger and other aromatic spices as breath fresheners (Shabbat 65a).

Furthermore, when tackling halitosis, it could be beneficial to keep a holistic approach in mind. Holistic medicine is a form of healing that considers the whole person, which includes a variety of therapies usually focused on nutrition and herbal remedies. Two herbal remedies to be explored are green tea and cinnamon oil. Green tea is an antioxidant-rich beverage made from the leaves of the *Camellia sinensis* plant. Studies suggested the main antioxidant in green tea, epigallocatechin-3-gallate (EGCG), may have many beneficial effects on health, including antibacterial properties. A 2013 study found that EGCG triggered cells in the gums to release an antimicrobial chemical that targeted *Porphyromonas gingivalis*, a bacterium that contributes to gum disease and halitosis [6]. A 2015 study also showed that green tea extract and EGCG reduced the growth of *Solobacterium moorei*, another bacterium that contributes to halitosis. Additionally, these treatments reduced the ability of *S. moorei* to produce chemicals that cause halitosis. Similar results were noted with cinnamon oil. A 2017 study showed that cinnamon oil had antibacterial properties against *S. moorei* and reduced levels of the volatile hydrogen sulfide [6]. The concern with using cinnamon oil was the misconception that it was abrasive to the gums; however, was shown to be unfounded. Additional research with human participants is necessary to determine the efficacy of green tea and cinnamon oil in reducing halitosis. Talmudic scripture (Shabbat 65a) suggests

that these home remedies were practiced in the past [7]. Herbal teas composed of fennel seeds, anise, cardamom, or cloves were encouraged to be consumed following big meals, especially those containing pungent flavors.

Ultimately, halitosis, once considered to be a disability, has become a very manageable condition. Cases of severe halitosis usually signal other medical problems, such as liver disease or poor kidney function. Talmudic scripture highlighted the issue of halitosis in marriage and in *cohanim* work in the Temple, highlighting how bad breath can heavily strain personal relations. The scripture has offered many natural home remedies in dealing with halitosis, using natural herbs and spices, mastic gum, and an oil-water mouthwash mixture to maintain personal oral health. Some of these ancient remedies were then explored today and have proven to have antibacterial properties. With the right lifestyle changes and treatment the patient with halitosis can overcome this adversity.

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[7] Shabbat 65a

Phototherapy refers to the use of Ultraviolet (UV) radiation to treat various ailments.¹ Heliotherapy treatments are those that specifically utilize the UV rays of the sun.² At the end of the 19th century, scientific discoveries and inventions resulted in the transition from heliotherapy to artificial forms of phototherapy.³ Historically, though, heliotherapy was relied upon as a healing method. Documentation from ancient Greece and ancient Rome points to the use of sunbaths for reasons of health, likely providing relief for those suffering from rickets as well as having antibacterial effects.⁴ Additionally, *Torah* sources point to early recognition of the therapeutic power of the sun.

In the first *Pasuk* of *Parshas Vayera*, *Avraham Avinu*, who has recently circumcised himself, is sitting at the entrance to his tent “in the heat of the day.” The *Midrash Aggadah (Beraishis 18:1)* claims that the fact that *Avraham* sat outside teaches that “heat is good for circumcision,” citing the *Midrash Beraishis Rabbah’s* statement (*Beraishis 18:1*) that “heat is good for plagues.” Additionally, Following *Yaakov Avinu’s* encounter with *Esav’s* angel and subsequent injury, the *Pasuk (Beraishis 32:32)* states that “the sun shone for him.” *Rashi* comments that the sun specifically rose early to heal *Yaakov*.⁵

In the *Gemara Nedarim 8b*, *Abayey* makes the claim that dust of the sun has the power to heal based on the *Pasuk* in *Malachi 3:20* which states that “the sun is righteousness, and healing is in its wings.” Although *Abayey* disagrees with him, *R’ Shimon Ben Lakish* states that the sun is the vehicle for reward and punishment in the world to come. G-d will “take the sun out of its covering,” he posits, and the righteous will be healed while the wicked are judged harshly.⁶

In the *Gemara Bava Basra 16b*, *R’ Shimon Bar Yochai* tells that *Avraham Avinu* used to be adorned with a stone that had healing powers for those who looked at it. When *Avraham Avinu* died, G-d granted that healing power to the sun.⁷

In a nineteenth- century study, scientists Arthur Downes and Thomas Blunt evaluated the effect of sunlight on bacterial growth. They discovered that those tubes inoculated with bacteria and exposed to sunlight remained clear, evidence of a lack of bacterial growth, while those that were covered and therefore not exposed to sunlight were turbid, evidence of bacterial growth.^{4,8}

In the late nineteenth- century, Niels Ryberg Finsen, who suffered from Pick’s disease, utilized sunlight for reasons of personal healing.⁹ Finsen then found that refractive rays from the sun or from electric arcs had were successful methods of treating *lupus vulgaris* and smallpox, winning the Nobel Prize in Physiology or Medicine in 1903 for his discoveries.^{9,11}

In Switzerland, Dr. Auguste Rollier used heliotherapy to treat patients with tuberculosis as well as skin and skeletal conditions. Dr. Jeremiah Metzger, an American physician who treated patients with tuberculosis (and likely suffered from tuberculosis himself) traveled to Switzerland to observe Dr. Rollier’s utilization of heliotherapy, later returning to America and founding his second tuberculosis treatment center.⁹

Although heliotherapy is no longer used to treat tuberculosis, it is still used by North American and European physicians to treat Psoriasis, rickets, childhood failure to thrive, and various other conditions.⁹ Additionally, phototherapy is commonly used to treat jaundice in neonates.¹⁰

In a 1995-1997 study, Israeli researchers evaluated the impact of Dead Sea heliotherapy on patients with Psoriasis. They determined that three hours of daily exposure to sunlight at the dead sea was an effective means of treating Psoriasis during March to November, but not in December.¹²

Presently, near- infrared photoimmunotherapy is being investigated in clinical trials in patients with inoperable tumors. Light-absorbing chemicals are attached to antibodies which are then injected into patients. The photo- receptor- containing antibodies eventually bind to the surface of the tumor. When exposed to near- infrared light, the chemical damages the cell membrane, ultimately resulting in cell death.¹³

While heliotherapy has proven an effective mode of treating disease, it is important to consider its potential adverse effects as well. Firstly, UV radiation may have mutagenic potential.¹ In a 2022 review and meta-analysis, Abdellatif *et. al.* claim a statistically significant association between neonatal phototherapy and various cancers.¹⁴ A 2020 review by Hu *et, al.*, however, determined that neonatal phototherapy does not increase risk of childhood cancer.¹⁵

Short- term side effects of phototherapy include erythema, pain, blistering, and crusting of the skin during and after treatment. Long- term side effects include pigmenting of skin, photoaging, and cataracts.¹⁶

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Autopsy is defined as a post-mortem examination. It is a specialized surgical procedure used to determine the cause and manner of death. Autopsies have been known to advance understanding of diseases, discover a patient's underlying illness, determine a cause of death in criminal circumstances, as well as other reasons. The medical procedure of autopsies dates back to the 4th century B.C.E. Back then, according to Avraham Steinberg from *Encyclopedia of Jewish Medical Ethics*, human bodies were dissected for medical studies, under the permission of king Ptolemy.[1] But even back then, the attitude towards autopsies was hesitant, a rare medical procedure. Some ancient societies, such as Greek, Indian, and Roman, prohibited the administration of autopsies due to religious beliefs. As medicine has advanced, autopsies have become increasingly more common. But as Jews, we must always turn to Halacha and Rabbinic sources in order to determine what falls under the parameters as permissible, and through what guidelines is it permissible.

The general opinion in the Jewish world is that autopsies are forbidden according to Halacha. It is not so transparent as to where that prohibition came from. As Jews, we know that it is important to maintain the sanctity, the sacredness, of the human body. According to *Sefer Vayikra* 19:28, it is prohibited to wound or mutilate oneself, as the *Pasuk* states, "You shall not make cuts in your flesh for a person. You shall not etch a tattoo on yourselves. I am the Lord." It is also known from *Sefer Yehoshua* 23:11, that one must take care of their health and body. But commandments only refer to a living body, what happens if the body is declared dead? For autopsies, it is important to see the status the Torah gives a dead body.

There is a passage in *Sefer Devarim* 21:23 that reads, "But you shall not leave his body on the pole overnight. Rather, you shall bury him on that day, for a hanging human corpse is a blasphemy of God, and you shall not defile your land, which the Lord, your God, is giving you as an inheritance." Rashi comments on the words "for a hanging human corpse is a blasphemy of God" stating that desecrating a human body, in regards to leaving it unburied overnight, is equivalent to desecrating God because man is created in the image of God.[2] From this, one can see that there is a Biblical prohibition in terms of desecrating a dead body. However, what is considered desecration is determined by the Rabbis and is dependent on the purpose of the autopsy. In addition to desecration via dissection/autopsy, some Rabbis consider taking the body out of the grave, viewing the body, or delaying the burial as desecration as well. There is a Biblical requirement, according to Rashi, *Sanhedrin* 46b, and Maimonides *Sefer Hamitzvot* (Mitzvah Asei #231), to bury the dead right away. Many times, those acts are required in order to do an autopsy.[2-4] According to Rabbi Moshe Feinstein, in his Responsa *Igrot Moshe, Yoreh Deah*, Part 2, #151, these said acts are a lower level of desecration and are permitted in certain circumstances.[5] There is another Biblical restriction of deriving benefit from a dead body. This is found in Rashi, *Sanhedrin* 47b. There is debate as to whether obtaining medical information from a dead body constitutes benefiting.[6]

The autopsy debate in Judaism is not just a question of physical desecration of a dead body, but also the spiritual desecration. The main purpose of the Jewish human body, the *Guf*, is to be a physical home for the *Neshama*, the spiritual soul. There is the idea, which many Rabbis believe, that the *Guf*, the physical body, retains *Kedusha*, holiness, even

after the *Neshama*, the spiritual body, leaves in death. According to Rabbi Y. Arieli *Torah SheBaal Peh*, Vol. 6, 5724 pp. 40 ff., autopsies would violate the *Guf's* holiness.[7] There is another opinion, according to *Derashot HaRan #7*, that the *Neshama* is never completely detached from the *Guf*, even in the case of death,[8] even to the extent, according to Job 14:22 and *Shabbos* 13b, that the soul is pained if the body is harmed.[9-10] Usually, Halacha is not dictated based on spiritual matters, but the human body's essence is equally spiritual and physical, requiring spirituality to be taken into account.

The Talmud in *Baba Batra* 154b, discusses a question that Rabbi Akiva was asked. The question posed was can the family of a boy who died examine the body for signs of maturity in order to determine the validity of a property transaction that the boy has done. Rabbi Akiva said that if the buyers of the property wanted to examine the boy's body, then they would be allowed to do so. This was based on the precedent that the money, for the buyer, is more important than the desecration of the body.[11]

A Talmudic excerpt found in *Arachin* 7b says that if a pregnant woman dies during labor, one must perform a C-section in order to take the baby from the womb.[12] From this, Rabbi Ben-Zion Uziel records in the Responsa *Mishpetei Uziel*, *Yoreh Deah* 1:28, that one may desecrate a dead body in order to save the life of another.[13] Rabbi Moshe Schick states a different approach in Responsa *Mahram Schick*, #347-348, saying that this is a unique situation, and one may only perform an autopsy if the life will be saved directly and immediately, like in the case of a pregnant woman.[14] Rabbi Yaakov Ettlinger has a completely different take on the excerpt, in his Responsa *Binyan Zion*, #170, saying that this situation is irrelevant to the autopsy debate, since this is what the mother would've

wanted.[15] It is clear from this, that there is much deliberation, even dating back to Talmudic times, on the autopsy topic.

Although the autopsy debate didn't start in the 20th century, it is still as prevalent in Jewish law. According to the *Encyclopedia of Jewish Medical Ethics*, in 1916, Rabbi Nechemiah Moseson allowed autopsy on the basis of gaining medical knowledge, while Rabbi Simeon Elbaum prohibited it. According to *Yagdil Torahi*, Year 9, *kuntres* 1, *Nissan* 5677, the rabbinical organizations in the United States agreed that the use of autopsy for medical study and research. Jewish medical students were expected to provide Jewish bodies for research, and if they did not provide the bodies, they were most times failed and expelled. The rabbis came out and said that a limited number of Jewish bodies can be donated, but this was strictly based upon the circumstances at that time.[16] This was not a *Psak* ruling. In Israel, beginning in 1925, autopsies were permitted on specific, rare occasions. There also needed to be certain requirements met, such as family approval and that the autopsy would provide information that would help prevent future deaths.

The first time that autopsies were dictated by strict Halachic guidelines, was in 1947, when Hebrew University opened. The Halachic guidelines were 1. required for a forensic medicine case 2. if it was required to determine the case of death 3. if it was required to determine the cause of death (affirmation of this from three doctors) 4. if the results would directly and immediately lead to the saving of a life of another sick patient (affirmation of this from three doctors) 5. if the autopsy would enable the saving of other relatives with the same condition (genetic disease). In 1980, the Israeli government added an amendment to the Anatomy and Pathology Act, requiring family

consent and a five hour waiting period before doing an autopsy.

Rabbi Yechezkel Landau and Rabbi Moshe Sofer were two early authorities that addressed the autopsy question. The *Noda B'yehuda*, published by Rabbi Landau, says that autopsies are a Biblical violation as one cannot disgrace the dead. He says that an autopsy for no reason is prohibited, but based on *Chullin* 11b, if there is a chance that an autopsy can save the life of another, like if the murdered man was a *tereifah* and so the murderer doesn't die, it may be performed.[17-18] The *Chatam Sofer*, published by Rabbi Sofer, agrees that autopsy is a Biblical prohibition, but, that since the body keeps its spirituality after death, and autopsy is not permissible, as it is a desecration of the holiness.[19]

After the responsa were published, two other authorities, Rabbi Yaakov Ettlinger and Rabbi Moshe Schick, published their opinions on autopsies in *Shomer Zion Haneeman*. Rabbi Ettlinger, in his responsa, *Binyan Zion*, states that dissecting a dead body is as if one is stealing from the dead. There is a Halacha that says, "one may not steal from a friend in order to save their life", and on that premise, Rabbi Ettlinger says that one may not perform an autopsy, even to save another life. Although this may seem extreme, Rabbi Ettlinger agrees with *Chullin* 11b and the Gemara in *Arachin*. In the case of *Chullin* 11b, he says it is better to desecrate a dead body than to kill. In the case of *Arachin*, Rabbi Ettlinger provides three reasons why cutting open a dead mother in order to save the fetus is allowed, 1. the mother would want herself to be cut open in order for her shield to live 2. cutting open the mother, in this scenario, would be an honor rather than a desecration 3. the mother has *rodef* status and since it is permissible to kill a *rodef* in order to save the one being chased, one can cut

open the mother to save the child's life.[20] Rabbi Schick, in his responsa, *Maharam Schick*, disagrees with Rabbi Ettlinger and states that the prohibition of stealing from the dead is waived in order to save a human life, as are all other prohibitions. His opinion is based on the Gemara in *Chullin* 11b, that if there is even a possibility that a human life may be saved, one is allowed to do an autopsy. But, Rabbi Schick limits the permissibility of the autopsy, based on the Gemara in *Arachin*, to cases where the life-saving situation is present in the here and now.[21]

Rabbi Moshe Feinstein and Rabbi Ben-Zion Uziel, two large present-day *Poskim*, also gave their opinion on autopsies. Rav Moshe Feinstein states that it is not permissible to conduct an autopsy to save a life in the potential future. His basis, *Chullin* 11b, explains that desecrating the dead is permitted only when it will undoubtedly prove the murder's innocence. When there is doubt, it is forbidden to disgrace the dead body. But, Rav Moshe Feinshein states, based on the Gemara in *Baba Batra*, allows for lesser desecration, delaying the burial for example, when that action can save another life. But, in delaying a burial, there must be a distinction between relatives and non-relatives. A relative, a *Karov*, may not delay a burial since they have an obligation to bury right away. In addition, Rav Moshe Feinstein gives a unique opinion saying that one would be able to perform any medical or surgical procedures, such as endoscopies, laparoscopies, and needle biopsies, on the dead that would be similarly performed on a living human. In contrast, Rabbi Uziel, in his responsa *Mishpetei Uziel*, states that the prohibition of desecrating the dead is waived in any life-saving situation. In his opinion, an autopsy is only considered a desecration when it is done without a purpose.

Can one perform an autopsy to learn anatomy? The *Noda Biyehuda*, *Chatam Sofer*, and Rabbi Moshe Feinstein all prohibit the dissection on Jewish body for the purpose of studying medicine. Although the studying of medicine is important, there is no immediate life-saving benefit. Although a Jew, in this opinion, is not allowed to conduct an autopsy, it is permissible to observe one for the purpose of medicine. The *Mishpetei Uziel* allows the dissection for different reasons. One reason it is allowed is on the basis of serving a purpose- the autopsy has a purpose of teaching future doctors anatomy.

What about to determine cause of death? One of the leading reasons one performs an autopsy is to determine a cause of death. There has already been an established precedent that one can perform an autopsy to save a life, immediately, defined as “*lefaneinu*”. The term “*lefaneinu*”, and its meaning, is debated among rabbinic authorities. The *Noda Biyehuda* and *Chatam Sofer* take an *Pshat* point of view, defining “*lefaneinu*”, in this situation, as a patient presently dying of a similar illness and there is a belief that the autopsy will help cure the dying patient. Other sources, such as the *Chazon Ish*, *Yorah Deah* 208:7, are more lenient, elaborating on “*lefaneinu*”, in this situation, to mean any death that is determined to be caused by a very common disease can entitle an autopsy, because there will be other individuals with the illness, and this information from the autopsy will be used to treat and save other people.[23] The *Mishpetei Uziel* is even more lenient, and deems any death a satisfaction of “*lefaneinu*”. This is due to the number of diseased and sick people in hospitals and any deceased human can provide valuable information to help cure other people. Many disagree and say that autopsies do not reveal enough information to save future lives, but according to Rabbi Y. Arieli in *Torah SheBaal Peh*, in specific

circumstances, like a pandemic or death caused by genetic disease, autopsies can be informative and are therefore permitted.

Can there be a financial reason that would deem autopsies permissible? The Gemara in *Baba Batra*, opened that debate that maybe when a non-relative claims they are owed money from a deceased, they can get an autopsy. An autopsy can only satisfy this purpose if the deceased is directly responsible financially, according to Rabbi Ettlinger. The *Noda B'yehuda* states that an autopsy, a full desecration, can be requested by non-relatives so that the financial claims they have are verified. Rav Moshe Feinstein states that only a minor desecration, delaying the burial for example, is allowed for a financial autopsy purpose.

Can one get an autopsy for legal reasons? According to the responsa *Tzitz Eliezer*, Part 4 #14, one can get an autopsy in order to identify a killer or exude someone from the claim.[24] Rabbi Yosef Shalom Elyashiv, one of the chief Ashkenazi Jewish authorities in Israel, limited the permissibility only to when it will lead to the murderers execution, not if it will just imprison them.

Does the will of the deceased play a role? The will of the deceased plays a major role in many medically ethic Halachic debates, such as organ donation and brain death. Autopsy is no exception. Rabbi Ettlinger states that if a person declared his body to be used for medicine and to be dissected, he is forgoing his honor and an autopsy is permissible. In contrasting opinion, Rav Moshe Feinstein, the *Maharam Schick*, and the *Chatam Sofer*, all have strict rules stating one can not allow his/her body to be desecrated.

Autopsies, according to Jewish law, are extremely complex and have no simple answer. The general consensus seems to deem

autopsies as impermissible due to the fact that one cannot desecrate the Jewish body, even after death. We, as Jews, are fortunate enough to have a piece of *Hashem* within us, making us holy. The holiness is not just for the *Neshama*, but also our *Guf*, our physical body. There are only a few circumstances where the benefit of an autopsy outweighs the desecration of that holiness. If autopsies are put in terms of holiness, it is understandable why they would be mostly prohibited. If one were to buy a sports car that they kept in their garage, never driving it, leaving it on display, they would still be furious if the car got scratched. *Kal Vachomer* our bodies. Our bodies are holy, and if one claims that after death our *Guf* serves no purpose, it sits in a “garage” and therefore we should be able to get an autopsy, they are forgoing all of the spirituality, the beauty, the *Neshama*, and *Guf*, hold.

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In recent years the success rate of oocyte preservation and later implantation has increased significantly, and to that end it has become a popular method of assistive reproductive technology for the population of women who fear that their natural fertility is on the decline as they are reaching their mid thirties [1]. Scientifically, this has yielded great results, however for the Orthodox community this procedure first required scrutiny by rabbinic authorities before being given the okay.

One of the main concerns when it comes to elective medical procedures is that there is a Torah prohibition against injuring (*chavala*) or endangering (*sakana*) oneself (Deuteronomy 25:3). Maimonides rules that self injury is prohibited based on the verse in Deuteronomy, yet Rabbi Moshe Feinstein concludes that when one is electing to do a surgery or procedure, this cannot be considered *chavala*, because when the person desires it it is neither degrading nor violating, which he maintains is the definition of the prohibition [2]. Endangering oneself, according to many rabbis, is combated by the principle of “*shomer peta'im Hashem*,” which means that when a procedure or practice is common and the risks have proven to be minimal, a person has the right to take that risk. Rabbi Yaakov Breisch clarifies that when many people have already undergone a procedure and it is no longer considered experimental, it is permissible to assume the risk and opt for the procedure [2].

Doctors across the board agree that the process of egg freezing is very effective and the difference in the success rates of fertilization whether the eggs were fresh or frozen is negligible. Dr. Joshua Klein, a reproductive endocrinologist devoted to egg freezing, notes that the optimal age for egg freezing is between 30 and 40 years old. This is because before the age of 30 women have a good chance of natural conception, so it is not

worth the cost and the risks of any medical procedure. Above age 40, the oocyte quality declines and therefore it is no longer worthwhile to freeze eggs, for similar reasons to the under-30 population; cost and risk, with a very low guarantee of good quality eggs [3]. There is further research that concludes that ideally oocyte retrieval and freezing should happen prior to age 35 [4-5].

Another issue that may come up in Orthodox communities is the question of what happens to the unused eggs. Preservation of life is taken very seriously, and the destruction or elimination of leftover oocytes may be considered a disregard for life. However, Rabbi Gideon Weitzman, director of the Puah Institute stated that “life in a petri dish isn’t life,” and therefore discarding unused eggs is permissible by Jewish law. Many fertility centers and organizations that cater to Orthodox patients consult rabbinic authorities to determine the most *halachic* course of action in each scenario. This entails making sure that everything done in the lab is in accordance with Jewish law, ensuring that new petri dishes are used, and that the labeling and storage of eggs is done in precisely the way that is mandated by *halacha* [5].

Procreation and family life are both *mitzvot* and strong values in Judaism. The commandment to “be fruitful and multiply” (Genesis 1:28) is typically understood to be a commandment that applies to men only (*Yevamot* 65b). The Talmud concludes that based on the fact that it is the way of men to conquer (as is the conclusion of the *pasuk*) and that the commandment is not written in the plural form, the *Torah* obligation is only applicable to men. However, based on a verse in Isaiah (45:18), commentaries such as the *Magen Avraham* and the *Chasam Sofer* do maintain that this commandment applies in some sense to women as well. Regardless of whether or not a woman is obligated by this

commandment herself, the *Ran* suggests that she does receive reward for assisting her husband and in that way she is part of the *mitzvah* [2]. Egg freezing is one way that more women can be included in this *mitzvah* if they have not had the opportunity to naturally procreate before reaching a certain age.

As with most medical advances, there are questions along the way and new advances are carefully considered before being adopted into standardized Orthodox practices, but based on the consent of many prominent rabbis and religious doctors, the practice of egg freezing has proven to be beneficial in many ways and harmful in very few, and therefore it is a practice that has been used by many and has produced astounding results.

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The Science Behind Some Mishnaic and Talmudic Passages

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There is much science in the Mishnah and Talmud and, without a proper background in the physical and natural sciences, earth science, mathematics and astronomy, the best the reader can do is to quickly gloss over the passages without understanding the intended meaning. To elucidate challenging *halachic* issues, the sages of the Mishnah and Talmud were cognizant of the world around them, both through astute observations and experimentation. At times, the initial recognition of a specific medical event can be attributed to a Mishnah and/or the Talmud. For example, whereas circumcision resulting in neonatal death was known, the first written observation that it was maternally transmitted in families as a genetic disorder was recorded in Talmud Yevamos 64b (Reisman, 2014). As *halacha* is all encompassing, the Talmud contains a wealth of scientific information (see Bernstein, 1938; Rosner, 2000) awaiting deeper explanations. This article is an attempt to delve into the *possible* science behind some Mishnaic and Talmudic passages.

Nyctalopia (Night blindness)

Nyctalopia (night blindness) is the inability to see well in dim light or at night. It is associated with an inability to quickly adapt to entering a poorly illuminated environment from leaving a well illuminated environment. In a section in the Talmud dealing with folklore remedies for human ailments, a potential aid to assist in night blindness is mentioned. A person experiencing night-blindness (Rashi) should bring a rope of animal hair and tie one end of the rope to one his legs and other end of the rope to the leg a dog (Gittin 69a). In essence, as noted by Goodman (1979), this may be the first recorded reference to the use of a seeing-eye dog.

Anosmia (Inability to smell odors)

The Talmud in Baba Basra (146a, b) related the following incident. Rav Yehuda, citing Rav, mentioned an incident in the Galilee involving a man who was informed that his betrothed (*erusin*) “wife” had an impaired sense of smell. If true, he intended to divorce her. He devised a plan. The scheme was as follows: he would hide a radish inside his garment, enter a ruin with her, and ask her a question related to detecting odors. By observing her response, he would ascertain whether she could detect odors. He said to her, ‘I smell the scent of radish in the Galilee.’ She responded, ‘Who will give us of the dates of Jericho that I shall eat them,’ indicating that she smelled dates (not, the radish that he brought with him). The story concludes with the roof collapsing, resulting in her death. There are other versions of this strange incident, all concerned with the woman’s inability to detect odors.

The inability to detect one or more odors is termed anosmia (“smell blindness”). Anosmia maybe be genetic disorder (transmitted as an autosomal or X-linked dominant) (Goodman, 1979) or maybe environmental (*e.g.*, caused by inflammation of the nasal mucosa). The condition may be permanent or temporary (as, noted upon infection with COVID-19) (Wikipedia, n.d.).

If the woman lacked a sense of smell, why was this considered to be cause enough for a divorce? Apparently, olfactory disorders have been linked to a variety of significant psychosocial consequences, including depression, stress and anxiety, impairment of eating experience, and relationship difficulties (Philpott and Boak, 2014). Blomkvist and Hofer (2021) reported that olfactory impairment had negative effects on close romantic social relationships, including eating

behaviors, sexual behavior, and social functioning and support. Although there is evidence to suggest that anosmia may have a negative impact on a young couple establishing a close bond, his approach to the situation needed much refinement.

Fear and menstruation

The female monthly cycle of ovulation (the release of the egg from the ovary into the oviduct) and menstruation (expulsion of uterine tissue prepared to receive an embryo) is a complex physiological event involving multiple organs. Hormonal interactions between the hypothalamus (a portion of the brain), the anterior pituitary gland (located at the base of the brain) and the ovaries (located in the lower abdominal cavity) regulate the female reproductive system; this interactive system is termed the hypothalamus-pituitary-ovary (HPO) axis. Communication among these organs is controlled by hormones and exhibits both positive and negative feedback mechanisms. In brief, the hypothalamus sends hormonal messages to the anterior pituitary gland, which in turn, sends hormonal messages to the ovary, causing the maturation and release of an egg into the oviduct. The ovary sends a hormonal message targeting the uterus to produce a highly vascularized bed, the endometrium, for implantation of an embryo. If the egg is not fertilized, there is no embryo to implant, and the endometrium is shed, the process is termed menstruation.

The HPO axis may be modified by stress, especially extreme chronic stress, which ignites the fight-or-flight response, *i.e.*, the hypothalamus - anterior pituitary - adrenal gland (HPA) axis. In this scenario, the body's focus switches from reproduction to survival. Stress is detected by the brain, which signals the hypothalamus to send a message to the anterior pituitary gland, which sends a message to the adrenal gland to release the

stress hormone, cortisol. Cortisol stimulates fat, carbohydrate, and protein metabolism, creating a surge of energy in the body and increases heart rate and breathing rate allowing more oxygen to be brought to muscles. Upon experiencing chronic stress, such as fear, the HPO axis may be turned off and the HPA axis turned on.

Apelian (1923) published his observation of the effect of fear on menstruation. Initially noting that the medical profession was knowledgeable that fear can suppress regular menstruation, he felt it important to mention his personal observations on the effect of war on menstruation. He wrote, "During the world war thousands of Armenian women were driven from their homes into the plains of Syria and Arabia, where they lived under a reign of terror. As the result of, and an uncertainty of the future, and anxiety for their killed beloveds, 80 percent, of mature women stopped menstruating, and some showed mental derangements. Of course, later on malaria and other anemic conditions raised this percentage. This condition lasted until the days of the armistice."

Not known to Apelian (1923), there is a much earlier published source for the effect of chronic fear on menstruation. A Mishnah in Niddah (4:7) discusses the case of a woman with a fixed period cycle. If the time for her period arrived and she did not examine herself, she is assumed to be *tamei* (ritually impure). Rabbi Meir said, If the case involves a woman who was in a hiding place and the time for her fixed period arrived and she did not examine herself, she is presumed to be *tahor* (ritually pure) because fear stops the discharge of menstrual blood. Rav (Talmud Niddah 16a) elucidated that the case in the Mishnah referred to a woman who was hiding in fear of bandits or an invading gentile army - exactly, the case recorded by Apelian (1923).

Aylonis

An *aylonis* is a female that by 20 years of age has still not showed sign of puberty, in that she lacks at least two pubic hairs (Niddah 47b). Other identifying signs of an *aylonis* include the lack of breasts, experiencing pain upon cohabitating, absence of a lower abdomen characteristic of females (Rashi: the lower torso does not bulge outward over the genital area), a masculine voice (Yevamos 80b), and underdeveloped internal female organs (Rambam, Hilchos Ishus 2:6). Her physiologic condition impacts marriage, divorce, *chalitzah*, and *yibum* (Gittin, 46b; Yevamos 12b).

There is a thought that an *aylonis* is a female with Turner syndrome, a genetic chromosomal disorder. All normal human beings contain 46 chromosomes in their somatic, or body, cells. A woman with Turner syndrome has somatic cells with only 45 chromosomes, lacking an additional X chromosome, which is typical of normal females (XX). This abnormality arises upon fertilization, when either the sperm or egg cell lacked an X chromosome, producing a zygote (*i.e.*, fertilized egg) with 45 chromosomes.

Girls with Turner syndrome are often short, do not start puberty, lack ovaries or have malfunctioning ovaries, have an immature uterus, lack a menstrual cycle, lack breasts, and cannot bear children. These overt physical signs parallel those of an *alonyis*. Other complications of Turner syndrome include heart defects, diabetes, a low level of thyroid hormone, and a reduced life expectancy. Most women with Turner syndrome have normal intelligence. Turner syndrome occurs in one in 5,000 females at birth (Wikipedia, n.d.).

Cesarian section

The intent of this discussion is to correct an error in the medical literature on the history of a Cesarian section, which is a surgical procedure involving the incision of the abdominal wall and uterus of a pregnant female, whether an animal or a human, and extracting the fetus through the incision rather than allowing for a vaginal delivery.

According to the medical literature, the first recorded case of a *successful* Cesarian section in a human, with “successful” defined as the case in which both the fetus and the woman survived, occurred in 1500 in Switzerland. Credit is given to Jacob Nufer, a Swiss sow-gelder, whose wife was in labor for several days and was unable to deliver the baby, despite the assistance of 13 midwives. Nufer, using a razor for the incision, delivered a healthy baby. The baby lived to the age of 77 years and his wife subsequently had five vaginal deliveries (O’Sullivan, 1990).

About a 1,500 years earlier Jews were successfully performing Cesarian sections on domesticated sheep, goats, and cattle and on humans, experiencing dangerously prolonged labor. *Yotze dofen* is the phrase in the Mishnah and in the Talmud to denote a Cesarian section. Jewish shepherds and cattlemen had expertise in performing Cesarian sections on pregnant domesticated animals, so that after extracting the viable lamb, kid, or calf, the dam remained viable and was capable of a later vaginal delivery (Mishnah Bechoros 2:9). The Talmud (Niddah 26a) discusses the case of a woman who gave birth to twins, the first, delivered vaginally, was deformed and nonviable, whereas the other twin, delivered by Cesarian section, was normal and viable. The question in the Talmud concerned the *halachic* requirement of the mother to bring a childbirth offering for the birth of the deformed, non-viable fetus. Implicit in this question is that the mother survived the operation.

This *halachic* issue was noted in Talmud Kereisos (7b), where the sages concluded, based upon that after a Caesarian section, the woman did not acquire childbirth *tumah*, did not observe the days of *taharah*, and was not required to bring a childbirth offering. This opinion was a point of disagreement between the sages and Rabbi Shimon (Mishnah Niddah 5:1). As the question was whether the woman was *halachically* required to bring an offering and to observe the days of *tumah* and *taharah*, obviously she survived the surgical procedure. As succinctly stated by Boss (1961), “Ante-mortem caesarian section, saving both mother and child, seems therefore to have been an accepted practice and not a fantastic exploit.”

In the Mishnah Bechoros (2:9) and again in Talmud Niddah (40a; Rashi) a piece of information is added to the surgical procedure: the Caesarian section was performed by *sam*: “By a *sam* they opened the uterus; they bought the fetus out, and she healed.” The definition of *sam* is obscure; possibly, it was a medication, an analgesic or a suave that promoted healing.

Brown (2019b) noted that when Mishnah Niddah “was edited around 200 B.C.E.; there were neither antibiotics nor anesthetics (at least in any modern sense) and there was no germ theory of disease. Postpartum maternal death following natural childbirth was common enough, but the rate of a woman surviving a Caesarian section must have been extremely low. Yet, here in the Mishnah teaching that a woman who recovers from this operation is exempt from bringing a sacrifice, which implies that surviving Caesarian section was an event so common that it required its own legal ruling.”

Jews in the Mishnaic and Talmudic eras were not strangers to surgery, and surgical operations were performed. Talmud Bava Metzia (83b) notes Rabbi Eleazar was obese

and underwent adiposectomy (excision of fat tissue). He was given a sleeping potion (an anesthetic), taken into a marble chamber (*i.e.*, the operating room), had his abdomen opened (laparotomy), and fat tissue was removed (Rosner, 2000). Perhaps more astounding is the case of cranial surgical noted in Talmud Kesuvos (77b) for the purpose of removing a type of growth or parasite resting on the meninges of the brain. The surgical protocol was as follows: (a) create a mixture/potion of pennyroyal and wormwood, to be used, perhaps, as an anesthetic or pain reducer; (b) choose the most appropriate operating room. A marble room where there was no draft was the first choice; if not available, then a house with thick walls was used. Apparently, although unbeknown to the surgical team, the prevention of a draft eliminated contamination by airborne microbes. (c) The mixture/potion was applied many times to the skull, following by (d) opening the skull. Although the instrument used was not mentioned, in Mishnah Ohelos (2:3) note was made of a *gimlet*, a tool used to make holes in the skull. Once the brain was exposed, the surgeon (e) identified and (f) disposed of the growth (Weinberg, 2006). Similar precautions may have been followed when performing Caesarian sections on woman experiencing dangerously prolonged labor.

Centuries later, after the finalizing of the Talmud, there is no mention of Jews performing Caesarian sections, possibly because of resistance by the Moslem and Christian host countries. Moslems absolutely prohibited a Caesarian section and a child born by this procedure would have been slain. In Christian Europe, the Jew practicing a Caesarian section was considered in league with the Devil, which would precipitate a bloody pogrom. The restrictions imposed upon Jewish communities either caused the Caesarian procedure to go underground or caused its transmission to be halted (Boss, 1961).

Rambam discussed a Caesarian section performed on a human and noted in Mishnah Bechoros (8:2): “One delivered by Caesarian section and the one following him - neither of them is a *bechor* in regard to inheritance nor in regard to redemption from a Kohen. Rabbi Shimon says: The first one is a *bechor* in regard to inheritance and the second one regarding the five *selaim*.” Rambam understood this Mishnah as follows: “It may happen that this woman is pregnant with twins, and one comes forth after the side of the stomach is incised (*i.e.*, a Caesarian section) and the later the other one comes forth by the ordinary route (*i.e.*, a vaginal delivery), and the first one dies after the second one comes out. But what some say, that a woman can live after her side is cut open and then bear a child, is contrary to reason and is exceedingly absurd.” It would appear the Rambam considered it medically impossible for a woman to survive a Caesarian section.

Rambam was much accomplished, a respected scholar and a respected physician, living in Egypt and serving the sultan. He authored, in Arabic, many treatises on medicine and health (see Rosner, 1988). Yet, his analysis of this Mishnah had a basic medical flaw, there is a minute possibility for a pregnant woman carrying twins to undergo a Caesarian section to deliver the first baby and immediately thereafter to go into labor to produce a second child by a vaginal delivery. Lurie (2006) stated, “The situation of a Cesarean section where the first twin is delivered abdominally (through a cut in the uterus) and the second one vaginally is physiologically virtually impossible and also illogical because it is easier and safer to deliver both twins abdominally.” Boss (1961) also commented on the weakness of the medical scenario presented by Rambam. As a rationalist and noted physician, Rambam would not have formulated an illogical medical event and

afterwards note that it was absurd. Rambam’s works were written in Arabic and, possibly, because of pressure from the dominant Moslem community, Rambam needed to conceal his true thoughts by presenting an impossible medical scenario, in which the pregnant woman could not survive the abdominal/uterine surgery. Jews, who are astute in Talmudic analyses, would have recognized the medical problem, especially as Rambam presented an analysis and concluded by stating “this is very strange.” Rabbi Y. Kafich (1989) modified Rambam’s interpretation of this Mishnah as follows: with the first pregnancy the baby was delivered by Caesarian section and, *at a later time*, there was a second pregnancy, and his baby was delivered vaginally.

The initial point of this section was to correct the medical history on a Cesarean section. The first recorded occurrence of a successful Caesarian section performed on a human, with both the woman and baby surviving, is noted in the Mishnah (Niddah 5:1). The story about Nufer and his wife is interesting, but not more than that. Rabbi Chrysler (2005) of the Kollel Iyun Daf Hadaf of Yerushalayim, regarding the Caesarian section, wrote: “It is not uncommon for the world to attribute newfound discoveries to the Gentile who discovers them in his day, even though we knew about them many centuries earlier.”

Dorketi family (Androgen insensitivity syndrome)

The Talmud (Kesuvos 10b) relates the following incident. A man came to Rabban Gamliel and said to him: ‘My teacher, I engaged in sexual intercourse and did not find blood. The bride said to him: My teacher, I am from the family of Dorketi, who have neither menstrual blood nor blood from the rupture of the hymen.’ Rabban Gamliel

investigated her claim and discovered it to be true. He told the husband to be happy as his wife will never be a *safek niddah*. The Talmud explains that the meaning of Dorketi is a 'truncated generation' [*dor kato 'a*]. Rabbi Hiyya explains that a woman who does not menstruate cannot bear children and Rabban Gamliel's congratulatory words were in vain. This idea is repeated in Talmud Niddah (40b) that Dorketi means a generation cut off from progeny. Goodman and Plato (1982) summarized Rav Hai Gaon, Rambam, and Bertinoro who all concurred that this woman was sterile.

Dissecting the information provided in the Talmud Kesuvos, several hints can be gleaned regarding the nature of the Dorketi syndrome. (a) It is a familial transmitted disorder, indicating a genetic component; (b) infertility occurs only in some of the females, and not in the male members of the family; (c) upon sexual intercourse there is no vaginal bleeding; and (d) these females do not menstruate. Goodman and Plato (1982) suggested that Dorketi woman suffered from androgen insensitivity syndrome (formerly termed, testicular feminization syndrome, or TFS), an X-linked recessive disorder.

A brief introduction to human embryology is required. Prior to day forty of fetal development, the fetus has a bipotential gonad, that can develop either into testes or ovaries, two sets of internal tubes, the Wolffian ducts which are the forerunners of the internal male reproductive structures (epididymis, vas deferens, seminal vesicles, and ejaculatory ducts) and the Mullerian ducts which are the forerunners of the internal female reproductive structures (oviducts, uterus, and upper portion of the vaginal canal); externally, the fetus is recognizably neither male nor female. If the fetus is a genetic male (XY), at day forty the gene, SRY, on the Y chromosome is activated and promotes the bipotential gonads to become

the testes, which produce testosterone (an androgen hormone) and anti-Mullerian hormone. Testosterone stimulates the Wolffian ducts to develop into the internal male reproductive system and anti-Mullerian hormone prevents the Mullerian ducts from forming the internal female reproductive system. Testosterone is converted to dihydrotestosterone which induces the fetus to develop external male genitalia.

A gene on the X chromosome, *TFS*, encodes for chemical receptors that allow the body cells to detect and to respond to testosterone, while the recessive mutant non-functioning form of this gene, *tfm*, does not permit the body cells to detect and to respond to testosterone, although it is produced. A normal phenotypic male is designated $X^{TFS}Y$, whereas an individual designated $X^{tfm}Y$ carries the defective gene and develops as a phenotypic female. Why? If the somatic cells cannot detect and respond to testosterone, then the Wolffian ducts do not mature to form the internal male reproductive structure. The testes, also produce anti-Mullerian hormone, which the body detects, preventing the Mullerian ducts from forming internal female reproductive structures.

As testosterone cannot be detected, externally there are no *obvious* male structures, rather, instead, there is a small protuberance thought to be the clitoris (but, actually, is the male organ). Also, externally there is an invagination of the body, thought to be (but, is not) the lower portion of the vaginal canal. Internally, if the abdominal cavity was opened, one would find only undescended testis. At puberty, the adrenal glands produce the sex hormones, both testosterone and estrogen. Whereas the body of this person does not respond to testosterone, it can detect and respond to estrogen, which stimulates breast development and has an overall feminizing effect. Individuals with androgen insensitivity syndrome, although genotypic

males, $X^{tfs}Y$, are noted for their very attractive female appearance, luxuriant hair, smooth skin, and well-proportioned body. These phenotypic females cannot menstruate (as they lack a uterus), do not produce hymenal blood (as they lack a true vaginal canal), and are sterile (as they lack ovaries) (Goodman and Plato, 1982).

Perhaps, androgen insensitivity syndrome is the disorder affecting some of the Dorketi females, then the defective gene would be transmitted within the family as follows: a normal male ($X^{TFS}Y$) marries a normal female ($X^{TFS}X^{tfs}$), who is a carrier of the defective gene. Their potential offspring would be:

- 25% $X^{TFS}X^{TFS}$ (normal female)
- 25% $X^{TFS}X^{tfs}$ (normal female; carrier)
- 25% $X^{TFS}Y$ (normal male)
- 25% $X^{tfs}Y$ (a Dorketi ‘phenotypic female’)

The defective gene remains within the Dorketi family because the carrier woman, $X^{TFS}X^{tfs}$, is a healthy, fertile female.

The Dorketi person is a genotypic male but a phenotypic female. A case was presented before Rabbi Eliezer Waldenberg, *t”zal*, that, *possibly* was androgen insensitivity syndrome. The child had a female outer appearance but had internal undescended testes. The question was whether such testes can be excised, as later in life they may become malignant. He ruled that it was permitted to remove the testes, as the child was medically sterile. He further ruled that accordingly to *halacha*, the gender of a person is determined visually, by the outer appearance of the person. As external organs determine gender, this child was a *halachic* female (Cohen, 1999; Weitzman, 2009).

Animal hybrids

The concept of *kil’ayim*, as applied to animals, includes mating different species to

create hybrids and using animals of different species to pull together a plough or a vehicle (Yavikra 19:19; Devarim 22:9-11). As no reason is provided for the prohibition of *kil’ayim*, it is considered a prohibition within the category of those commandments whose reasons are beyond man’s ability to understand (Yoma 67b). Yet, Biblical scholars try to understand a rationale for these prohibitions. Rambam (Guide for the Perplexed 3:37) considered animal hybridization as a form of idol worship, S’forno (Bereishis 1:11) noted hybridization produced sterile progeny, and Ramban (Yavikra 19:19) espoused that hybridization denies that *HaShem* created a perfect world. Maharal (Be’er HaGolah 2:10) suggested that animal hybridization hinted at licentious sexual relationships and thus was comparable to illicit relationships (Twersky, 2016).

An animal hybrid is the offspring from a sexual mating between two distinct species. According to the Biological Species Concept, animals considered to be of different species cannot breed together or if they breed together, produce infertile or nonviable offspring or offspring with abnormal phenotypic traits. Deleterious hybrid traits, collectively termed hybrid incompatibility (HI), act as reproductive barriers in speciation, explaining why flocks/herds of hybrids are not known. As a hybrid contains chromosomes from each parent, HI arises from improper interactions between multiple genes (Johnson, 2010). Yet, the Biological Species Concept is not a hard-fixed rule, as there are exceptions. Lions and tigers hybridize to produce a fertile liger, which may mate with either of its parent species or with another liger (Colston-Nepali and Leigh, 2019),

The hybrid animals most discussed in the Talmud are the *koy* and the mule. The definition of a *koy* is not definitive, but one thought that it is the offspring of a male goat

(a domesticated animal; a *behema*) and a female gazelle (a wild animal; a *chayya*). Another thought is that it is *beriah bifnei atzmah* (a unique creation), perhaps, the *Ayal HaBar* (i.e., the wild ram), for which there was uncertainty if it is a wild or a domestic animal (Chulin 80a, b). *Koy* were not common and there are no herds/flocks of *koy* (Aleph Society, 2015). Rather, it is mentioned in numerous gemoras to serve as the test case for discussions of the *halachot* of kosher hybrid animals. Thus, the precise zoologic identity of the *koy* was not of importance, rather that it is the offspring of different *halachic* types of kosher animal species and therefore trigger many questions. For example, there is a type of fat (*chelev*) forbidden to eat from a domesticated animal but permitted if it was from a wild animal. A pertinent question would be: does consumption of *chelev* from a *koy* obligate the person to bring an *asham taluy* (a provisional guilt offering)? (Kerisos 17a, b).

The mule is the hybrid offspring from the mating of a female horse with a male donkey. Mules were desired as they exhibit “hybrid vigor,” defined as when the hybrid exhibits a trait more superior than either parent. Mules are as intelligent as horses and are more patient, hardier, and longer-lived than horses; mules are more intelligent than donkeys, are perceived as less obstinate than donkeys, and can successfully handle rougher terrain than donkeys and, therefore, are valued as pack animals. However, mules are sterile and cannot breed. Horses have 64 chromosomes, donkeys have 62 chromosomes, and mules have 63 chromosomes. Sterility may be for several reasons, such as the failure to produce viable oocytes and sperm cells, thus effectively blocking normal estrous cycles, sperm cell development, and fertilization (Wikipedia, n.d.). Yet, fertility has been noted in some mules. This was previously noted in the Talmud (Kesuvos 111b): “Regarding a female mule that indicated a desire to mate,

one may not mate her with a horse or a donkey, but rather, one may mate her only with her own kind - a male mule.

Recently there have been documented reports of mules mating and producing foals. Most probably, more mules than realized are fertile, but there are few attempts to breed mules. Most mule owners castrate male mules and spay female mules to remove their ovaries, in hopes of their changing behavior associated with estrus or aggression (Extension Horses.org, 2019; NPR 2007).

The possibility of fertile mules raised a question in Talmud Chulin (79a) of whether one *halachically* was allowed to breed mules. Is a mule itself viewed as two distinct species, so that breeding two mules may entail crossing the maternal side of the male offspring (derived from a horse) with the maternal side of the female offspring (derived from the donkey)? If so, that would be forbidden. However, *Chazal* viewed a mule as a distinct new species, not an organism that is part horse and part donkey. Biologically this is correct, as each somatic cell in a mule contains half the number of its chromosomes from a horse and the other half of its chromosomes are from a donkey. There are no somatic cells in a mule that contain only donkey chromosomes or only horse chromosomes. As a distinct species, mules may be bred because both the male mule and female mule have the same number and kind of chromosomes in the somatic cells.

Talmud Pesachim (54a) notes an interesting incident regarding the origin of mules. Bereishis (chapter 36) lists the sons of Seir the Chori. Seir had many offspring, including Tzivon, the father of two sons, Alah and Anah. Mention is made that Anah discovered mules (*yemim*) in the desert while pasturing his father’s donkeys (Bereishis 36:24). Apparently, the Torah is telling us something about Anah and mules. Rashi, citing Pesachim

(54a) notes that Anah was a momzer, as his father was Tzivon (a son of Seir) and his mother was Seir's wife, *i.e.*, Anah was both the son and brother of Tzivon. Apparently, Anah, himself born from an incestuous union, experimented by mating horses with donkeys, producing mules, also offspring from a forbidden union.

The *halachic* questions in Chulin 79 of the status of a hybrid animal would be applicable to a chimera, such as the geep. A sheep, with 54 chromosomes per cell, and a goat, with 60 chromosomes per cell (Long, 1990), can mate to produce hybrid offspring containing 57 chromosomes per cell. In the laboratory, scientists fused a sheep embryo with a goat embryo to create a geep. A geep is a chimera, not a hybrid, as it has distinct sheep cells (with 54 chromosomes) and distinct goat cells (with 60 chromosomes). Thus, for example the hide of a geep is a mosaic of sheep cells, producing wool, and goat cells, producing hair. A geep (fig. 1) would be the quintessence of *kil'ayin*.



Figure 1. A geep

The concept of crossbreeding species to create hybrids is noted in the Talmud, with mules used as the representative animal. According to Rav Nechemyah, the first mule was created by *HaShem* at “*bein ha’shemashos*,” on the first *eruv Shabbos* of Creation (Pesachim 54a, b). Rashi added that this prototype of a hybrid animal was not created by crossbreeding a horse with a donkey, but rather was created from earth. However, further on that daf a Baraisa is brought that *HaShem* brought to Adom a horse and a donkey, crossbred them,

and produced a mule. Rav Nechemyah added that fire was also created by *HaShem* at “*bein ha’shemashos*.” *HaShem* gave Adom the understanding that rubbing and grinding two stones together produced sparks, which could be used to create fire.

Apparently, there is something to be learned from this information. If fire is representative of the physical sciences and mules are representative of the natural sciences, perhaps, *HaShem* was giving mankind creative ability, *i.e.*, the “*da’as*,” to manipulate the world by taking what exists and improving upon it (Sefas Emes). Thus, fire as a form of thermal energy may be alluding to mankind’s development of other forms of energy, *e.g.*, nuclear energy. The crossbreeding of a horse and a donkey to produce a mule is a Biblical prohibition, yet, *in vitro* fertilization of a horse egg with sperm of a donkey would not be prohibited as there is no sexual contact between the two species. Or, during the *sh’midah* year in Israel, growing vegetables by hydroponics would be permitted. The above examples are but a few of man’s ingenuity, applied within the framework of *halacha*, to improve the world we live in.

The Mishnaic and Talmudic passages presented illustrate the deep understanding Chazal had of the natural sciences, often elucidating ideas and concepts centuries before their discovery by modern scientists.

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