

# Derech HaTeva

A JOURNAL OF TORAH AND SCIENCE

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**DEDICATION** We dedicate this year's Derech Hateva journal to our esteemed biology professor Dr. Babich. Through his devotion, inspiration, and unceasing efforts, Dr. Babich continues to play a prominent role in the realization of this Torah and Science production.

Dr. Babich, we thank you for being so dedicated to your students. We appreciate that it is always with an extended hand and caring heart that you offer your services as friend and teacher.

Thank you for helping to make Derech Hateva, Volume 5, a reality.

# THANK YOU

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# Derech HaTeva

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"Hafoch bah v'hafoch bah,  
d'cholah bah" (Avos 5:25)

Delve in it [the Torah]  
and [continue to] delve in it,  
for everything is in it.

—•

# Exploring Mitzvot on the Moon:

## *The New Halachic Frontier*

As science fiction becomes scientific reality, our rabbinic leaders have the challenge of adapting theoretical halachic principles to practical halachic applications. In the area of space travel, the advances of the past fifty years have been mind-boggling – indicating that in the next fifty years science will

generate even more awesome achievements. As we explore this new, uncharted frontier, as always, we look to our halachic foundations and precedents to guide our way.

Before delving into the many halachic implications of traveling in space, one must first determine whether space travel is permissible according to the Torah. At first glance, it appears as if G-d instructed man to remain on earth, to “fill the earth and subjugate it” (Genesis 1:28). King David wrote in Psalms that “the Heavens are the Heavens of the L-rd, but He has given the Earth to the children of men” (115:16). According to these pesukim, it

seems that man’s domain is restricted to earth. However, based on this reasoning, another posuk in Psalms, “the high hills are refuge for the wild goats, and the rocks for the badgers” (104:18), implies that humans may not climb hills or rocks! Rather, it would seem that “the Heavens are the Heavens of the L-rd” means that G-d is everywhere, both in the Heavens and on earth, and G-d established man’s place on earth – including the atmosphere and everything in the cosmos.

Other Biblical passages seem a little harder to reconcile with the authority of man to travel in space. The prophet Isaiah

warned Nevuchadnezzar, the king of Babylonia: “you said in your heart ‘I will ascend to the skies, I will place my throne above the stars...I will be like the most High,’ – you will be brought down to the depths of the pit” (Isaiah 14:13-15). The Gemora (Pesochim 94a) explained that Nevuchadnezzar actually intended to ascend to the heavens. Yet the midrashim stress that the king of Babylonia was motivated by pride. Nevuchadnezzar said, “The creatures of this world are not fit to dwell among; I will make myself dwelling in the clouds...” (Tosefta Sotah 3:6). Another midrash (Mechilta 15, 11) added that Nevuchadnezzar “called himself a god.” His punishment was a result of his motive, not necessarily the action of ascending the heavens.<sup>1</sup> Similarly, the sages explained that mankind was punished for attempting to build a tower to heaven (Genesis 11:1-9), either

because of their pride or as a result of their desire to rebel against G-d. As long as man travels to "heaven" with the proper motivations, it should be permissible. As Maimonides wrote, "What is the way to love and fear Him? When one considers His wonderful and great acts and creations..."

Once the permissibility of traveling in space has been established, numerous halachic questions arise regarding the nature of mitzvot in space. The most radical position, presented by Rabbi Ben Zion Firer in the 5730 issue of *No'om*, asserts

**"Rabbi Shlomo Goren asserts that theoretically time-bound mitzvot are not incumbent upon humans on the moon because time, as measured by the sun, does not exist there. As a result mitzvot such as Shabbat and Keriyot Shema would not exist on the moon."**

that mitzvot are only applicable on earth. He derived his only proof from a Gemoro (Kiddushin 37a) which maintained that commandments which are personal in nature apply in the Diaspora as well as in Israel. The Gemoro quoted a posuk (Deuteronomy 12:1) "...all the days that you are olive on the earth." Rabbi Firer posited that the stipulation, "on the earth" is a prerequisite for these mitzvot. Therefore, according to Rabbi Firer, man is exempt from the performance of mitzvot when he is not "on the earth."

Another position, presented by

Rabbi Shlomo Goren (Ho-Tzofeh, 10 Av 5729), asserts that theoretically time-bound mitzvot are not contingent upon humans on the moon because time, as measured by the sun, does not exist. One side of the moon experiences constant sunlight while the other side experiences constant darkness. As a result, mitzvot, such as Shabbot and keriyot shema would not exist on the moon. However, in reality, even these time-bound mitzvot are obligatory on the moon. Rabbi Goren, as well as Rabbi David Shluch (Torah shebe'al Peh, Jerusalem 5725), argued that

because astronauts, whether traveling through space or situated on the moon, rely on materials from earth, such as food and air, they are actually dependant on Earth, and therefore all mitzvot which are applicable on Earth are incumbent upon space travelers as well.<sup>4</sup>

Rabbi Firer defended his position regarding mitzvot being linked to their performance on Earth against Rabbi Goren's objections that dependence on Earth materials determines the obligation to observe all Earth-mitzvot. He supported his claim based on a Gemora (Gittin 7b)

which discusses the status of the waters surrounding the land of Israel. The Gemoro states that these waters are not considered part of Israel and, thus, if a ship is in these waters, it is considered outside the borders of Israel. However, once the ship scrapes the bottom, it is considered to be within Israel. Rabbi Firer argued that just as the ship attains the halachic status of Israel by coming into contact with land, so astronauts coming in contact with lunar materials acquire a lunar status – even if they are dependant on Earth.<sup>4</sup>

In sharp contrast to Rabbi Firer, Rabbi Menochem Kasher (No'om 5730) supported the belief that mitzvot are personal obligations, incumbent upon man in every environment. Even in space or on the moon, man is obligated to perform mitzvot.<sup>4</sup> Rabbi Azriel Rosenfeld also argued that mitzvot, such as Shabbot and festivals, would still be applicable on the moon. The themes of the festivals, "in commemoration of the Exodus from Egypt," are timeless. And certainly Shabbot, with its universal theme, "in commemoration of the Creation at the Beginning," would still be relevant and incumbent upon man.

Even after the obligation to perform mitzvot in space or on the moon has been established, the question still remains: if there is no time as measured by the sun, how is one to perform the time-bound mitzvot?

According to Rabbi Kasher, the situation on the moon is identical to that on the North Pole. The polar



are personal obligations, incumbent upon man in every environment."

regions experience month-long days and nights. Rabbi Kasher suggested that the residents of the polar regions must establish 12-hour alternating periods of "day" and "night" regardless of the actual presence or absence of the sun.<sup>4</sup> Rabbi Goren, former Chief Rabbi of the Armed Forces in Israel, also proposes such a system in a letter regarding the halachic issues of mitzvoth in the polar regions. Rabbi Kasher extended the practice of the polar regions to the inhabitants of the moon – they must establish fixed "days" based on calculated time periods. Once these time periods are set, one may perform mitzvoth according to this artificial time.

Rabbi Rosenfeld provided a rationale for this practice of a 24-hour day on the moon. He distinguished between cases in which it would be possible to follow the "sky day" and cases where this practice would be impossible. For the first category, he submitted the case of a ship which circumnavigates the world at a latitude of 60° south, starting just east or west of longitude 180° and proceeding eastward or westward at the rate of 15° of longitude per 24-hour day. During the voyage, the International Date Line is not crossed, and the question

arises: when do the passengers keep Shabbat? The question is significant because as a result of the ship's motion and direction, the passengers would observe sunsets at either 23 or 25-hour intervals, rather than the standard 24 hours, depending on their direction. In this case, the passengers would follow the "sky time" and keep Shabbat after every seventh sunset regardless of the clock time. In a second case, Rabbi Rosenfeld offered the seemingly contradictory situation of the polar regions, where the inhabitants observe a 24-hour day even when the astronomical phenomena do not correspond.

These cases can be reconciled, according to Rabbi Rosenfeld, by recognizing that when it is possible to observe the sky time, even when it does not correspond to 24-hour periods, that is preferred. Yet in the polar regions, where the sky-time is impossible to observe, fixed 24-hour intervals must be kept by the inhabitants. Therefore, in the case of a lunar base, where the space travelers observe month-long intervals between sunsets, as well as a space traveler in an equatorial-orbit satellite who sees the sun set approximately every 90 minutes, the precedent of the polar regions serves as a model for establishing 24-hour days because the sky-day would be impossible to observe. However, argued Rabbi Rosenfeld, if a colony would be established on Mars, the day would be a little over 24-hours and the inhabitants would observe

the sky-day. The difference between the ship case and the Mars case, conceded Rabbi Rosenfeld, is that the passengers on the ship remain in step with the communities they pass on their voyage, whereas the colonists on Mars would get progressively out of step with the inhabitants of Earth. Another issue, which remains to be resolved, arises regarding the distinction between observing sky-time and setting up clock-time. Where would one draw the line between sky-time and clock-time? Also, what would be the implications of relativistic time-dilation effects? According to Einstein's Special Theory of Relativity, there will be a difference in time intervals between the clocks on earth and those in space.<sup>5\*</sup>

Rabbi Shlush arrived at a different conclusion. He argued that space travelers in orbit around the Earth who observe sunsets in 90 minute intervals, must keep Shabbat after every seventh sunset they see during their flight. He supported his claim with the biblical dictum, "It is Shabbat...in all your places of settlement" (Leviticus 33:3), in which the Torah makes the Shabbat dependent on "your places of settlement." Additionally, since the purpose of Shabbat is to commemorate the Creation of the world in six days followed by a seventh day of rest, with each day determined by "and it was evening and it was morning," Rabbi Shlush maintained that space travelers should observe their "days" and "nights" to determine their Shabbat.

This is considerably different than Rabbi Rosenfeld who argued that in this exact case, space travelers should establish "clock time" because the "sky time" is so different from Earth time.

Yet, when it comes to the festivals, Rabbi Shlush asserted that the day is established by the day of the month, which is determined by the phases of the moon, which are the same for space travelers in orbit. Therefore, the festivals should be observed for 24-hour time periods starting from the moment the satellite is over a point on earth where the festival begins. However, Rabbi Shlush did not explain how the observance of the 24-hour festivals could work in conjunction with the observance of Shabbat in 90-minute intervals.

Rabbi Shlush also reaches conclu-

sions regarding observance in space of other mitzvot dependent on time. For example, he argued that one is only obligated to wear the tzitzit when one can "see them" by natural light, which are the daylight periods in orbit. In terms of daily prayers, according to Rabbi Shlush, Shacharit, Mincha, and Maariv should be recited only once every 24-hour period, but at times corresponding to morning, afternoon, and evening respectively, in the orbital day (even though this runs on a 90-minute day!). Shema should be recited before and after the travelers' sleeping periods, and Rabbi Shlush did not insist on these times corresponding to their orbital day and night. However, there is also an opinion that if a space traveler finds himself in a black hole, he is exempt

from praying because of the grave danger.<sup>10</sup>

Another interesting discussion involves the recital of Kiddush Levana (the blessing on the full moon) when situated on the moon. According to Rabbi Rosenfeld, it is plausible that Kiddush Levana is only applicable inside the moon's orbit. The Lubavitcher Rebbe also concluded that there is no reason to bless the moon when one is situated on it.<sup>2</sup>

As man's travels take him deeper into outer space, the halachic applications penetrate with him. What once seemed far-fetched becomes far-reaching as the realities draw nearer. Our ageless halachot travel well in our modern space age.

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#### A C K N O W L E D G E M E N T S

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# Hair it Goes Biblical Baldies

Whether it is an age-old problem or a mark of old age, baldness affects an estimated 40 million men and 20 million women in the United States.<sup>1</sup> The general term "hair loss" can refer to many different problems ranging from mild hair thinning to total baldness, and these can occur for

many different reasons. The loss of hair is often trivialized but baldness may indeed have profound effects on a person's well being and quality of life. Thus it is important to get to the root of the problem.

Medically, hair loss falls into several categories: telogen effluvium, drug side effects, medical illnesses, tinea capitis, traumatic alopecia, and male pattern baldness or alopecia. Telogen effluvium is a generalized, diffuse hair loss that happens a couple of months after a major body stress, such as a prolonged high fever, major surgery, or serious infection. Certain medications such as lithium, beta blockers, blood

thinners such as warfarin and heparin, amphetamines, and levodopa cause hair loss as a side effect. Daunorubicin and other such medicines used in cancer chemotherapy can also cause a sudden generalized hair loss. Hair loss can be a symptom of a medical illness, such as lupus erythematosus, syphilis, thyroid disorder, sex hormone imbalance, sarcoidosis, and serious nutritional problems, especially deficiencies of protein, iron, zinc or biotin. The fungal infection of the scalp, tinea capitis, is manifested as a form of patchy hair loss; the causative agent is the fungus *Trichophyton tonsurans*, which causes the hair to break

off at the scalp surface. Traumatic alopecia is the general term for the man-made form of hair loss. It is caused by hair-dressing techniques that pull the hair, expose the hair to extreme heat, or damage the hair with strong chemicals. Alopecia, the most common type of hair loss in men, follows the typical "male" pattern of a receding front hairline and thinning hair at the top of the head. It is usually caused by the interaction of three factors: an inherited tendency toward baldness, male hormones, and increasing old age. Quite similarly, women may develop a mild female pattern of alopecia. The pattern is different, however, as thinning occurs over the whole scalp, so that the frontal recession apparent in men does not occur.<sup>1</sup>

Combing through Biblical and Talmudic literature provides evidence indicating that the symptoms and treatments for baldness

have many parallels to the issue nowadays. Causes of baldness in Biblical and Talmudic sources are varied, ranging from Divine intervention to natural causes. Chazal were obviously cognizant of the medical aspects associated with baldness, along with its psychological effects.

The Torah (Voykro 13:42) differentiates between anterior baldness, gabbachat, and posterior baldness, karachat, when describing the differential diagnosis between baldness and leprosy. Leprosy, as described in the Torah, is a spiritual malady and the hairless head may thus be the source of illnesses and the basis of judgments regarding the skin of the body. Posterior baldness is defined as absence of hair from the vertex, kodkad, sloping to the rear, and anterior baldness, from the vertex sloping anteriorly. The Mishnah presented the following definition: karachat is the absence of hair from the crown sloping to the rear as far as the piko of the neck (Negoim 10:10), which the Rambam interpreted to mean the first cervical vertebra.<sup>2</sup>

### “As recorded

In Tanach, one of the causes of baldness is punishment by Hashem. Amos confessed that Hashem revealed to him that He would punish the Jews by striking them with baldness (8:10). Yeshoyahu prophesized: “Instead of perfume you shall have the stench of decay, and a rope in place of a girdle, boldness instead of

hair elegantly coiled” (3:24).<sup>3</sup> Further on, Hoshem said that He will “smite the crown of the head of the daughters of Tzion with boldness” as a punishment for their excessive immoral indulgences (Yeshayahu 3:17). This punishment is extremely severe in view of the fact that baldness in women is extremely rare.

There was an old custom to cut off one’s hair as a sign of grief and mourning. Yeshayahu prophesized that in the country of Moav “the hair

### may be a cause of baldness.”

#### in Tanach, physical trauma

will be torn from every head and every beard shaved off” (15:2). Apparently, the Moovites shaved their hair out of sorrow because of the devastation of their country.<sup>3</sup> Female war captives shaved their heads as a sign of mourning for their relatives killed in the war (Devorim 21:12).<sup>4</sup> Moreover, Michah prophesized the condemnation of Samaria and Yerushalayim by exhorting the people to “shave the hair from your head in mourning for the children of your delight; make yourself bald as a vulture for they have left you and gone into exile” (1:16).<sup>3</sup>

As recorded in Tanach, physical trauma may cause baldness. When Nevuchadnezzar’s army marched to attack Tyre, his soldiers became bald and developed sore shoulders because of the severe amount of war materials that they hauled on their heads and shoulders (Yechezkel 29:

18).<sup>3</sup>

The use of a caustic material, neso or nesom, may permanently eliminate hair, when either smeared onto the head or ingested (Negoim 10:10). According to the commentators this word is the dialect form of “som,” which is the usual designation for any pulverized type of drug.<sup>2</sup> In modern medicine it is now known that medication-induced alopecia is an occasional side effect of many ingested pharmaceuticals. Most of

the mood stabilizer and antidepressant drugs can lead to this condition. Some antipsychotic and anti-anxiety agents induce alopecia. For example, lithium causes hair loss in 12-19% of long term users and valproic acid and divalproex precipitates alopecia in up to 12% of patients.

Loss of hair was thought to be brought about occasionally by severe emotional shock. In Bamidbar Robboh (24:4), it is reported that a man once passed through a wilderness and accidentally stepped on a sleeping snake. Although the snake did not awaken, he became so terrified (nitbohel) from the sudden, severe fright that his hair fell out and from then on they called him “meruto,” meaning baldhead.<sup>2</sup> The influence of psychological factors on the development of alopecia is well documented in medical literature. Psychiatric disorders, mainly generalized anxiety disorder, depression, and phobic states, are major causes

of hair loss.<sup>6</sup>

A bald person, *kereach*, was the object of ridicule in ancient times. On his way to Bet-el, Elisha was jeered at by many small boys who come out of the city and said, "Get along with you, bald head, get along." He turned, looked at them, and cursed them; and two she-bears came out of the woods and mauled 42 of them (Melachim 2:23-24).<sup>2</sup> It is contested in the Talmud, regarding marriage laws, whether baldness in women is a physical blemish. Sorceresses, considered to be the embodiment of everything hateful, are also referred to as bald-headed (Pesachim 110a).<sup>3</sup> "Baldheaded buck" is an abusive term for a castrate (Shabbat 152a).<sup>4</sup> "The bald-headed person should become balder" (Yerushalmi Ketubot 20) is a curse mentioned by Rashi concerning Rabbi

Akiva's surname, Karcha (Berachot 58a). A bald-headed Kohen is unable to serve in the Beit Hamikdash.<sup>5</sup> The exclusion of such priests from service is based solely on their unsightly appearance and not on a moral defect (Berachot 43b).<sup>7</sup>

The opposite of the bold man is the *kivvetz*, the man with thick and long hair. A case of excessive development of hair, *hypertrichosis*, is described in the Torah. At birth, Eisav emerged as a hairy garment (Beraishit 25:25) and even later was still called a "hairy man" (Beraishit 27:11), as opposed to the smoothness of his brother, Yaakov.<sup>2</sup> Furthermore, Hashem sent Eliyahu, a prophet with wavy hair, to the Jewish people. They ridiculed him and called him, *ba'al se'ar*, a hairy man (Melachim 2, 1:8). Hashem then sent a man without hair, Elisha; he was

insultingly called "baldhead." Apparently, people can never be satisfied.<sup>2</sup>

Baldness is an ancient phenomenon recorded in Tanach and the Talmud. Medical literature is replete with references to hair loss causes, symptoms and treatments, some of which are on the brink of modern-day discovery. It is interesting to note, though, the limited advantage afforded to a bald person as stated in the Midrash: "If a person with a thick head of hair and a bold person are standing together on a threshing floor, chaff would fly into the hair of the former and become entangled there while the bald man need only pass his hand over his head to remove such chaff!"<sup>2</sup>

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#### NOTES

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# Siamese Twins and Halacha

Late in the 1800s, in Bangkok, Siam, a woman named Nok gave birth to Chang and Eng, who were joined at the abdomen. Their public exposure coined the term "Siamese Twins" referring to any conjoined twins. In one out of 50,000 births, a fertilized ovum fails to divide completely into separate

twins and a conjoined twin results.<sup>1</sup> Although conjoined twins were first publicized in the 1800s with Cheng and Eng, this phenomenon is discussed in early Jewish literature. A large portion of Jewish law deals with halachot that are specific to individuals, including Siamese twins. These halachot are most interesting and complex. What constitutes individuality? Does a shared abdomen strip a human being of the right to be an individual? Also, what if the conjoined state threatens the lives of the twins? Can one twin then be sacrificed in order to save the life of the other?

In the Gemora (Menochot 37a) there is a discussion relating to a

two-headed man. A scholar named Plimu asked a rabbi a question about the law of placing tefillin on the heads of a two-headed person. The rabbi angrily responded that there is no such being! However, soon thereafter, another man approached the Beit Din, stated that his wife had just given birth to a two-headed baby, and asked whether he should redeem this firstborn son with a single or a double monetary portion. Another Gemora (Eruvin 18a) states that Adam was created with two faces and suggests that Adam and Eve were created as one body and joined at the back. G-d then separated them through Adam's rib.<sup>2</sup>

There is a question in halacha

as to whether or not conjoined twins should be considered as separate individuals. Rabbi Jacob Reisher, in his responsa Shevut Yaakov, asserts that the reason Adam and Eve were created as conjoined individuals was to establish that Siamese twins are, indeed, separate individuals. The Torah refers to Adam and Eve in the plural: "Male and female did He create them... and He called their name Adam" (Genesis 5:2).

King Solomon also tried to resolve the question of whether conjoined twins were considered as one or two individuals regarding inheritance. The conjoined twins claimed that they deserved a double portion of inheritance. According to this midrash, King Solomon heated water and poured it over one of the heads. Both heads screamed in pain. He concluded that Siamese twins should be considered to be one individual. This question arose with regard to on

inheritance. However, according to the Shittah Mekubezet, if Siamese twins have a separate set of organs, they should be considered separate individuals even if they respond simultaneously to a painful stimulus. This is also the halachic status of twins who are attached and do not have a complete set of internal organs. Although this may seem to be a positive ruling for Siamese twins, it can cause inconvenient problems for these individuals. For example, those twins who have separate heads and separate nervous systems, but who share a torso, are forbidden from marrying. Each twin is allowed to marry. However, consummating the marriage would cause the twin who is unwed to commit adultery. He would, in a sense, be lying with his brother's wife.<sup>3</sup>

Now that it is established that Siamese twins can be regarded as separate individuals, the question of whether one can be sacrificed to save the other must be raised. In 1977, in Philadelphia, infant sisters joined at the chest were born. A normal four-chamber heart was fused to a two-chamber heart. The connecting wall was too thin to divide, and even if it could be divided, the two-chamber heart was incapable of supporting life on its own. One twin would have to be sacrificed in order to save the life of the other twin. There are serious moral and halachic questions as to whether or not this is permitted. The parents of these twins consulted the ruling of Rabbi Moshe

Feinstein. Rabbi Feinstein used an analogy cited in the Gemora (Terumat 8:10) to arrive at a decision. The Gemora discusses a situation where a group of heathens tell a group of travelers to give over one of their men to be killed. If the travelers fail to do so, the heathens would kill the entire group. In this situation, the travelers are forbidden from choosing to kill one soul in order to save the others. However, if the heathens specified a single individual to kill, the travelers are allowed to sacrifice that life. So too, the twin "designat-

maintains that in the case of conjoined twins, if one twin threatens the life of the other, the weaker one is seen as a pursuer and should be sacrificed to save the life of the stronger twin.

The concept of a pursuer may seem like a perfect analogy and, therefore, the determinant of holach. However, Rabbi Akiva Eiger pointed out that in the case of Siamese twins, each twin threatens the life of the other. One twin is not clearly pursuing the other. Therefore, sacrificing one twin is not holachical-

"According to Midrash, King Solomon poured hot water over one of the heads of Siamese twins. They both screamed in pain. King Solomon's conclusion: Siamese twins are to be considered as one individual."

ed" for certain death, may be killed in order to save the life of the other. In this case, the twin with the two-chambered heart could not survive on her own and she may be sacrificed. Rabbi Feinstein also used another analogy of a "pursuer" to prove this point. If two men jump from a burning plane and only one of the men has a parachute, the second man is not allowed to grab onto the first man, but must rather die. The reason is that the second man is seen as a pursuer if his living will cause another's death. Rabbi Feinstein

ly justified unless the four-chambered heart can be shown to belong exclusively to one twin. How can this be done? Closer proximity of the strong heart to one twin does not establish scientifically or halachically that the heart belongs to her. Instead, the entire 6-chambered heart may be viewed as belonging to both twins. The only way the pursuer argument would be valid is if it could be established that the four-chambered heart belonged exclusively to one of the twins.

The incident with the group of trav

elers cited in the Gemara also can be seen to involve two pursuers. The person designated to die threatened the life of the group and the group, in turn, threatened his life. However, Rabbi Feinstein, in *Iggerot Moshe*, argued that the individual victim can be seen qualitatively as the greater threat and thus, may be killed to save the lives of the group. This is similar to the case of the conjoined twins. Even though they are actually pursuing each other, if one twin can be seen as the more aggressive pursuer,

she can be sacrificed. For unexplained reasons, the right twin usually has cardiovascular anomalies that cannot be corrected by surgery. Rabbi Feinstein reassured that since the right twin threatened the life of the left twin to a greater extent, the right twin, designated the pursuer, was sacrificed to save the life of the left twin. However, there are other rabbis who disagree with his line of reasoning and would come to a very different conclusion regarding the separation of Siamese twins.

The question of how to treat Siamese twins is very complex and has many moral as well as religious ramifications. Jewish law addresses these issues in a logical and comprehensive manner. "In a world full of ethical issues...the truth of the Torah can increasingly serve as a 'Light Unto the Nations' (Isaiah 42:6)."

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# Chicken Soup: Jewish Penicillin?

**H**ave you ever been ill, suffered a relentless cold or cough, or felt that the mere sight of food could exacerbate your condition? What did doctor mom suggest? Most likely she cooked a large pot of chicken soup and persuaded you to eat it every few hours. For virtually thousands of years,

Jewish mothers have used this home remedy to medicate their sick children for a wide variety of ailments. Although the ancient practice of using chicken soup as medication seems quaint, current studies suggest that it has certain indisputable physiological benefits.

Maimonides, a twelfth-century philosopher and physician, once recommended chicken soup "as an excellent food as well as medication." In addition, he emphasized its therapeutic efficacy towards different microbial agents. In *Medical Aphorisms of Moses*, one of Maimonides' best known medical writings, he proposed that boiled chicken soup

carries the capacity to neutralize the body's constitution. He also wrote that the consumption of fowl "is beneficial for feebleness, facial paralysis and edema." This wise physician believed that eating chicken soup prevented the production of white bile in the body, a proposed cause of most fevers, and also endorsed chicken soup as an effective remedy for treating patients who suffer from asthma.

It is clear, through Maimonides' professional medical advice, that chicken soup was regarded as a vigorous anti-microbial agent. Nevertheless, today's use of antibiotics supercedes the antimicrobial effectiveness of chicken

soup to treat the sick. In truth, the pertinent issue is what action to take when microorganisms become resistant to medication or when allergic reactions occur in ill individuals. Is chicken soup truly an effective alternative to taking antibiotics in such situations?

The efficacy of chicken soup as a remedy has received much attention. The potency of chicken soup in comparison to other fluids, such as hot and cold water, was investigated in a study designed by Sokelkhuo et al.,<sup>2</sup> to test its influence on nasal mucus velocity and airflow resistance. An increase in nasal mucus velocity could be evidence of chicken soup's therapeutic efficiency because it allows the body to rid itself of harmful pathogens through nasal secretions. This study revealed that a certain component to the chicken soup was responsible for the rise in nasal mucus velocity. Researchers hypothesized that this increase

was connected to the specific scent of the soup. Coincidentally, Maimonides' based his theory that eating chicken soup is beneficial for the treatment of asthma on the same exact principle.

Another possible explanation for the increase in nasal mucus velocity due to ingestion of chicken soup might be related to its temperature. Perhaps a hot stimulus is capable of gradually causing the nasal cavity to vasodilate. This vasodilation may be responsible for the increase in mucosal flow and thus, the excretion of destructive pathogens.

In addition, the size of the nasal

Chicken broth's seemingly mystical powers can be traced as far back as the ancient Babylonian Talmud. In Sabbath (145b), an incident was recorded about Rabbi Abba's fowls. Rabbi Fafra proclaimed that Abba boiled them in a stew as a remedy and described it as having a noxious odor and taste. Perhaps this can be attributed to its method of preparation: after the chickens were thoroughly cooked, they were soaked in hot water until they were fully dissolved! During this period of time, most people ate fowl, along with bread and wine, as the basic com-

calcium often causes individuals to readily lose bone mass and, as a result, they are more likely to experience hip fractures and other types of breaks. To repair this problem, many patients are advised to eat foods rich in calcium, such as yogurts and cheeses. However, many people often cannot tolerate such food, due to lactose intolerance, hypercholesterolemia, or caloric restriction. In these situations, Maimonides would advise his patients to eat chicken soup. Soups are an excellent source of calcium if cooked with a bone for an extended period of time.\* To prove this point, researchers compared the calcium content of three different types of soups. ● One soup was cooked entirely of vegetables, the other with vegetables and a bone, and the third with just a bone and distilled water. Soups cooked with a bone had higher levels of calcium than soups prepared without it. It is astounding to see how this relatively recent experiment agrees scientifically with Rabbi Abba's method of chicken soup preparation dating back to the second century.

Quite often, sickly individuals suffer from water or electrolyte imbalance. To help their patients heal rapidly, most physicians recommend consuming large amounts of liquids every few hours. When patients vomit or experience diarrhea, they are more prone to suffering this imbalance and immediate action is necessary to overcome this potentially life-threatening complication. According to Doctor George E.

“Maimonides used soup frequently as a remedy. If his patients were losing large amounts of body fluid, chicken soup was an effective and inexpensive means of replenishing their electrolyte deficiencies.”

space is directly related to changes in nasal airflow resistance; the larger the space, the more air can enter.<sup>2</sup> In an experiment conducted by Bang et al.,<sup>3</sup> the thermal stimulus of hot chicken soup proved to be more effective for widening the nasal cavity than any other hot substance. Although hot water and tea also aided in the expansion of the nasal space, they did not prove to be as powerful as chicken soup. Indeed, hot broth from a chicken appeared to retain an unidentified component that elevated nasal mucus velocity and helped to expand the nasal cavity, allowing for less resistance to airflow.<sup>3</sup>

ponents of their meal. To eat chicken as a dissolved liquid may have repulsed many individuals. In addition, its identification as a remedy or medication may have automatically alerted the ill to an offensive sensation. Perhaps the broth did not contain the flavor or spices that are customarily added today. Nevertheless, the benefits gained by eating it were greatly recognized. This may explain why the Gemara related the preparation of Rabbi Abba's chicken broth in such extensive detail.

The therapeutic powers of chicken soup can also be attributed to its high level of calcium. A low level of

Burch of Tulane University School of Medicine and Charity Hospital, soup is the ultimate replacement liquid for electrolyte loss. He explained that soups made from animal and plant tissues contain the same intracellular and extracellular fluids found within human beings and are therefore beneficial to those seriously dehydrated. The doctor voiced his opinion that "soup is truly a physiologic fluid."<sup>5</sup> Perhaps this is why Maimonides used soup so frequently as a remedy. If his patients were losing large amounts of body fluid, chicken soup served an effective and inexpensive means of replenishing their electrolyte deficiencies.

Interestingly, the employment of

chicken soup in electrolytic complications dates back to the ancient Egyptian Empire. There is much evidence that during this time males were afflicted with a certain unknown fatal disease which, at times, reached epidemic proportions. Their diets were meticulously analyzed in an attempt to explain why they became so ill. It was revealed that healthy males consumed large quantities of soups or stews made from boiled chicken and vegetables.<sup>6</sup> The Egyptian men who died did not incorporate chicken soup into their diets. By denying themselves one of nature's most potent medications, it appears that these individuals were unable to

effectively restore their bodily fluids. This ultimately exacerbated their conditions until death became inevitable.

The Jewish mother, much maligned by twentieth century popular literature, triumphs in the end. Without any formal medical training and lacking an extensive Talmudic education, she has arrived at the very same conclusion as Maimonides and modern health professionals. Mom, you were right - chicken soup is good for you!

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# Anatomy of a Bracha

**A**beyei said, "When one comes out of a privy he should say: Blessed is He who has formed man in wisdom and created in him many orifices and cavities. It is obvious and known before your throne of glory that if one of them was to be ruptured or one of them blocked, it would be impossible for a

man to survive and stand before You. Blessed are You Who heals all flesh and does wonders" (Brachas 60b).

This unique bracha is known as Asher Yatzor and is recited after one uses the restroom. However, the Shulchan Aruch and the Mishna Brura in Oroch Chaim 6:1, and many other commentators, explain that the bracha of Asher Yatzor is not simply to praise G-d for enabling one to use the restroom, but rather to praise G-d for enabling all of our bodily functions to work properly. Rabbi Mordechai Hummer explains that the reason that Asher Yatzor is singled out to be recited after using the restroom is

because one must realize that even using the restroom involves great wisdom and is of extreme importance.<sup>1</sup> Rabbi Tsaiah Wohlgenuth notes that it is necessary to say this bracha after each time one uses the restroom because it is truly a special kindness from G-d that allows one to have the ability to care for one's self.<sup>2</sup> In the Kuzari, Rabbi Yehuda Halevi explains that brachos, although consistently repeated, should not become a burden, but rather should add pleasure, as they remind a person how much in life is positive and deserving of appreciation.<sup>3</sup>

Asher Yatzor begins with "Blessed is He who has formed

man in wisdom." The Eitz Yosef explains that there are two different approaches to understanding this opening statement. The first interpretation connects the wisdom with G-d, meaning that G-d, in His wisdom, created human beings that function in a remarkable manner. The second interpretation is that through His creating, wisdom was imbued in man.<sup>4</sup> Of all creations, human beings have the highest level of intellect and wisdom; it can be applied in many ways, including personal health decisions about diet or exercise. The bracha continues to say, "And He created in him, many orifices and many cavities." Rabbi Yaakov Emden explains that "orifices" refer to the parts of the body that are located externally and have openings, such as the mouth, ear, nose and anus. The cavities are those parts of the body that are hollow and are located internally such as the heart, esophagus,

trachea, stomach and intestines.<sup>3</sup>

Rabbi David Abudraham explained the special purpose for individual organs. The eyes were created for vision and the eyelids for sleep, enabling one to voluntarily close one's eyes. The ears are for hearing, the nostrils are for smelling and breathing, the mouth for speaking and eating, and the teeth for grinding food. The tongue is involved with the process of eating and speaking and the throat for swallowing food and drink. Food is received in the esophagus. The intestines process the waste products for excretion. The female and male reproductive systems are designed for perpetuating the species. The bones give the body its structure and strength and the joints connect the bones together. The veins supply the whole body with blood. The neck, shoulders, arms, hands, thighs, knees and feet were designed to turn the head, spread out, hold, touch, walk, bend, bow, jump, sit and stand. Skin is multifunctional; it covers the entire body for warmth, it enables the body to retain moisture, and it protects the internal organs. The brain was created to hold both knowledge and the soul. Everything that G-d created in a human being is purposeful and enables the individual to live. This wisdom, involved in the creation of human beings, is great and nothing is comparable to it. Although the Abudraham lived in the 14th century, his knowledge of the functioning of the bodily organs is most remarkable. It is written in

Parshot Ho'ozinu (34:4) that G-d's work is perfect and complete. Thus, one should not think that if the body were to be constructed differently, it would function more efficiently.<sup>4</sup>

The next verse of the brocho states that "It is obvious and known before Your throne of glory that if one of them were to be ruptured or one of them blocked, it would be impossible to stand before You." Rabbi Hummer questions why the throne of glory is mentioned in conjunction with a brocho that is said after using the restroom. He answers that even from such a high and honorable place,

mo (lung cancer), all cause blockages throughout the body. A cataract is a blockage of the eye in which a film covers the lens or its capsule. Cystic fibrosis can involve blockage of the pancreatic ducts, prohibiting digestive enzymes from reaching the small intestines. Asthma, bronchitis, emphysema, and pneumonia are all examples of chronic obstructive pulmonary diseases causing airflow obstruction. The common headache can be caused by an inflammation that decreases the oxygen supply to the brain. Cerebrovascular accident, which is commonly known as a

"The bracha of Asher Yatzar is not simply to praise G-d for enabling one to relieve oneself, but rather to give praise for enabling all our bodily functions to work properly."

with a myriad of angels surrounding G-d, even there, G-d is supervising these mundane but vital aspects for each individual.<sup>1</sup> Rashi (Brochos 60b) explains "ruptured" in relation to the body cavities, such as the heart, stomach, and intestines. Rashi continues that "blocked" is in reference to the openings of the mouth, nose and anus. Rabbi Wohlgenuth points out that a heart attack is a common and current example of blockage. There are many more medical conditions that also result from a rupture or blockage.<sup>2</sup> Cancers, such as Hodgkin's disease, leukemia, or bronchogenic carcinoma,

stroke, can be brought on by a burst blood vessel. Aneurysms, sections of weakened veins or arteries, bulge to form a balloon structure, which may burst, leading to a fatality. A typical sprain can arise by the partial rupture of a joint. A hernia, commonly seen in the abdomen, is a ruptured membrane wall or cavity.<sup>3</sup> With any of these or other medical complications, in a critical state, it would be impossible to stand before G-d.

The blessing concludes by saying, "Blessed are You Who heals all flesh and does wonders." Rashi (Brochos 60b) cites that the ability to eliminate wastes is truly the healing of the

entire body, as this healthful measure prevents an accumulation of toxicity and disease. Rabbi Dr. Elie Munk explains the “wanders” as related to how the body and soul interconnect. The soul is connected to the body and, therefore, it is affected by the health of the body. Rabbi Munk continues to explain that although, in relation to religion, using the restroom can appear as a repulsive, disgusting physical act, even this bodily function can be transformed through

this brocho.<sup>8</sup> All that is physical can truly be raised to a spiritual and holy level.

On a deeper level, the brocho of Asher Yatzar illustrates that G-d created the human body and maintains it in a truly intricate and magnificent manner. The continued utterance of this brocho can allow one to find comfort in that G-d created the human body with care for its needs. Unfortunately, as Dr. Kenneth Prager mentions in his article, “For

Everything A Blessing,” people often take good health for granted and do not realize that it is a precious gift from G-d.<sup>9</sup> This brocho reminds one that good health is priceless and that it is especially important to always express gratitude.

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# Smiling Through the Ages

A beautiful smile is very often a person's gift to the world. Whether it is a gloomy day or one filled with excitement, a smile can make the entire day better. Biologically, when a person smiles, endorphins are released, making the person happy. Also, smiling is an important characteristic of the human

race as it is a universal language, understood everywhere in the world. With the importance a smile can bring, it is no wonder that the beauty of a person's teeth has been as much of a concern nowadays as it was in the time of the Bible and Talmud.

In Talmudic times, teeth that were white were regarded as beautiful. "A person who whitens his neighbors' teeth is better than one who gives him milk to drink" (Ketubot 111b). The importance of giving someone beautiful white teeth even surpasses the importance of alleviating their thirst. In the Bible, Jacob promises his son Judah, "teeth whiter than milk" (Genesis 49:12). Even lovers compliment each other

in the Song of Songs (4:2 and 6:6) and say that their teeth are like a flock of sheep that have come up from the washing. The Babylonian Talmud (Bechorot 43b) also recognizes how someone with a toothless smile can adversely affect the community. For example, a priest cannot work in the Temple and be a messenger of the people of Israel if he is missing teeth, since he is a public figure. Furthermore, a priest cannot work in the Temple if his facial muscles are weak and spittle drips from his mouth.<sup>1</sup> All these defects prevent the priest from having an aesthetically pleasing smile and from properly representing the people of Israel.

The Talmud asserts that imperfec-

tions in the mouth, such as missing teeth are considered ugly. The Talmud in Nedarim<sup>1</sup> states that Rabbi Ishmael made the daughters of Israel beautiful by making false teeth for them to replace their missing real ones. These artificial teeth were probably made from gold. Artificial teeth were also made from silver, wood, and even ivory.

The topics of artificial teeth and gold teeth, are discussed at length in the Talmud. The sixth chapter of the Mishna Shabbot notes, "an artificial tooth and a gold tooth, Rabbi Meir permits and the Sages forbid." This Mishna is discussing the permissibility of a person walking with a gold or artificial tooth on the Sabbath.<sup>2</sup> According to Jewish law, it is prohibited to carry objects in the public domain on the Sabbath. The debate is about whether an artificial tooth constitutes the carrying of an object and focuses on women, as only women wore artificial or gold

teeth. Many commentators give reasons as to why a woman might come to carry her gold or artificial tooth on the Sabbath. Roshi (commentary on Shobbat 65a) says that when a woman sees her friends, she will want to show off her gold tooth and will remove it. This might lead to her carrying it while walking. Maimonides (Mishna Commentary Shobbat 6:5), on the other hand, explains Rabbi Meir's lenient approach. He says that since a gold tooth is usually used to carry up a decayed tooth, the woman will not remove the gold tooth because in doing so she will

would also pick it up. Another possibility is that if it falls out, the woman would be too ashamed to walk around without it and reveal her toothless smile or decayed teeth. Therefore, in these cases the woman would pick up the artificial tooth and come to carry it. The Talmud (Shobbat 64b-65a) gives another reason for a woman not to wear an artificial tooth on the Sabbath. The woman might feel that if her friends see her false tooth, they will laugh, and so she will remove the tooth and walk with it in her hand, carrying it on the Sabbath in the public

aged tooth (copped teeth). Maimonides refers to damaged teeth as black or red. A black tooth is a nonvital tooth, which lost its natural color due to degraded blood cells caused by a hemorrhage in the pulp. A red tooth occurs when caries attack the inner part of the clinical crown leaving most of the outside layer intact, and the blood vessels in the pulp cause the tooth to appear red.<sup>1</sup> Gold was used to cover such diseased teeth.

The book of Exodus (21:27) stresses the importance of having one's own teeth. If a master causes his servant's or maidservant's tooth to come out, the master must let the slave go free. Even if the master is a physician and the slave asked him to fix his tooth, if the master caused the slave's tooth to come out, the slave goes free (Baba Kommo 26b).<sup>2</sup> If the slave's tooth was loose but usable and the master caused the tooth to be unusable, then the slave is freed (Tosefta Baba Kommo 9:27). Clearly, the Bible and Talmud regard teeth as extremely necessary and important.

People in Talmudic times also cared about the health of their teeth and they practiced dental care, orthodontics, and oral hygiene. Doctors practiced cleaning the base of the tooth, known today as scaling, to keep a person's mouth healthy.<sup>3</sup> Toothpicks and wooden splinters were used to dislodge food stuck in people's teeth (Betsoh 33a). To freshen their breath women used peppercorn, ginger, and cinnamon (Sabbath 64b - 65a).<sup>4</sup> Woodchips were used

"A person who whitens his neighbor's teeth is better than one who gives him milk to drink. Clearly, the importance of giving someone beautiful white teeth even surpasses the importance of alleviating his thirst."

expose her own decayed tooth and be embarrassed. Apparently, this is an early reference to the "copping" of decayed teeth. In the Jerusalem Talmud (Shobbat, chapter 6 page 37), a different reason is given for why a woman might come to carry a gold tooth on the Sabbath. Since gold is valuable, if a gold tooth fell out of her mouth, she would pick it up to put it back. The Jerusalem Talmud goes further and says any artificial tooth is forbidden since if it falls out, the woman, embarrassed to ask the artisan to make her another,

domoin.<sup>3</sup> Nevertheless, all these possibilities centered on the prohibition of women wearing false teeth on the Sabbath.

Artificial or gold teeth were used in two ways. If a person lost a tooth, an artificial tooth was made and mechanically inserted into the resulting gap. These "dentures" were considered temporary, since the artificial tooth would act as a wedge, pushing the two surrounding teeth apart, causing the artificial tooth, in time, to fall out.<sup>4</sup> Artificial or gold teeth were also used as a covering for a dam-



to align a person's teeth and to fix crowded teeth (Tosefta Shabbat 5:1).<sup>5</sup> Maimonides even urged his readers to harden and strengthen their teeth with astringent medications (*Medical Aphorisms of Moses Ch.7*).

People nowadays are still concerned about healthy teeth and a beautiful-looking smile. Cosmetic dentistry is a growing field, expanding every day with new techniques to make a person's smile incredible. Procedures like bonded restorations, bleaching, and porcelain veneers restore a white smile to anyone. In bonding, a technique used to repair chipped, cracked, or broken teeth; the tooth is rebuilt with a composite

resin matching the color of the original tooth. Bleaching is used to whiten discolored teeth, by either a solution of hydrogen peroxide or carbamide peroxide, or by in-office laser bleaching using a high-energy light. Veneers are porcelain covers that are placed over the tooth's surface and that closely resemble the tooth's natural color.<sup>6</sup> Veneers are in modern times what gold teeth were in Biblical and Talmudic times.

Although we have more options for a healthy white smile today, there is no denying the importance a healthy smile and mouth had in the time of the Bible and Talmud. Compliments and blessings were exchanged

about white teeth. Priests were forbidden to work in the Temple if they did not have a full set of teeth. The Talmud discusses the emotions of a woman who wore artificial teeth and how she might come to violate the Sabbath by carrying the tooth. A diseased tooth was covered by gold to avoid the unpleasant appearance of a decayed tooth. Toothpicks, astringents, and even scaling procedures were used to keep teeth healthy. The universality of a white healthy smile is quite apparent since it is just as popular today as it was thousands of years ago.

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# Yitzchak: A Man of Vision

Combining the Biblical study of the past with the technological knowledge of the present provides insight into the Torah and its personalities. In Genesis 27:1, the Torah states: "And when it came to pass, that when Yitzchak was old and his eyes were dim, so that he could not see..." An examination

of the details of the story of Yitzchak in light of current medical knowledge can shed light on Yitzchak's eye ailment. Although no absolute conclusions can be drawn, by using evidence from the psukim and modern medicine, we can propose a number of possible suggestions.

In Genesis 27, the Torah gives a vivid portrayal of the end of Yitzchak's life. Having reached the age of 123 and recognizing that his eyesight had begun to diminish, Yitzchak realized that he was nearing the end of his life. He wanted to give Esav, his first born, the patriarchal blessing to ensure that his children would be G-d's chosen people.

He asked Esav to prepare venison for him to eat so that afterwards he could bless him. Overhearing this conversation, Rivkah, Yitzchak's wife, was determined that this blessing, so important to the future of their descendants, must go to their younger son, Yaakov. She used Yitzchak's foiled eyesight as a tactic to deceive him into giving Yaakov the blessing that was intended for Esav. She sent Yaakov to his father with a prepared meal and dressed him in fur, to give his arms a hairy feel like those of Esav. When Yaakov went to his father, Yitzchak heard his voice as that of Yaakov's, but felt his arms and ate his food and

concluded that it must be Esav. Thinking that it was Esav, Yitzchak gave the patriarchal blessing to Yaakov, ensuring that his children would be G-d's chosen people.

It is interesting to note in the story of Yitzchak that only his eyesight was diminished, while his other senses remained quite acute. In fact, the Torah seems to go out of its way to describe details of Yitzchak's use of his other senses. Yitzchak had a good sense of touch and used it to identify which of his sons was before him. In the pasuk, Yitzchak says, "Come near, I pray thee, that I may feel thee, my son, whether thou be my very son Esav or not." Yitzchak also had a keen sense of hearing, as is evident from the pasuk, in which he states, "The voice is the voice of Yaakov, but the hands are the hands of Esav." Although his sense of touch led him to believe that it was Esav, his hear-

ing was strong enough to be able to differentiate between the two, creating doubts in his mind. His sense of taste also seems to have been undiminished. Yitzchak asked for specific foods to be brought to him and Yaakov brought him venison to eat and wine to drink. The Torah also describes Yitzchak's sense of smell as being acute: "And he [Yitzchak] smelled the smell of his [Yaakov's] raiment, and blessed him." It is also evident from the psukim that Yitzchak's mind was clear. When Yaakov entered with the food, Yitzchak asked: "How is it that you were so quick to find, my son?" It seems apparent that Yitzchak's eyesight was the only one of his senses that had weakened.

What exactly was Yitzchak's eye ailment that led him to make this error? The Torah states: "And when it came to pass, that when Yitzchak was old and his eyes were dim, so that he could not see..." (Genesis 27:1). The posuk uses the word *keha*, or "dim" to describe the condition of Yitzchak's eyes. In a number of sources, this passage is understood to mean that Yitzchak was blind. According to one opinion, the smoke from the idol worship of Esav's wives blinded Yitzchak, because G-d wanted to spare him from continuing to see idol worship in his house.

The Talmud differentiates between different types of eye ailments. It describes the difference between those whose eyes are dim, *keha*, and those whose eyes are dark, *choshech*, and those completely

blind. This suggests that the term *keha*, which is used in the case of Yitzchak, may refer to something other than blindness. From the context of the *pasuk* in which it is written, there is a connection between Yitzchak's old age and his diminished eyesight. The *posuk* reads: "when Yitzchak got old, and his eyes were dim." His declining eyesight, therefore, may have been due to the process of aging. There are a number of eye conditions that are linked with aging, including cataracts, glaucoma, presbyopia, and macular degeneration.

been shown that the prevalence of cataracts increases dramatically with age, and if left untreated can lead to blindness.

Glaucoma is another eye ailment that is linked with aging. Glaucoma is a disease of the optic nerve in which the nerve fibers are injured, usually due to high intraocular pressure. Glaucoma occurs in two percent of all patients over the age of 40 and its prevalence increases with age. One of the common symptoms of glaucoma is an impairment of dark adaptation. Perhaps this is what the *pasuk* refers to as dimming

**"Prosopagnosia may have inhibited Yitzchak's recognition of Yaakov even though he was able to see him, leading him to use his senses of hearing, touch, taste, and smell to identify his son."**

A cataract is a clouding of the lens of the eye. The lens, which is elastic, focuses light rays into images on the retina, allowing the eye to focus on nearby and distant objects. As people age, biochemical changes take place within the proteins of the lenses, causing them to lose their elasticity. Aging can also cause the proteins to clump together, resulting in opaque, cloudy areas known as cataracts. Cataracts can block the passage of light into the eye and interfere with the formation of images on the retina, resulting in cloudy vision. Perhaps this is what the Torah describes as the dimming of Yitzchak's eyes. It has, in fact,

of Yitzchak's eyes.

Presbyopia is a condition that involves a loss of the focusing power of the lens, eventually resulting in farsightedness. The focusing power of the eye depends on the elasticity of the lens. This elasticity is gradually lost with age, resulting in a decrease in the ability of the eye to focus on objects that are close up. Research has shown that presbyopia occurs, to some degree, in everyone during the aging process.<sup>4</sup>

Macular degeneration is a progressive disorder caused by damage to the retinal nerve, which results in a gradual loss of central vision. This condition is caused by the break-

down of the insulating layer between the retina and the blood vessel behind the retina, causing destruction of the retinal nerve. Macular degeneration is common among the elderly and is the most common cause of visual impairment in people over the age of 50.<sup>4</sup>

Another instance in the Torah where the word *keha* is used is in the story of the death of Moshe. The *pasuk* states: "And Moshe was a hundred and twenty years old when he died; his eye was not dim, nor his natural force abated" (Deuteronomy, 34:7). The *pasuk* uses the same word as it did with Yitzchak, but here it seems that although Moshe lived to the age of one hundred and twenty, his eyes did not dim. This suggests that the dimming of eyes referred to as *keho*, may not be an inevitable deterioration of eyesight due to old age, but rather may be a specific condition.

One possible condition, which

seems to fit with the description of Yitzchak, is an impairment known as visual agnosia. People afflicted with primary visual agnosia are able to see and have intact mental powers, but cannot recognize familiar objects or people unless they hear, smell, taste, or palpate them. Prosopagnosia is a specific type of agnosia which affects recognition of faces. Rather than being an ailment related to eyesight, however, visual agnosia is a result of damage to the brain. The ability to recognize objects depends on the visual pathways of the cerebral cortex as well as the primary, secondary and tertiary visual cortical areas. Damage to these areas can cause an impairment of visual recognition, but does not result in loss of intelligence, motivation or attention. Perhaps this is the impairment that affected Yitzchak. He may have been able to see Yaakov, but unable to recognize him, leading him instead to use his senses of hear-

ing, touch, taste and smell to identify his son. Perhaps Rivkah was aware of Yitzchak's condition and used this knowledge as a method of deceiving him into thinking that he was blessing Esav.

The story of Yitzchak clearly indicates that his visual limitations were not related to a decline in his other senses or in his intellectual abilities. In this paper I have reviewed several possibilities of visual conditions that might fit the description of Yitzchak, as given by the Torah. It is interesting to note that although in this narrative Yitzchak is at the end of his life, he clearly displays a strong will and an active engagement in the world around him, using his senses and intellectual abilities to ensure the best legacy for his children. In this sense, Yitzchak truly was a man of vision.

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# Designer Genes... At What Price?

**S**cintillating Torah Scholar Meets Beautiful, Wealthy, Middosdic Girl!" Sounds like the perfect match, no? Perhaps it was. What could be more promising than the potential blending of these enviable traits. However, Torah scholarship and middos are developed, not inherited.

Since the founding of the State of Israel in 1948, much research has focused on the genetics of the various Jewish communities in-gathered from the Diaspora. As Ashkenazim represent the dominant Jewish population (approximately 80 percent), scientists focused on studying the so-called Jewish genetic diseases within the Ashkenazi population. One of the first genetic diseases to be analyzed was idiopathic torsion dystonia (ITD), an autosomal dominant disease, which is manifested by twisting and repetitive movements affecting the voluntary muscles. It was estimated that 90% of early-onset ITD in Ashkenazim originated from a

single mutation that arose about 350 years ago. Although a mildly deleterious autosomal dominant genetic disease, the incidence of the heterozygote frequency is high. Why? One thought is that a founder's effect (i.e., a form of genetic drift, caused by the establishment of a small population by a limited number of individuals whose genotypes carry only a fraction of the different kind of alleles in the parental population) was operative. Polish historians suggested that the founder's effect was correlated with a small but wealthier segment of the Jewish population who had a greater number of their children survive

to adulthood than the poorer segment of society. This wealthier segment of the Polish Jewish society, which may have been as low as a few thousand individuals, presumably are the primary forerunners of the present day Ashkenazi population. Mutations within such a small gene pool were amplified with population expansion, resulting in a high frequency of specific genetic mutations.<sup>2</sup>

While a founder's effect may explain the high heterozygote frequency of ITD, on autosomal dominant disease, what can explain Tay-Sachs, Goucher disease, and Neimonn-Pick disease, which are autosomal recessive diseases also with an elevated heterozygote frequency? The mutated gene for Goucher disease is located on chromosome 1, Neimann-Pick disease on chromosome 11, and Tay-Sachs on chromosome 15. Of these diseases, the responsible muta-

## “About one in every 2,500 Ashkenazi newborns

tions at the molecular level have been fully elucidated for Goucher disease and Tay-Sachs.

Tay-Sachs, the most well known Jewish genetic disease, manifests itself as a progressive neurodegenerative disease and results from a deficiency of the enzyme, hexosaminidase A. Hexosaminidase A normally breaks down a naturally occurring substance, a glycosphingolipid, occurring in lysosomes. The deficiency of this enzyme leads to the toxic accumulation of this ganglioside, mainly in the lysosomes of cells of the nervous system. For a child to have this disease, both parents must be carriers and with each pregnancy there is a 25% chance of having a Tay-Sachs baby. About one in every 2,500 Ashkenazi newborns is afflicted.

Tay-Sachs is characterized by the early and severe onset of both mental and physical retardation occurring during the first 4-8 months of infancy. The infantile form of this disease is usually fatal by the age of 2-3 years, when the child's central nervous system becomes completely debilitated. An early warning sign of this disease is the unusual appearance of the eye; a gray-white area surrounds the retinal fovea centralis, due to lipid laden ganglion cells, leaving a central 'cherry red' spot. This can be observed only by the use of an ophthalmoscope. A second early symptom of this disorder is a prolonged 'stortle reaction' to sound. The later onset form of Tay-Sachs

(L.O.T.S.) strikes later in life, usually between adolescence and one's mid-30's. Early warning signs of this form "include clumsiness, hand tremors, muscle weakness, speech impediments, swallowing difficulties, gait and balance problems, and seizures. Some L.O.T.S. patients suffer from memory loss and comprehension difficulty. Psychiatric problems such as severe depression or mood disturbances occur in 40 percent of L.O.T.S."<sup>2</sup> Unlike the infantile form of Tay-Sachs, people with L.O.T.S. may live a normal life span because the disease progresses so slowly. Carrier screening, counseling, and prenatal diagnosis are available options to people who are at risk for having a child affected with Tay-Sachs. While there is currently no treatment for this debilitating and devastating disease, a cure may be on the way. Dr. Evan Snyder, at Harvard Medical School Children's Hospital in Boston, has halted Tay-Sachs disease in mice. Through the use of neural stem cells, this neurologist has developed a methodology to supply the missing gene to the brain, thereby reversing, or at least halting, genetic diseases like Tay-Sachs.<sup>3</sup>

While Tay-Sachs disease may be the most well recognized of all Jewish genetic diseases, Gaucher disease is the most common, afflicting one in every 2,500 Ashkenazi Jews of Eastern and Central European ancestry.<sup>4</sup> The disease itself can be further subdivided into three distinct health effects. Type 1

Gaucher disease is characterized by later age of onset and the absence of neurological involvement. Type 1 manifests itself mostly among Ashkenazi Jews, with an estimated one in every 25 Jews a carrier of the recessive Type 1 Gaucher gene. Type 2 begins in infancy and is a fatal neurodegenerative disorder, in part, similar to Tay-Sachs. Type 3, a very rare form found mainly in Sweden, is a juvenile onset form which has neurological involvement.

Like Tay-Sachs, Gaucher disease is a biochemical genetic disorder, with a genetically determined deficiency in the enzyme, glucocerebrosidase. This enzyme is normally involved in the metabolism of glucosyl ceramide. The inability of this enzyme to break down this substrate leads to its accumulation in certain Gaucher cells, the bone marrow, spleen, and liver. Gaucher cells in the bone marrow can cause bone and joint pain, fractures, and other orthopedic problems. The presence of Gaucher cells in the spleen and liver causes enlargement of these organs. In addition, blood abnormalities (i.e., anemia, excessive bleeding, and easy bruising) are occasionally seen. The spectrum of

is afflicted [with Tay-Sachs]."

symptoms for Type 1 disease is very widespread and subjective, making it very difficult to diagnose. Interestingly, in both Tay-Sachs and Gaucher disease, the lysosomes of the cells are adversely affected.

A basic question is why Jews were singled out to have an elevated incidence of Tay-Sachs and Gaucher disease (as well as the genetic disease, Niemann-Pick), which all involve a defect in lysosomal enzymes concerned with the storage of lipids. All explanations are highly speculative. One explanation is that the Jews were selected from the rest of the population by chance. Deleterious genes may transiently rise to high frequencies in small populations, through a founder effect or genetic drift.<sup>4</sup> This theory is in accordance with the fact that the Eastern European Jewish community began with only a small number of Western European immigrants in the 13th century. However, it does seem uncommonly strange that three of the most common Ashkenazi diseases, Tay-Sachs, Gaucher, and Niemann-Pick, all involve abnormalities in lipid storage, resulting from defects in three separate lysosomal enzymes - hexosaminidase A (Tay-Sachs), glucocerebrosidase (Gaucher), and sphingomyelinase (Niemann-Pick).<sup>5</sup> This phenomenon cannot be mere coincidence. Perhaps, though, if other populations were scrutinized as much as the Ashkenazi population has been, there would be similar findings. The presence of two or more deleterious alleles strongly sug-

gests that some sort of a selection took place over time. Tay-Sachs is now known to be caused by two distinct common mutations, as well as by other rare ones. Gaucher disease, the most common of the lysosomal diseases has five mutations that collectively account for about 97 percent of Jewish Gaucher disease alleles. The relative heterozygote frequency of each mutant allele, of 0.05 or 2.8 percent, seems to be unusually high, considering that the disease has no apparent benefits and leads to severe debilitation and

not on their non-Jewish neighbors?<sup>6</sup> What in their past environment could have legitimized - even more so - provided benefit to the individuals with the genes for these genetic diseases? What compensatory advantage would these genes have held for their carriers (heterozygotes)? Much thought and discussion has been given as to what possible benefit these harmful genes may have conferred upon their carriers. Three main hypotheses exist. These theories are by no means definitive - they are merely educated opinions. The

“What selective force could have acted on Eastern European Jews to develop genetic mutations leading to diseases like Tay-Sachs, and what compensatory advantages would these genes have held for their carriers?”

even to death. One would think that a selecting process would diminish the frequency of such potentially harmful alleles. Four of the mutant Gaucher alleles occur in Jews in the context of only a single haplotype (i.e., a set of alleles from closely linked loci carried by an individual and usually inherited as a unit).<sup>7</sup> This indicates that that the mutation arose in Jews recently and has, within a very short time, been dramatically increased to a high frequency of selection.

In the words of Jared M. Diamond: “What selective force could be acting on Eastern European Jews, but

first theory suggests that these genes provided some sort of resiliency towards contracting tuberculosis in the crowded urban ghettos of Eastern Europe. An unexpectedly low frequency of deaths from tuberculosis among Tay-Sachs heterozygotes has been reported, but the findings remain inconclusive.<sup>8</sup>

This concept is similar to the rationale for the high frequency of the genetic disease sickle-cell anemia in blacks. For many years scientists wondered why the frequency of sickle-cell anemia was so high among the African population. Apparently African carriers for the disease had a

higher survival rate compared with their non-affected homozygote counterparts; the mutation for sickle-cell anemia protected them from contracting malaria, a disease common in Africa. However, this phenomenon was not found to be true of Goucher disease. A second theory is that these deleterious genes were selected for to survive and thrive in a life of commerce, as Jews were barred from agricultural industry. A third theory is that these genes were specifically selected for yielding potentially viable offspring. A wise, young marriageable rabbi was a jewel of a potential husband to a wealthy and respectable young woman, who in turn, presumably had both the physical

and monetary wherewithal to produce and nurture a large number of offspring. In short, this sexual selection led to increased reproductive success.<sup>5</sup> In general, selective factors, favoring these mutant deleterious genes have been difficult to identify and confirm, as they may have dissipated from today's environment, such as the decrease in severity of tuberculosis.<sup>3</sup>

Human genetics, in general, is very much a new science. In order to test theories and explore new territory, the Jewish population has proven to be an ideal mine, as it is a nation that has existed since the beginning of time and with geographically isolated communities that have remained comparatively

intact. However, as one can undoubtedly surmise from this article, there is still a long way to go in this area of research in order to be able to piece together the incredibly intricate and fragile fragments of this fascinating puzzle of life. For now, these ideas and theories merely remain food for thought. The recent sequencing of the human genome may shed some light on why such genetic diseases are at elevated incidences, as well as, perhaps, constructing genetic remedies/treatments to prevent the development of these genes in affected individuals.

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# Epilepsy in the Talmud

For centuries, the human brain lay largely beyond the reach of science, but new tools and techniques have enabled a neuroscientific revolution. Several neurological diseases are mentioned in ancient literature. For instance, epilepsy is a neurological disorder that has been described in most

of the world's major religions. The Talmud notes some religious legal (halachic) issues that might arise from medical conditions or practices, but comprises very few detailed clinical descriptions of diseases. In fact, there is no specific medical fit of the epileptic in the Talmud, yet the legal status of epileptic cases is discussed, and some eminent figures, such as King Saul, are thought to have experienced epileptic seizures. However, before exploring these references and interpretations, we will examine the current scientific definition of epilepsy and attempt to explain how numerous disorders described in the Talmud, according to their symp-

toms, may be correlated to epilepsy.

Epilepsy remained for many centuries closely linked to demonology, in both ancient Jewish and non-Jewish sources. However, as Hippocrates vehemently argued, epilepsy is definitely not a sacred disease, but rather a natural disease with neurological causes (i.e. an excess of phlegm rushing into the blood of the brain). Epilepsy is defined as a recurrent neurological disorder characterized by sudden, brief attacks that may alter motor activity, consciousness, or sensory experiences. Some attacks are preceded by an aura with complex hallucina-

tions or sensory illusions. Convulsive seizures are the most common type of paroxysmal event, but any current seizure pattern is considered epilepsy. In some cases, a brain tumor, an infection of the central nervous system, a cerebral trauma, or a congenital defect may be responsible. However, in the majority of cases, no pathologic basis for the seizure is evident (idiopathic epilepsy).<sup>1</sup>

During the time of the Talmud, the Jews referred to an epileptic person as a *nikpeh*, meaning "one who writhes," perhaps also "one who is bent or forced over (by the demons, nephilim)." The Hebrew *nikphe* (from the noun *kefiyah*) has actually the same meaning as the original Greek term *epilambano*, to seize, to attack. Later the term *holi nophel* was used, being an equivalent to the Latin *morbus caducus*, the so-called "falling sickness."<sup>2</sup> Maimonides draws a compari-

son between epilepsy and several syndromes described in the Talmud, where the patient is "sometimes in full conscience, sometimes like insane" (Terumat 1:3; Rosh Hoshono 28a). It was assumed that the disease could possibly be induced by the froth that appears during the attack, which would render the patient's breath dangerous. We find in the Talmud some hints of this approach, not directly directed to *nikhpe*, but with another, controversial, syndrome called *ro'aton*.

Other syndromes are related to

Maimonides called *kordiokos* a form of epilepsy and considered the patient to be delirious even after the seizure occurred. The clinical fact that epileptic seizures are often a port of delirium may provide the explanation for his comments on *kordiokos*.

Talmudists considered epilepsy a serious disease which may be hereditary and contagious. Genetic and eugenic aspects are mentioned: "a man should not marry a woman coming from a family of epileptics" (Yebamot 64b). An epileptic is

suggest a disorder that persists beyond an episode of disturbed consciousness, even if the epileptic patient is considered normal most of the time, but insane, i.e., irresponsible, at given times. Curiously, indecent behavior during cohabitation is often stated to be a cause of epilepsy. The relationship between epilepsy and coition was common in ancient medical literature, and eminent authors such as Democritus, Hippocrates, and Areatus considered coition as an equivalent to a slight epileptic attack.<sup>4</sup>

The Midianite priest and prophet Balaam called himself "fallen down (*naphel*) with open eyes" (Numbers 24:16). Rosner asserts that the term "fallen down" is the designation of epileptic,<sup>5</sup> and thus Balaam might have been epileptic. The term *vayipol* is used in relation to Saul after he became manic: "and he fell down the entire day and the entire night" (1 Samuel 19:24), that is, he had frequent epileptic seizures. Therefore, the evil spirit, *ruah ra'ah*, mentioned in the passage: "the spirit of the L-rd departed from Saul, and an evil spirit from the L-rd tormented him," (1 Samuel 18:10) may refer to epilepsy. According to Preuss, King Saul was a complicated psychiatric case and probably not a status epilepticus.<sup>6</sup>

The clinical picture, etiology and diagnosis of epilepsy are still to be elucidated by scientific progress. Epilepsy was of great concern in antiquity and today it affects approximately 0.5% of the American popu-

"The Midianite priest and prophet Balaam called himself "fallen down (*naphel*) with open eyes." The term "fallen down" is the designation of epileptic, and thus Balaam might have been epileptic."

epilepsy, such as *kordiokos* (perhaps delirium tremens), *bulmos* (bulimia), *dalaria* (possibly delirium), and *ruah qezara* (also interpreted as asthma). All these syndromes have in common a psychic condition leading to confusion or even unconsciousness. In the Talmudic description of the organic brain syndrome *kordiokos*, the victim falls suddenly into a state of mental confusion and dizziness. Maimonides commented that the patient experiences an epileptic seizure accompanied by "confusion of the senses," and attributed the symptoms to a filling of the chambers of the brain (Gittin 67b, 70b).

unsuited to serve in the Temple all the time, "even if it occurs only once in days" (Bekhoroth 44b), and concealed epilepsy by a woman may be grounds for divorce.<sup>3</sup> Maimonides lists lunatics, which means not only insane persons but also epileptics, among ten categories of people who are incompetent to attest or to testify (Yad, Eduot 9:9-10). Maimonides remarked that there are epileptics whose minds are deranged even when they have no attacks and, thus, the validity of testimony should be checked by the court with the utmost thoroughness (Mishneh Torah, Eduot 9:9). These discussions in the Talmud

lotion. The causes of recurrent epileptic seizures cover such a wide range as trauma, tumors, congenital, metabolic, vascular, degenerative, and infectious diseases. The International League Against Epilepsy has classified seizures and the current imaging technology applied on brain damage allows

more clinical findings. Talmudist commentaries raised the supernatural aspect of this disorder and many symptoms described in the Talmud relate to the current clinical examination of epileptic cases. Because medical practice was not the object of the Talmudists' intellectual efforts, epilepsy has mainly been considered in its

legal implications. The legalistic relationship of epileptic seizures with insanity may help us understand Chazal's consideration of King Saul as a tzadik, despite his injustices toward David.

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# Talmudic Dolphins

**D**olphins have always been mysterious creatures of interest to man. Although today we are able to separate a lot of the fact from the fiction written, people still feel there is something special about these animals. The Talmud, the codification of Jewish law from antiquity, makes reference to the

existence of dolphins. The text reads, "Dolphins (dalphanim, in Hebrew) are fruitful and multiply like human beings." Rab Judah interpreted that dolphins are the living beings of the sea like humans are of land (Bekhorot 8a). Rashi interpreted the text very differently based on the difference of just one word. He stated that the text read, "dolphins are fruitful and multiply from human beings," meaning that a dolphin could bear offspring from having sexual relations with a human. Apparently, these hybrid sea creatures possessed human features and would be today's idea of a mermaid. The Tosephta questioned Rashi's view

by discussing whether various types of animals have the ability to crossbreed (Bekhorot 1:5). Since dolphins cannot crossbreed with humans, the key phrase must read "like human beings." The natural conclusion is that Rashi and other commentators must have possessed manuscripts copied with small errors.'

Kohut suggested that the intention of the Talmud was that dolphins are like human beings with regard to sexual intercourse, and that the female, for instance, does not lay eggs but rather gives birth to live offspring and suckles her young (Bekhorot 7a). Kohut further noted that dolphins

are like humans because they show extreme devotion to humans and are termed "philanthropic animals."<sup>1</sup> Today we know that dolphins are classified as mammals, and they therefore possess some characteristics resembling humans and some resembling fish.

Whales, dolphins, and porpoises are categorized in the scientific order Cetocea. Of the two suborders, Mysticeti and Odontoceti, dolphins are in the latter. Delphinidae, the largest family within this suborder, is composed of what we commonly call dolphins, but there are over 30 different species of dolphins in this family. Because of their curiosity for people, the dolphin most familiar to the general public is *Tursiops truncatus*, the bottlenose dolphin.

Most Odontoceti, including dolphins, feed on whole fish or squid, using muscles in their tongue to squeeze the fish

down.<sup>1</sup> Dolphins communicate by way of pulsed sounds (like clicks and whistles), breaching, and pectoral fin and tail slaps, in addition to body posture and jaw popping. They can produce and hear sounds up to 200,000 vibrations per second. Studies show that their vocalizations are structured enough to support a language, but this is demonstrated for many other animals as well.<sup>2</sup> Unlike humans, dolphins do not communicate through facial expressions or a spoken language, as they do not have vocal chords.<sup>3</sup>

When not eating or communicating, dolphins spend about 33% of the day sleeping. This sleep may only occur in one hemisphere of the brain.<sup>4</sup> They only rest half of their body at a time, so the other half will know to periodically rise to the surface and breathe. If they were to fall asleep completely, they would drown.<sup>5</sup> A dolphin cannot breathe under water. When it surfaces, it breathes through a single blowhole on the dorsal side of the head. Respiration will exchange 80% of its lung air, much more efficient than the 17% for humans. Another adaptation to its environment is a thick layer of blubber under the skin to insulate the body in the cool water. There is also countercurrent heat exchange. Heat is transferred from the traveling blood of the arteries to the surrounding veins, and is not lost to the environment.<sup>6</sup>

Dolphins have very large folded brains that imply great intellectual capacity. They have the second high-

est brain-to-matter ratio, with humans the highest.<sup>7</sup> There is no adequate methodology, however, to measure their intelligence. Scientists have observed that they learn quickly, can generalize, understand complicated language-like commands, are self-aware, and have dexterity and inventiveness.<sup>8</sup>

Dolphins live in pods, long-term social units that vary in size from two to 25 members. Just as humans stay with their families, members of a pod stay together for hunting, protection, and familial obligations. Sometimes

is rich with fat and protein to help the baby quickly develop the thick, insulative layer. The mother will continue to keep a close watch over the calf and attentively direct its movements. Mothers and their calves have been observed to stay together in the same pod for 3 to 6 years before the calf leaves for a juvenile pod. Mature males are usually not seen with a maternity or juvenile pod.<sup>9</sup>

Young dolphins display a playful side like that of human children. The first stage seems to be spent chasing one another for fun. Then comes the

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“The Talmud states: ‘Dolphins are fruitful and multiply like human beings.’ Says Rashi: ‘Dolphins are fruitful and multiply from human beings.’”

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a social hierarchy can be found in the pod, where one will establish dominance through aggression. Like humans, they will use their bodies as weapons against one another. Sometimes, a member of the pod will leave to investigate unfamiliar territory and bring back the information to the pod. If one of the members is ever ill or injured, the others will all stand by and even support and guide it to the surface to breathe.<sup>4</sup>

The gestation period is around 12 months. There is usually an assisting dolphin, called the ‘auntie,’ which is the only one allowed to be close to the new mother and calf. The calf will nurse for up to 18 months. The milk

teasing, in which you can see the mind at work in terms of acting deliberately and anticipating reactions. For example, a dolphin would place a piece of squid in front of the opening to the cave of a grouper fish. Just as the grouper would come out for this bait, the dolphin would snatch the squid up. This teasing repeatedly happens and may show the ability of the dolphin to develop an idea.<sup>4</sup> Dolphins have also been considered playful creatures because of their tendency to ride the wake of a boat or because of their spectacular dives, leaps and spins. This ‘play’ may however serve for communication, food herding, or defense.<sup>5</sup>

As magnanimous as these creatures are, human beings have directly or indirectly affected the mortality rates for dolphins. Natural deaths result mainly from predators, parasites, or disease. Unfortunately, humans have created many more causes of death. Plastic bags, found in dolphins' stomachs, have caused internal injuries. Chemical pollution can suppress their immune system and cause reproductive failure. They are still being hunted for sport, food, or tradition. It is naturally possible for dolphins to live into their forties. Studies in Florida showed, however, that 38% of beached dolphins died before the age of two and 64% died under the age of 10.5. Several

species are dwindling, threatened by over-fishing, accidental capture, pollution, and damage to their habitat. Coastal fishermen claim the largest toll; about 70% of all the dolphins killed worldwide.<sup>7</sup>

Apparently, Kohut's suggestion that dolphins have many similarities to human beings was well-founded. His view is in accordance with the Jewish concept that to every terrestrial animal, there is a complimentary aquatic animal. According to Kohut, dolphins are the complimentary species to human beings. In Hebrew, there is the expression "ein le'dolphonim memshalah bayobasho" meaning "dolphins have no dominion on dry land." However, because they live in

the sea, they are often referred to as "the rulers of the sea."<sup>1</sup> G-d made reference to these gentle animals, which have expressed a great affinity for man. Humans, the most intelligent creatures, have scientifically observed the human-like characteristics of dolphins in terms of their playfulness and affection, and ironically, have continued to prey on them. If people would understand and be educated about what it is they are destroying, it just might not be so easy. "Only then can we and the ocean world finally live in something approaching ecological peace."<sup>9</sup>

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# White Blood Cells in the Talmud

Historically, Jews have been highly educated in scientific fields, as well as in Judaica. In the past, scholars have combined both areas of study to reach new insights. In the eighteenth century, the Vilna Gaon said, "All forms of wisdom are necessary for the understanding of our Torah and are

included within it." The Vilna Gaon often used his wide range of knowledge in science and math to enhance his study of both the Bible and Talmud. Today, our superior understanding of the sciences has increased our capacity to integrate these two areas of knowledge. One aspect of the biological sciences that can be traced to discussions in the Talmud is the white blood cell and its various physiologic functions. With an awareness of this very basic component of human physiology, one may recognize that certain aspects of the malfunctioning of white blood cells are mentioned in the Talmud. Such knowledge can

enhance our interpretation of certain Talmudic sections.

The white blood cell, termed the leukocyte, is the basic cell type of the immune system. Leukocytes, unlike erythrocytes (red blood cells), contain nuclei that house chromosomes with their DNA. The two main categories of leukocytes are the granular and the non-granular leukocytes. The non-granular leukocytes include monocytes and lymphocytes. Granular leukocytes, as well as monocytes, are phagocytic and thus ingest foreign substances that enter the body.<sup>1</sup>

There are two types of lymphocytes: T and B cells. Although not

phagocytic, these cells are integral to the immune response. The T cells, formed in the bone marrow, migrate to the thymus, a gland located just above the heart. In the thymus they develop immunocompetence, the ability to recognize specific invaders such as microorganisms that are identified by their surface antigens. A multitude of different T cells are produced, each programmed to recognize a specific antigen and assigned a specific task. The inducer, helper, cytotoxic, and suppressor T cells oversee T cell development, initiate the immune response, lyse cells infected by virus and terminate the immune response, respectively.

The B cells form and complete their maturation in the bone marrow. As with the T cells, they are then released to circulate in the blood and with other extracellular fluid. When a B cell encounters a specific foreign antigen

that it has been programmed to recognize, such as a specific bacterial invader, it divides rapidly to produce plasma cells and memory cells. The plasma cells release antibodies that complex with the antigen-bearing, invading cells and thereby target them for destruction. Antibodies, also termed immunoglobulins (Ig), are protein in nature and are classified, based on structure and function, into several subclasses.<sup>1</sup>

Various pathologies caused by the malfunctioning of the immune system are noted in the Talmud. The most obvious Talmudic reference to a

immune response to an antigen. The IgE antibodies, however, do not circulate in the blood, but adhere to tissue mast cells and certain other leukocytes that have specific membrane receptors for these antibodies. The allergen binds to the antibodies attached to the mast cells and leukocytes. When a person is exposed to the same allergen a second time, the allergen then combines with the IgE antibodies on the surface of the mast cells and stimulates the secretion of pharmacologically active chemicals, including histamine, which produces the allergic symptoms.<sup>1</sup>

What is there in the nasal discharge? Rav replied: this is the case where it was drawn and discharged through the mouth.<sup>2</sup> A stuffed nose, another aspect of rhinitis, is referred to in Bekhoroth (43b) by the term *hotem boloom*. Rashi interprets this as "the nose of which the nostrils are blocked."<sup>2</sup> Although the cause of this rhinitis was not known at the time of the Talmud, these references indicate that the existence of nasal allergies was recognized.

Another reference to an immunopathology mediated by white blood cells is vitiligo, a condition that causes loss of skin pigmentation. There are several theories on the nature of this disease. One theory is that it is an autoimmune disease, caused by malfunctioning of leukocytes. Apparently, antibodies attach to the antigens on the surface of the melanocytes, the cells that produce the black pigment, called melanin. These melanocytes, once tagged by antibodies, are destroyed by leukocytes.<sup>3</sup>

The Talmud mentions a case of rapid whitening of the hair. In Berokoth (27b28a) it notes that the position of chief of the Sanhedrin, the court that functioned in the time of the Mishnah and the Talmud, was offered to Eleazar the son of Azariah, a learned scholar who was only seventeen years old. His wife was worried that because he looked so young and had no white hair, he would not be awarded respect by the older rabbis. On the day that his wife expressed this concern, which

"There are three partners in the creation of a person: G-d, the person's father, and the person's mother. The individual's father seeds the white substance from which the bones, sinew, nails, brain, and white of the eye are formed; the mother seeds the red substance from which the skin, flesh, hair, and the black of the eye are formed; G-d places in him the spirit of life, the countenance, eyesight, hearing, power of speech, walking, and insight and understanding."

white blood cell malfunction is to nasal allergies. The allergic response results in immediate hypersensitivity, caused by an abnormal B cell response to an allergen (an antigen), and produces fast appearing symptoms, such as rhinitis (runny or stuffy nose), conjunctivitis (red eyes), allergic asthma, and atopic dermatitis (hives). These symptoms result from the production of IgE antibodies instead of IgG antibodies, which are usually secreted into the blood as an

Symptoms of rhinitis are mentioned in several tractates in the Talmud. In Baba Metzio (107b) it states, "and the nasal excretions are injurious when in great quantities, but beneficial in small." Rhinitis is further mentioned in Bekhoroth (43b) by the term *hotem notef*, meaning a dripping nose. Another aspect of nasal allergy is postnasal drip, which is referred to in the Talmud in a discussion regarding spittle. In Niddah (55b) it states, "and nasal discharge.



was his eighteenth birthday, his hair suddenly turned white. The commentaries offer various suggestions as to exactly what occurred. Traditional commentators, such as Rashi, attribute this event to a miraculous phenomenon. Maimonides suggests that his intense and diligent study caused the young scholar's hair to whiten prematurely. As G-d's miracles are often performed through the manipulations of natural processes, it is conceivable that the sudden appearance of Rav Eleazar's white hair was due to vitiligo. Although vitiligo usually refers to loss of pigment in the skin, loss of pigment in the hair shafts also occurs. It is plausible that the incident mentioned in the Talmud is a case whereby G-d caused the sudden whitening to occur via the autoimmune disease vitiligo. A two-step process causes the sudden appearance of the white hair. The melanocytes are destroyed and then the white hairs simultaneously grow long enough to be seen, or there is a selective loss of the pigmented hair. This explanation coincides with Maimonides' interpretation of the event, as appearance of vitiligo is usually associated with individuals in stressful situations.<sup>4</sup>

The third example of integrating scientific knowledge with Talmudic study acknowledges the inherent differences between red and white blood cells. There is a dispute among the rabbis as to the validity of using blood typing to determine paternity. Rabbi Alfred Cohen<sup>5</sup> discusses this controversy, which centers around a

Talmudic passage in Niddoh (51a). The Talmud states, “There are three partners in the creation of a person: G-d, the person's father, and the person's mother. The individual's father seeds the white substance from which the bones, sinew, nails, brain, and white of the eye are formed; the mother seeds the red substance from which the skin, flesh, hair, and the block of the eye are formed; and G-d places in him the spirit of life, the countenance, eyesight, hearing, power of speech, walking, and insight and understanding.” In their comments on this passage both the Vilno Goon and the She'iltos add the word “blood” to the list of maternally derived body parts. Evidently, all colored body parts were thought to emerge from the mother. Based on this Talmud, Rav Waldenberg ruled that blood samples, which represent the mother's contribution, may not be used to establish paternity. Other rabbinical authorities disagree. In light of the words in Erubin (13b), “These words and those words are words of the living G-d”, it is proper to try to synthesize the two approaches so that each has merit.

A greater understanding of the distinctions between white and red blood cells is necessary to see that both rabbinic opinions are correct, although in different circumstances. Blood consists of three types of cells, all of which originate in the bone marrow: (1) Platelets, which are fragments of a type of bone marrow cell; (2) red blood cells, red because of their pigmented hemoglobin; and

(3) white blood cells, the white being evident in the appearance of pus, which consists of dead white blood cells. At functional maturity, when they are released from the bone marrow, red blood cells lose their nuclei, and therefore their DNA. Conversely, white blood cells retain their nuclei and thus their DNA. Paternity testing based on blood type examines the antigens on the red blood cells of the child, the father, and the mother. This method of genetic analysis cannot be used to determine paternity, but can only make certain that someone is unquestionably not the father of a particular child.<sup>6</sup> A child inherits one antigen from each parent. If an alleged father is blood type AB, the mother blood type A, and the child blood type O, it is impossible for this man to be the father of the child, because the child did not inherit either the A or B antigen from this man. Hence, the blood typing cannot establish paternity. However, samples of DNA extracted from the white blood cells of the child, the alleged father, and the mother can positively establish paternity through the method of DNA fingerprinting. Consequently, the red blood cells, which according to the Talmud in the tractate Niddoh are derived from the mother,

cannot be used to identify the father. However, the white blood cells, which according to that tractate are derived from the father, provide DNA that can be used to identify paternity.

The tradition of amalgamating scientific knowledge and Talmud study is apparent in the accomplishments of Torah scholars such as

Maimonides and the Vilna Gaon. The abundance of knowledge in this century has enabled us to learn from the precedent of those who came before us and use these discoveries to infuse possible new meaning in Talmudic texts. Our understanding of the white blood cell, its role in the immune system, and its distinctiveness from red blood cells, have pro-

vided the basis for further analysis and explanation of some Talmudic texts. The white blood cell is just a small component of a vast field of scientific knowledge that can be utilized in order to further our understanding of the Torah and Talmud.

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# Man: G-d's Clone

**T**he famous quote in Jewish tradition (Koheles 1:9), "ein chadash tochas hoshemesh," is translated as, there is nothing new (i.e., original) below the heavens (i.e., on earth). Each human being is created in the image of G-d, our role model. As stated in the Talmud (Shabbos 133b), "Just as He is

Merciful, so you be merciful; and just as He is Kind, so you be kind." Becoming more G-dly is the greatest level a human being can achieve. In this way, Judaism already has a concept of cloning as we try to clone ourselves after the Almighty!

Whenever a new technological advance arises, there are questions that should be asked, especially by Torah-abiding individuals. Human cloning is one such biotechnological advance that triggers many halachic issues. Cloning of animals is relatively new and, as of yet, many governments prohibit cloning a human. However, one cannot help but wonder what halachic

issues may arise from, and what potential answers may be generated for, the question of human cloning. This article attempts to hypothesize and solve some of those issues. The reader has to be aware that the views portrayed in this article are not halachic decisions issued by poskim, rather, they are assumptions.

There are many fears regarding human cloning, more so than with any other breakthrough in biotechnology. "People perceive cloning as an affront to their humanity and sense of individuality," said Rabbi Shraga Simmons of the Aish Hatorah Institute. What people do not realize, however, is that being

genetically identical does not mean having identical personalities. For example, identical twins are genetically alike, but grow up with different likes and dislikes, as each has a unique soul and goes through different life experiences. A major difference between identical twins and a nuclear donor and its clone is that identical twins are the same age, whereas a clone might be a generation or two apart from its donor. In order to calm these fears, an understanding of human cloning and how it can be beneficial to mankind is presented.<sup>1</sup>

Human cloning involves three components. A donor supplies the nucleus; the resulting clone will be genetically identical to this donor. The nucleus is then injected into an enucleated egg (an egg from which its nucleus was removed). This egg, with its new nucleus, is eventually inserted into the womb of the woman, termed the gestational mother. In

the simplest scenario, the donor of the nucleus, the source of the enucleated egg, and the gestational mother may be the same person. In this case, one female, without a male, may produce a child. In the most complex scenario, the abovenated event may involve three different women. In this case, a child is produced through the interaction of three females, but still no male. Another case may involve a male nucleus donor, a female who supplied the enucleated egg, and this female or another female serving as the gestational mother. The story gets

become more restricted in their potential, until eventually the cells are fully programmed to function as only one specific cell type (e.g., liver cell; spleen cell; retinal cell). Although all cells in the body contain the some genetic information, as the cells develop and are programmed into one pathway, some genes become permanently inactivated, whereas others remain active. In the cloning of the first animal, Dolly, a sheep, the scientists were able to deprogram the genes in an adult mammary gland cell and then implant this totipotent adult (not fetal)

caused by a mutation in the DNA of a person. A person with a genetic disease may pass this defective DNA to some or all of his children. With biotechnology, a scientist can remove a genetic defect from the nuclei of cells of the donor and then implant the genetically-altered nuclei into enucleated eggs, which will be implanted in a surrogate's womb. The resulting child would be healthy, without the genetic defect.<sup>2</sup>

A couple in which either spouse cannot naturally produce gametes now has an option to have a child that is identical to at least one of them. Cells taken from a recently deceased child can be used to clone that child.<sup>2</sup>

Experimentation on animal cloning may aid organ transplantation in humans. Cloning, for example, can create animals with organs that are immunologically compatible to humans. These organs can then serve as transplant replacements, without the danger of host rejection.<sup>2</sup>

There are potential problems to consider. Adult cells periodically have been exposed to environmental stresses and thus may have acquired defects. There is also the possibility that a clone may have a shortened lifespan because the cells originated from an adult. There are also psychological implications to consider. How would a cloned child feel knowing that it originated from biotechnological procedures and not through natural means?<sup>2</sup>

What is the Torah's view on human cloning? Tiferet Yisrael (Yodayim

“Becoming more G-dly is the greatest level a human being can achieve. In this way, Judaism already has a concept of cloning as we try to clone ourselves after the Al-mighty.”

even more complicated if not all constituents are Jewish.

Cloning, at least with animals, became practical when scientists learned to dedifferentiate the genes in a mature, adult cell. Because the nucleus of the donor cell is derived from an adult differentiated, specialized cell, its genetic versatility is limited. During normal embryological development, the early embryonic cells are totipotent, each with the potential to develop into any body tissue. However, as development progresses, the genes

nucleus into an enucleated egg of another sheep. This cell, after reactivation in culture, was inserted into the uterus of this second sheep (which, also was the gestational mother) that gave birth to a lamb genetically identical to the source of the nucleus.

Like any other scientific breakthrough, there are many advantages and disadvantages to cloning.

Using the cloning technology developed by the Roslin Institute, scientists will have a new methodology to correct genetic defects in DNA. A genetic disease is a result of a defect,

## ● "Cloning might be used to recreate a gadol ha-dor

or, at the other extreme, an evil individual."

4:3) stated that when the Torah does not specifically prohibit an activity, then that activity is permissible. Assuming that there are no harmful medical effects, the procedure and principles of doning do not involve any halachic prohibitions. In fact, cloning has a halachic advantage over artificial insemination, because sperm are not needed. The mode for procurement of sperm needed for the various types of in vitro fertilization, is halachically problematic. Furthermore, according to the Ramban (Bereishit 1:26 and 1:28), G-d gave man the right to master all powers embedded in the physical, chemical, and biological world in order to "rule the world" (kivshulho). Thus, human cloning represents no more than a power to explore and control. Cloning technology has great medical potentials. As expressed in Shemot (21:19) and in Bava Komo (85a), "verappo yerappe," a Jew is permitted and even obligated to utilize all in his power to cure the sick.<sup>2</sup>

One can argue against human cloning that it goes against *teveh* (the natural order of life), because no natural sexual process is involved. The application of *derech hatevo* might include the principle that each human being has the right to be the product of two parents and that each parent must contribute to its formation. Therefore, cloning a human using a nucleus from a male that is inserted into an enucleated egg of a female might not go against the *hoshikafa* of procreation, whereas

using cells only from females might be problematic. Bereishit Rabba (1:26) stated that Adam was created from *odommo* (earth), Chava from Adam, and thereafter *be-tsolmenu ki-d'mutenu* - no man without woman, no woman without man, and not both of them without the Shekina. It would seem, at the very least, human cloning using cells derived only from females may be problematic, while human cloning using an enucleated egg from a woman and a donor nucleus from a man would eliminate some difficulties.<sup>2</sup>

Many secular ethicists claim that the problem of cloning lies in eugenics, i.e., the select breeding of a human race. Cloning might be used to recreate a *gadol ha-dor* or, at the other extreme, an evil individual. However, there is no guarantee that the clone will have the same personality or will follow the same goals as the nuclear donor. Environmental factors play a large role in human psychological and moral development. Keep in mind, a human clone, although derived from an adult, needs to grow and develop like any other child. Growing up in a different generation, with different pressures and conflicts, will develop a different person. As noted in Nedarim (81a), families of *talmidei chachamim* do not necessarily have children who are *talmidei chachomim*. Rav Yosef stated that this is because the development of a *talmid chacham* is not "genetically" (the Gemara used the term, *yerusho*) determined. Obviously Rav Yosef

understood the different impacts of "nature" (genetics) versus "nurture" (social environment) on human development.<sup>2</sup>

Cloning is different from other advances in technology as it has the potential for much abuse. In 1997, when I first heard that Dolly was cloned, an image of human babies growing in incubators came to mind. This concept of human cloning is like the theme of a science fiction novel; what was thought to be impossible, become possible. One fear is that cloning might lead to "growing" humans for cheap labor or for using their bodies as a warehouse of "spore parts" for organ transplantation. Jewish tradition possibly would concur that cloning for the purpose of saving a life is permissible. We find in Yevomot (64a), the Shulchan Aruch (154:6-7), and the Aruch Hoshulchon (154:52-53) that the Torah recognized a variety of motives for couples to have children, including to help take care of themselves in their old age. Based on the above, Rabbi Brody wrote that a couple who has a child to save the life of another would be doing two good deeds - having a child and saving the life of another.<sup>3</sup>

Rabbi Moshe Tendler, professor of medical ethics, Talmudic

law, and biology at Yeshiva University, said that, "The real problem is whenever man has shown mastery over man, it has always meant the enslavement of man." Rabbi Tendler also noted that restrictions on human cloning should be directed to current ethical issues and was of the opinion that human cloning has the potential for good use. Yet, he understood that the danger of abusing the science was too great to allow human cloning at this time. The Talmud says that man has to learn to sometimes soy to the bee, "neither your honey nor your sting."

(yesh me'oyin), which only G-d can accomplish. Human cloning is creating something from something.<sup>4</sup> Perhaps, however, a human clone should be considered a golem (an artificial person created through mysticism), which there is no prohibition to create. The difference between a golem and a human clone is that a human clone comes from a womb and a golem from soil. A golem is created by placing G-d's name on a manuscript which is then placed in its mouth or by inscribing G-d's name on the forehead of the golem. Another distinction is that a

an enucleated egg that then undergoes a normal gestational period. Rabbi Broyde stated, "A clone, no less than any other 'born' child, meets the prima-facie test for humanness and is human."<sup>3</sup> Rabbi Bleich concluded, "The crucial distinction between a golem and a clone is that a golem clearly lacks a human progenitor. A human clone, although the product of asexual reproduction, does have a human progenitor."<sup>3</sup>

Rabbi Bleich presented another interesting point. "Offspring produced from a cloned cell of a monkey or a chimpanzee implanted in a human womb, although having both the genotype and phenotype of an animal, would be regarded as human for the purposes of Jewish law." As noted in Nidda (23b), "An animal-like creature born of a human mother is regarded as a human being." Keeping this in mind, the definition of humanness, being born from a human mother, seems enough to give a clone humanness (considering that the current cloning method uses a human being as the gestational mother).<sup>5</sup> What if some time in the future, gestation could occur outside of a human womb? Rabbi Broyde explained that the "Talmudic conclusion seems to be simple. When dealing with a 'creature' that does not conform to the simple definition of humanness, one examines context to determine if it is human. Does it study Torah or is it at the pulling end of a plow?" By asking such questions one can measure that a clone,

"Dr. Avram Steinberg explained that true creation is creating something from nothing (yesh me'ayin), which only G-d can accomplish. Human cloning is creating something from something."

Are we good enough to handle good technology? Of course we are, if we can set limits on it. And when we can train a generation of children not to murder or steal, we can prepare them not to use this technology to the detriment of mankind.<sup>3</sup>

A significant concern regarding human cloning is that it challenges the prohibition of creating new life forms. Dr. Avrom Steinberg, in a lecture at a Symposium on Modern Medicine and Jewish Law (February, 1999), explained that true creation is creating something from nothing

golem is incapable of speech because speech is associated with a soul and a golem lacks a soul. This explains why destroying a golem does not violate the prohibition of murder. One can then ask: Is a clone considered human? Rabbi J. David Bleich explained that with a golem the "replication of already existing human genetic material is completely lacking."<sup>5</sup> This is clearly demonstrated in the way a golem is produced, essentially from earth, where as a human clone is generated from the insertion of genetic material into

“If one partner in the cloning process is a non-Jew, . . . a child’s

even one fully incubated artificially outside a human womb, would be human since it would have human intellectual ability and attributes.<sup>3</sup>

We must now ask what are the family relationships of the clone. Some suggest that the relationship between the clonee and the clonor would be that of siblings and not of parent and child. Genetically, the clonee/clonor relationship resembles that of identical twins. The problem with this theory is that the definition of siblings in Jewish law is based on, at least, one common parent. Yevamot (97b) notes a case of twin brothers who were in their non-Jewish mother’s womb when she converted to Judaism. They share no halachic genetic relationship to each other, although they are siblings due to their sharing the uterus of the same mother. In the relationship of the clonor to the clonee, there is no common parent. Being genetically identical does not make them siblings either. For example, consider the instance of twins who clone themselves. The clones are not only genetically identical to each twin who cloned them, but are identical to the twin’s brother. Yet, each clone is the nephew to the clone’s identical twin brother, and the clones are first cousins. The presence or absence of a common mother reinforces this.<sup>3</sup>

According to Jewish law, as religious identity is based on the mother, the question of who is the mother becomes an even more crucial issue. Jewish law insists that the child of a Jewish mother is Jewish, independ-

ent of the religious status of the father. The child of a gentile woman is a gentile, whether or not the father is Jewish. If one partner in the cloning process is a non-Jew, Rabbi Bleich quoted the opinion of Rabbi Shlomo Zalman Auerbach, that such a child’s identity would be subject to doubt and it would therefore be best to convert the child.<sup>3</sup>

Jewish tradition would be very inclined to establish the gestational mother, the one who carried and delivered the clone, as the halachic mother. Consider the case of a Jewish woman with no ovaries who conceives subsequent to an ovarian transplant. Even though originally the ovaries were not hers, her body ovulated, conceived, nurtured, and bore this child. Children conceived in a test tube are the halachic progeny of the surrogate woman who gave birth to them, just as children conceived in a woman who had an ovarian transplant are progeny of the birth mother.<sup>3</sup>

According to Rabbi Bleich, a number of halachic authorities would maintain that it is possible for a child to have two mothers. In the case of surrogate motherhood, for example, the donor of the fertilized egg and the carrier and deliverer of the child are both the mothers of the child. Following this interpretation, one can conclude that anyone who contributes to the development of a child, whether it be a fertilized egg or, perhaps, only mitochondrial DNA, would be considered a halachic mother to the child.<sup>3</sup>

If, however, one followed those authorities that consider only the gestational mother as the halachic mother, several areas of uncertainty arise. If the nuclear donor is a woman, just as in cases of surrogacy where the fertilized egg is donated, one might claim her to be the halachic mother in which, at the very least, the child would be prohibited from marrying into her immediate family. Halachically speaking, the man who provides half of his genetic material (as in the form of sperm) is the father, yet the woman who contributes half of her genetic material to the child might not always be the halachic mother, as in a case of surrogacy, whereby a second mother functioned as the gestational mother. In traditional thought, both biologically and halachically, only a man can be a father and only a woman can be a mother. In human cloning, if a woman donates the nucleus, then perhaps she would be the halachic genetic father and the gestational mother (another woman) would be the halachic mother.<sup>3</sup>

A third possibility of motherhood or fatherhood independent of gender is discussed by Rabbi Joseph Bobad. He noted the case of an androgynous male (a male with both male and female organs) who fathered a son and then had a

identity would be subject to doubt and it would therefore be best to convert the child.”

sexual relationship with that child. Rabbi Bobad speculated that if the relationship was with the father's female organs, then perhaps, the son was liable for relations with his mother. The classical Jewish law codes leave no room for this discussion, which seems to uncouple gender from parental status in the case of one whose gender status is uncertain.<sup>3</sup>

Some even go so far to say that the halachic father of the clone is the father of the female nucleus donor, as half of his DNA is transmitted indirectly through his daughter to the clone. There is also the possibility that there is no halachic father, as in the cases of *shetuki* (an individual who does not know his/her father) and *gerut* (a convert).<sup>2</sup> There is no definitive answer, yet there are definite problems that will arise through cloning. For example, is there a prohibition against a mother and a daughter producing a clone together? What would be the *yichus* (i.e., Kohen, Levi,

Yisroel) status of a clone? Another interesting idea to note is that cloning can never produce a *mamzer*. According to the *Shulchan Aruch*, only through foreign sperm is there the possibility of a *mamzer* and cloning does not use sperm.<sup>2</sup>

Cloning opens a wide array of questions and complications to our society. It would seem that although cloning itself is not specifically prohibited (since it does not cause any known harm, as of yet), it will definitely arouse issues requiring analysis. For example, consider the *pesok* of Rabbi Auerbach in regard to a single woman having children by artificial insemination. He wrote that children should be born within a nuclear family structure only. Such a case might apply to a single woman cloning herself. Rabbi Eliashiv claimed that cloning offers a social change that would go against *hashkofat hatorah* with respect to the role of parents in raising children.

Robbi Waldenberg was of the opinion that halacha would have a negative view on implementing any fundamental social change within the basic family unit.<sup>2</sup>

As of yet, all that we can do is wait to see what happens. The future is uncertain and that leaves us with speculation alone. With this in mind I would like to end with a quote from Rabbi Simmons: "It is our prayer that the world will use its powers only for the purposes which are good, holy and truly human."<sup>1</sup> As it is written in *Sanhedrin* (37a), "Only one man was created. This should indicate that he who ruins a human soul destroys an entire world, and he who saves a human soul, saves an entire world. One cannot be arrogant saying, 'My kin is nobler than yours.' Every person should remember that the world was created for him and he is responsible for it."<sup>4</sup>

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# The Interface of Halacha and Biotechnology

The Jewish religion is based on an eternal document, the Torah, the divine code of Jewish law. Because of its infinite nature, each generation is often confronted with new issues concerning the application of laws and the problematic settlements made by individuals. In fact, as soon as Moshe

Rabbeinu began teaching the various halachot (Jewish laws), it became evident that a Rav would always be necessary to facilitate the application of halacha for each situation and a Beit Din (Jewish court) would need to be established to ensure speedy settlements of conflicts amongst individuals. In Devarim (19:15) it is written, "al pi shenayim eidim ah al pi shlosho eidim yakum dowar." The testimony of two or three witnesses establishes something as fact in the scope of Jewish law. The rabbis and judges tried to follow this principle as stringently as possible. However, this often proved to be extremely difficult. This difficulty resulted in the development of two classical issues in

regard to Jewish court cases. The first involved the testimony of unqualified witnesses who were the only source of information. The core of the second issue was whether circumstantial evidence could be accepted in a Beit Din. These issues have become further complicated with the advent of modern technology. The discovery that human DNA (deoxyribonucleic acid) is highly individualized and the subsequent mapping of the human genome have entirely changed our focus of the world and mankind. Since halacha technically operates within its own principles and rules of evidence, it is necessary to determine the extent in which these technologies can be incorporated

into the system of Jewish law. Many issues, including tracing Jewish relationships, paternity suits, and forensics, have been halachically reanalyzed with the advent of modern technology.<sup>1</sup>

Before these issues can be discussed at length, it is necessary to have a working knowledge of DNA, our genetic material. DNA occurs as a double-stranded helix composed of nucleotide building blocks. Each nucleotide is a complex of three subunits - a pentose sugar, a phosphate, and a nitrogen-containing base. There are four nitrogenous bases and, therefore, four different DNA nucleotides. It is precisely this variation of nucleotides within the polynucleotide strands that fulfills the requirement of DNA as a genetic material. DNA is replicated prior to cell division, transmitted from cell to cell and from generation to generation, and is able to store information that pertains to the development and metabolic activities within the cells of an

individual. Finally, DNA can undergo rare changes, called mutations, that are necessary for biodiversification.<sup>2</sup> Because of various environmental pressures, as well as innate biological differences among human beings, the DNA of any one individual is not identical to that of another individual. It is only recently, through the development of sophisticated biotechnological methodologies, that these subtle, yet discrete, differences can be easily recognized, identified, and visualized.

DNA polynucleotide strands are composed of various coding and non-

coding regions that led to the study of the "Kohen gene."<sup>3</sup>

All Kohanim are direct descendants of one man, Aharon HaKohen. Priesthood has been passed from father to son for nearly 3,300 years without interruption. Exodus (29:9) confirms this point by stating, "And they shall have the priesthood as a statute forever, and you shall consecrate Aharon and his sons."<sup>3</sup> In earlier generations, every Kohen received a "Sefer Yuchsin," a document that validated his lineage. Unfortunately, this method ceased to exist, thereby casting doubt on the authenticity of

markers of the rest of the Jewish nation. The male Y chromosome consists of mostly non-coding DNA and therefore mutations will resist selection. As the information on the Y chromosome is passed from father to son without genetic recombination, the genetic information on a Y chromosome is virtually the same in a man living today as it was in his male ancestors who lived thousands of years ago. Obviously, some mutations occur. These neutral mutations, collected over many generations, are transmitted as a haplotype, a set of linked genes or DNA sequences that tend to be inherited together. Such a haplotype can be considered a genetic seal of a man's male ancestry.<sup>3</sup>

Dr. Karl Skorecki, a researcher who made significant contributions to the field of molecular genetics, headed several studies to test whether Kohanim have a certain haplotype found at a greater frequency than that of the rest of the Jewish males. The results of one study showed that there was indeed a particular genetic marker that was detected at a significantly higher frequency in Kohanim than in other Jewish males. In a subsequent study, Dr. Skorecki and his associates discovered that a particular pattern of six chromosomal markers was found in 97 of the 106 Kohanim tested.<sup>3</sup> This collection of markers, known as the Cohen Modal Haplotype (CMH), can be considered the standard genetic signature of the Kehuna. Quite amazingly, the chance of these genetic markers happening at random is one in 10,000.<sup>3</sup> However, it is important to understand

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descendants of one man, they should all share a common set of genetic markers on their Y chromosome known as the Cohen Modal Haplotype. The chance of these genetic markers happening at random is one in 10,000."

coding regions. The coding regions of genes specify the sequences of amino acids in the resulting proteins. The non-coding regions contribute to gene regulation. Genetic markers are variations in the nucleotide sequences of DNA that arise by mutation. Mutations that occur within genes can be deleterious and may, for example, cause congenital disorders. Due to natural selection, these mutations disappear over time. However, mutations found in the "non-coding" regions of the DNA may linger for generations. It is precisely these non-

each Kohen. This issue blossomed into a large debate. The Ramah explains that since a Kohen does not have a definitive status, the rest of the nation is exempt from bringing the required gifts to the Kohen. However, the Biur Holocho proclaims, "heaven forbid that one should impugn the genealogical purity of Kohanim in the present time!"<sup>1</sup>

Theoretically, if Kohanim are descendants of one man, they should all share a common set of genetic markers on their Y (male-determining) chromosome, unique from genetic

that, at present, there are no halachic ramifications of this discovery. No one can be certified nor disqualified as a Kohen because of his genetic markers. The reasons for this include that only about 70% of all Kohanim have these markers in common. In addition, a small tribe in Africa that may have Jewish ancestry also has many males carrying these markers. Finally, according to the Magen Avrohom, even if a Kohen would have the CMH, this genetic evidence could not be used to validate his status, as his lineage may have included an ancestress (e.g., a divorced woman) who was forbidden to marry a Kohen.<sup>1</sup> Therefore, further scientific research is needed to make these findings halochically acceptable.<sup>1</sup>

Kehuno is only one aspect of a father-child lineage. There are many other situations in which paternity status is very important. For example, genealogy, inheritances, the obligations of a father to feed and educate his children, circumcise his sons, and redeem his firstborn as well as the obligation of children to honor their father are all dependent on paternity status. Unfortunately, situations may arise in which a man denies or claims that he does not know whether he is the father. For example, on the biblical verse “Avraham gave birth to Yitzchak,” (Bereishit 25:19) Rashi commented that “since scoffers of that generation were saying that Sarah become pregnant from Avimelech, Hashem made the appearance of Yitzchak’s face similar to that of Avraham.”<sup>1</sup> The striking physical resemblance between father and son

was taken as proof of Avroham’s paternity.

Interestingly, there are some rabbinic sources that indicate that such resemblances are helpful in establishing paternity. However, when the Maharshom was questioned regarding the proof of such resemblances, he responded that Rashi never intended to teach a halacha. Rather, when people observed the striking physical similarity between Avrohom and Yitzchak, they assumed that they were father and son.<sup>1</sup> In all likelihood, the use of scientific technologies is much more suitable. The various methods used to clarify paternity are based on the principle that half of the genetic constitution of the child is derived from the mother and half from the father. The genetic constitution of the child can be examined to clarify whether the husband is the father.

There are several scientific systems to disprove or establish paternity. Although blood typing is one of the initial procedures used in paternity cases, it has limitations. The ABO blood groups and other inherited antigens of red blood cells are often used in legal situations involving identification of disputed paternity. A comparison of the blood types of mother, child, and alleged father may exclude the man as a possible parent. Blood typing does not prove that an individual is the father of a child; it merely indicates whether he is a possible parent. For example, a child with a blood type of AB, whose mother is type A, could not have a father whose blood type is O. Any mole with blood type AB or B could be the

potential father. Because many people have identical blood types it is, therefore, neither legally nor halochically possible to state that a specific person is the father of the child.<sup>4</sup>

An interesting halochic theory was proposed regarding the blood typing methodology. The Talmud (Niddah 21a) teaches that every human being is the product of three “partners,” his father, his mother and the Almighty. The Talmud further explains that the mother contributes the “red” elements of the child. According to Rav Waldenberg, this “red” includes the blood and therefore no ruling regarding paternity can be established through blood typing. In addition, Rav Waldenberg mentioned that since technologies are always changing, methodologies suitable in one time period may prove to be unacceptable in future years. However, the Rambam was of the opinion that although the medical profession occasionally errs, its discoveries should be accepted, even when they appear to contradict classical halachic opinions.<sup>1</sup>

Tissue typing is a more accurate method of establishing paternity. In this method, the human leukocyte antigens (HLA) system is analyzed in the involved parties. The HLA antigens are genetically determined; every individual has a

unique set of HLA antigens that cover the surface of all nucleated cells in the body. Each HLA antigen is encoded by a specific gene. In human cells, the HLA system appears to consist of two main loci, each with five distinguishable alleles. Therefore, human cells can potentially carry ten different surface antigens, half paternally derived and half maternally derived. A possible test for paternity is to examine the child's HLA antigens.<sup>3</sup> However, the Supreme Rabbinic Court in Jerusalem declared that, "HLA testing cannot be used at all to establish paternity, that the doubts on this matter from the

o particular variation of an enzyme and it is genetically transmitted. The similarities and dissimilarities of isoenzymes are visualized by protein gel electrophoresis. Basically, the isoenzymes migrate in an electric field and the molecules settle at different sites depending on their charges, melting points, and size. Differences in isoenzymes between the child and the alleged father can be compared; those isoenzymes noted in the child, but not in the mother, must be of paternal origin. Two Rabbinic courts in Israel have accepted the results of isoenzyme analysis.<sup>4</sup>

tion becomes more complex when the switch is noticed initially in older children. If a blood or DNA test indicates that this child, although raised by a family which biologically could not possibly be the parents, the halachic principle of *chazako* is triggered. Chazaka mandates that something which has been accepted for a long time as true, has a presumption, i.e., a *chazaka*, that it is fact. Because of this, could DNA evidence counteract the *chazaka*? This intriguing question, like many others, needs to be halachically analyzed.<sup>1</sup>

With the aforementioned methodologies it is possible to disprove paternity with an accuracy of 98 to 99.9% and establish paternity with an accuracy of 95 to 99.8%.<sup>4</sup> It is not possible to prove paternity with 100% certainty since there is always a chance for laboratory error, either at the fault of the technician or the machinery. Furthermore, with more research, our scientific perceptions and understandings may change. As all these errors are negligible with appropriate precautions, the accuracy of these methodologies is as close to absolute certainty as possible.

The uses of the aforementioned technologies have unfortunately become very popular in recent years due to the escalation of terrorist activities in the Middle East. The State of Israel has suffered tremendously as a result of the Palestinians' malicious behavior, including many suicide bombings and persistent violent fighting. Therefore, this region of the world merits careful consideration by local security forces, medical and

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of utilizing these scientific methodologies in relevant circumstances. For example, in a case involving the possible switch in the hospital of two newborn babies, scientific testing can determine parentage."

Jewish legal point of view are tremendous and that this method of testing is insufficient to definitively establish paternity without additional supportive evidence.<sup>4</sup> This court also ruled that judicial courts have no power to force HLA testing, and if one of the parties refuses to be tested, this refusal cannot be used as evidence against that person.

Testing for specific blood isoenzymes is another method used to establish paternity. An enzyme is a type of protein capable of catalyzing a chemical reaction. An isoenzyme is

Many rabbeim are in favor of utilizing these scientific methodologies in relevant circumstances. For example, in a case involving the possible switch in the hospital of two newborn babies, scientific testing can determine parentage. In regards to this specific case, Rav Shlomo Zolman Auerbach ruled: "If this scientific investigation is known and accepted in the entire world through many clear tests which show it to be true and clear, then it is reasonable that also from the viewpoint of *holachava* can rely on it."<sup>1</sup> However, this situa-

forensic services, and rabbinic authorities. Obviously, as for as Jewish law is concerned, positive identification of human remains is one of the most important tasks in mass disaster investigations. The reasons for this are many, including that it is forbidden for a woman to remarry unless she is certain of her husband's death. In the 18 suicidal terrorist bombings that took place in Israel between the years 1993-1996, 127 victims and 19 perpetrators were killed and their severely fragmented bodies were identified within 24 hours.<sup>4</sup> Jewish law mandates immediate burials. Close collaboration between the different emergency agencies and the implementation of various biotechnological techniques have contributed to the efficient completion of the identification process.

There are several methods used to positively identify victims. In the forensic sciences, recognition of the deceased by family members is considered a presumptive method of identification. Halochically, visual identification in itself is acceptable, provided that the face or a unique external body feature is preserved in compliance with Jewish laws. For example, in a plane crash, a man's entire body was not found, only body parts and artifacts. His wife testified in a Beit Din that her husband wore a ring with the initials "A.D." on it. After a man's hand was found with this type of ring and after his dentist identified a gold tooth as belonging to the victim, Rav Moshe Feinstein granted the woman permission to remarry.<sup>1</sup> Obviously, in multi-victim

situations, visual recognition plays an important role in the resolution of the identification process. Initially, probable identity of the victim is established based on the data collected at the scene and then identity is confirmed by visual recognition by a close relative.<sup>4</sup>

At times, scientific methods of identification are more accurate than visual recognition. In the State of Israel, all citizens who serve in the Israeli Defense Force (IDF) have a ten-finger doctilar record in their military file. This procedure was first instituted following the Yom Kippur War in 1973 for male personnel and in 1985 for female personnel. Citizens who have not served in the IDF, or who served prior to these dates, have no military dactilar records. Because of these military records, police crime-scene investigators have been able to gather fingerprint impressions from residences, cars, and personal effects and compare them to the fingerprint impressions from those victims whose identity they wish to confirm.<sup>4</sup>

Just like everyone has a unique doctilar fingerprint pattern, each person possesses a unique pattern of DNA sequences. Just a small amount of DNA is necessary to accurately identify a person. A technique called polymerase chain reaction (PCR) can create millions of copies of a single gene or any specific fragment of DNA. Following PCR, DNA fragments can be subjected to the procedure of DNA fingerprinting. In this process, DNA is treated with restriction enzymes, which result in a unique collection of different sized fragments.

Restriction fragment length polymorphisms (RFLPs) exist among individuals. By DNA gel electrophoresis, these DNA fragments are separated according to their lengths and the various RFLPs of individuals can be compared.<sup>7</sup> In this way DNA profiles obtained from cadaveric blood and tissue samples enable the reassociation of body fragments. In addition, the comparison of genetic markers in DNA collected at the crime scene to DNA isolated from the blood samples obtained from first degree relatives of the missing persons can lead to positive identification of a victim.<sup>4</sup> As a consequence of the various terrorist bombings in Israel in the last few years, it is obvious that a centralized data bank of DNA fingerprint profiles, as well as doctilar fingerprint patterns and dental records would greatly facilitate the identification of human remains. Therefore, it may be desirable to store blood samples which can be used to generate DNA profiles of the entire Israeli population.

Generally, Jewish courts are prepared to accept somewhat "unorthodox" evidence (i.e. beyond the biblical requirements of two Jewish adult male eyewitnesses) if they are convinced that the given information appears true and is necessary to arrive at a just

resolution of the situation. There is a judicial clause recognized by the Talmud that has a direct influence on the question of incorporating scientific findings into the halochic process. This device, known as "umdenoh," is defined as an assumption or a condition that is not verbalized but is viewed as an obvious principle that can be accepted as fact.<sup>1</sup> A clear understanding of this principle and its incorporation in a Beit Din can be achieved by examining the Rambam.<sup>2</sup> The Rambam states that "if facts are so well known that they are accepted by all, the judge can accept them as such; only when there is some doubt as to the true facts of the case, is the testimony of two witnesses essential." However, whenever two witnesses come before a judge, the judge should rule in accordance with their testimony, even if he is unsure about the validity of their statements.<sup>3</sup> As evident, these

halochic principles used today have their origin in the eternal Torah. The rabbis are now in the process of deciding if modern technology can be used and incorporated within the Torah principle of "umdenoh."

Rav Avraham Steinberg is of the opinion that Jewish law does not forbid genetic engineering. He emphasizes, "that science and technology per se are morally neutral; the only morally determining factor is their use." Furthermore, Rav Steinberg insists that, "genetic engineering is neither playing G-d nor interfering with nature in an unacceptable way." His reasoning is that genetic engineering "does not entail creating something from nothing." Finally, Rav Steinberg declares, "studying genetics is not only not a way of playing G-d, but a way of strengthening belief in G-d."<sup>4</sup>

In Bomidbar (18:3) it is written, "Tomim tiheyeh im Hashem Elokecho - You shall be wholehearted with the L-rd your G-d." This posuk teaches that, "There is a point beyond which one should not attempt to discern what lies in the future, a point beyond which one should not endeavor to prevent the unpreventable, a point at which we must recognize that we dare not be overly concerned and overly protective of ourselves and our progeny."<sup>5</sup> We must remember our obligation to formulate approaches that will continue to guide our nation in the ways of truth and justice. In this way we will hopefully be able to create conditions in which redemption will li'YH become a reality.

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# Noach and the Tayva

## Some Torah, Some Biology

Everyone is familiar with the story of Noach and the tayva. The intent of this article is not to review the entire incident in depth, but to focus on those aspects that have biological overtones. However, for continuity in thought, the entire story is briefly summarized. Furthermore, it is understood that

all the events in the story of the tayva were orchestrated and directed by HaShem. Any mention of a biological explanation for a specific event is not meant to suggest that it occurred by the laws of nature without Divine intervention. As Rabbi David Brown<sup>1</sup> states, "It is recognized that the laws of nature were created by G-d at ma'ase b'royshis and, in effect, represent His will. Even nissim are not completely contrary to the forces of nature. We find that when G-d performs nissim He still works through the mechanisms of nature."

In the year 1056 (2705 B.C.E.) (MeAm Loez, Genesis 7:4) a son was born to Lemech. This boy, named Noach, was unusual from birth. First, Noach was born circumcised (Torah Sheleimah 5:78). This

was the first such birth since the creation of Adam HaRishon. Second, this was the first baby to be born with clearly defined, separated fingers. Up until this period all people had hands with nonseparated (or, webbed) fingers. Noach, known as "the man of the earth," was born with hands suitable for husbandry and tilling the soil (Torah Sheleimah 5:79). He was credited as the inventor of farm tools, such as the plow, scythe, and axe (Torah Sheleimah 5:78). Interestingly, there is a present-day remembrance ("zechar") to the fact that antediluvian man had webbed hands. Today, during early human embryological development, every fetus has webbed fingers. By the process of programmed cell death, or apoptosis, lysosomal activity in the cells comprising the web

cause that tissue to gradually disappear, so that when born, the baby has distinct fingers.<sup>2</sup>

Noach was a righteous person, wholehearted in his generation (Genesis 6:9). In his time, civilization was steeped in sins including idolatry, theft, embezzlement, immorality, and in particular, bestiality. Animals mimicked human sexual misbehavior and interspecific cohabitation between animals was the norm. As noted in B'rayshis Rabbah (28:8) dogs would seek out she-wolves and peacocks would mate with hens. Most commentaries do not mention that such interspecific matings resulted in hybrid offspring. The N'tziv, however, does suggest that interspecific matings between animals resulted in hybrid offspring (HaEmek Davar, Genesis 7:23). Many pre- and post-zygotic isolation mechanisms hinder the formation of hybrid zygotes and it is rare in the animal kingdom that interspecific matings yield viable, strong hybrid offspring. The most notable exceptions are the mule (horse x donkey) and the zebroid (horse x zebra). But, owing to chro-

mosomal differences between the parents, mules and zebroids are sterile.<sup>3</sup>

At the age of 480, in the year 1536 (2225 B.C.E.), Noah was commanded to build a *toyva*. The *toyva* would serve as a refuge for Noah and his family, as well as for selected representatives amongst the animals during the subsequent *mabbul*. The *MeAm Loez* (Genesis 6:9) notes that the task of building the *toyva* took 120 years as, essentially, Noah started from scratch: he planted cedar trees, tended for them, cut them into boards, planed them, and finally constructed the *toyva*. The *toyva* was to house Noah, his wife, their three sons and their wives, and a male and female of each *min* of nonkosher animal and seven pairs of males and females of every kosher *min* of animal. The dimensions of the *toyva* were approximately 180 yards in length, 30 yards in width, and 18 yards in height. The obvious question is how all the animals were able to fit into this limited space. For example, there are over 800,000 species of insects, 35,000 species of spiders, 8,600 species of birds, 6,000 species of reptiles, and 2,200 species of frogs and toads.<sup>4</sup>

The *Ramban* (Genesis 6:19) is troubled by this problem, which is compounded when also considering the large size of specific mammals (such as elephants and giraffes). The *Ramban* concludes that fitting the animals into the *toyva* was itself a miracle.

*Rebbe* Brown<sup>5</sup> has a different and unique theory regarding the numbers of animals brought aboard the *toyva*. Before explaining *Rebbe* Brown's theory, some initial background information is needed. First, whereas a zoologist classifies animals according to phyla, the Torah's classification is simply *behaymos*, *choios*, *shrotzim*, and *dagim*.

There is no correlation between the zoologists' classification and the Torah's classification of animals. For example, the Torah's category *shrotzim* includes insects, reptiles, and some mammals (e.g., weasel and mouse). According to a zoologist, these animals are categorized in three different phyla. Second, the zoologists' terms, genus and species, have no equivalent in Torah terminology. Instead, the Torah uses the term *min* to identify discrete groups of animals. At *mo'ase* B'rayshis *HoShem* created distinct *minim*, which, after relatively short time periods, diversified to yield different genera and species. *Rebbe* Brown postulates that Noah took aboard the *toyva* two animals of each *min*, rather than all the varieties that developed from each *min* since *mo'ase* B'rayshis. This interpretation fits very well with the verses: "Of all living creatures, of all flesh, two of each you shall bring to the *toyva* to keep alive with you, a male and a female. Of the birds to their *minim*, of the beasts to their *minim*, of all the creepers on the ground to their *minim*, two of each will come to you to maintain life." Based on this interpretation, the number of creatures brought on the *toyva* is greatly reduced. *Rebbe* Brown cites the *sefer*, *Biur HoRadol*, on *Pirkoy d'Robbi Eliezer* which states that there are 365 *minim* of birds, 365 *behaymos* and *choios*, and 365 *minim* of *sh'kotzim*. Apparently, these specific *minim* contained all the necessary genetic information, so that postdiluvian diversification yielded the different genera and species of animals recognized by today's zoologists.

In this *parsha* there is some discussion amongst the commentaries of fossils and of dinosaurs and other giant creatures. One thought, championed by the *Tiferes Yisroel* (in his *sefer*, *Drush*

*Ohr HoChayim*), is that dinosaurs, as well as the other fossilized animals, were not creatures from our world, but lived in some of the prior 974 generations created on this planet. *Rebbe* Brown<sup>6</sup> interprets these "974 generations" as "974 distinct worlds;" this interpretation will be followed throughout this article. These prior worlds were literally and figuratively overturned because of the refusal of their intelligent life forms to accept the Torah. Creatures on any of these prior 974 worlds were distinct and unique and were not descendants from creatures of any other world.<sup>7</sup>

The *N'tziv* and the *Malbim*, however, suggest that dinosaurs were contemporaries of Noah. According to the *N'tziv*, the dinosaurs were the hybrid offspring of interspecies matings, similar to mules (horse x donkey). As these creatures arose from forbidden sexual relationships, they were destroyed in the *mabbul* (*HoEmek Dovor*, Genesis 7:23). The *Malbim* does not mention that dinosaurs and other large creatures resulted from forbidden matings between species, but rather that they were part of the natural fauna in a world that had rich topsoil and an overabundance of food and solar energy (Genesis 7:23; 8:21). To quote from the *Malbim* (Genesis 8:21): "The ground was then still in the days of its youth, very potent and providing for great longevity. It caused creatures to arise that were imbued with immense body strength, powerful and of giant stature. And today, deep within the earth, are being uncovered giant skeletons of these strange colossi who perished during the *mabbul*, leaving no survivors. Creatures that lived for a long time and who, our Sages tell us, could uproot cedars. In comparison with them, lions



and leopards were as small as ants." In ecological terms, the dinosaurs were a natural reflection of the high carrying capacity of the antediluvian environment. An environment can support no more than a certain number of individuals of any particular species. This number, termed the environmental carrying capacity, is determined by the availability of resources – food, energy, shelter – as well as disease, predators, and social interactions.<sup>5</sup> In the antediluvian period, soil productivity and solar energy were in over-abundance and, thus, the environment was capable of sustaining dinosaurs. In the postdiluvian period, HaShem weakened nature by changing the atmosphere, by decreasing the solar radiation which, in turn, reduced primary productivity (i.e., lessened photosynthesis), and by removing the top soil (hence, reducing soil productivity). According to this approach, the dinosaurs were destroyed, not as a result of their being hybrid offspring, but of their being a life form that could no longer be sustained in the new post-mabbul environment.

According to the Tiferes Yisroel's thoughts concerning dinosaurs, radiocarbon dating of their skeletal remains at an age much earlier than the 5,761 years since ma'ase B'rayshis is not problematic. In fact, it is supportive of the 974 worlds that were created prior to our world.<sup>6</sup> An obvious problem exists with the theories of the N'tziv and Malbim, who suggest that dinosaurs were contemporaries of Noah. The most commonly used test to date organic matter is based on the ratio of radioactive carbon 14 (C14) to non-radioactive carbon 12 (C12). This technique assumes that the ratio of C14 to C12 is constant and has not changed over the period for which any particular

object is being dated. C14 is unstable and disintegrates slowly, with a half-life of 5730 years. It is formed in the outer atmosphere surrounding the Earth through nuclear reactions utilizing energy from cosmic radiation. Apparently, cosmic rays form energetic neutrons, which react with nitrogen 14 (N14) in the atmosphere to form C14, which then reacts with oxygen to form carbon dioxide. Most of the carbon dioxide in the biosphere consists of nonradioactive carbon (C12); the total amount of C14 in carbon dioxide is small (less than 1%) compared to C12. Radioactive carbon dioxide along with nonradioactive carbon dioxide distributes itself throughout the Earth's atmosphere and eventually is absorbed by living plants and animals. When an organism dies, it no longer takes in carbon dioxide. Thus, by measuring the amount of C14 relative to the amount of C12 in a formerly living organism, and knowing the decay rate of C14, it is possible to extrapolate back in time, and calculate how many years ago this particular organism lived. Radioactive dating assumes that the intensity of cosmic radiation striking the Earth is uniform all over the Earth and at all times.<sup>7</sup> According to the Malbim and the S'forno, today's radiation strikes the Earth at a different angle from radiation during the antediluvian period. As noted in Genesis [8:22], when HaShem assures Noah that the world will never be destroyed again, it states: "As long as the Earth endures, seedtime and harvest, cold and heat, summer and winter, day and night, they shall not cease."<sup>8</sup> Most commentaries interpret this to mean that prior to the mabbul the Earth was in continual springtime (B'rayshis Rabboh 34: 11); the changes in seasons were a postdiluvian innovation. The four seasons or a

result of the 23° tilt of the Earth as it revolves around the sun. As noted by the Malbim (Genesis 8:22), prior to the mabbul the Earth's ecliptic revolution around the sun was coplanar with the terrestrial equator. Thus, in the antediluvian period the amount of radiation striking the Earth was not similar to that of today's world. Furthermore, many commentaries note other major changes in cosmology immediately before, during and after the mabbul (Midrash Rabboh 34:11; Berachos 59a), Rabbi Brown<sup>9</sup> expands (see pages 146 to 149 in his sefer) the Malbim's theory and lists the many different time periods since ma'ase B'rayshis when the amount of cosmic radiation striking the Earth was modified. The C14 test is reliable to date organic matter if one makes the assumption that the amount of radiation the Earth received in the past was identical to the amount of radiation the Earth receives today. However, if one acknowledges the various cosmological changes noted by Chozal and if these modifications in the relationship of our Earth to the universe resulted in changes in the intensity of cosmic radiation striking the Earth's atmosphere, then the utility of radioisotope techniques to date fossils of dinosaurs is questionable.

The toyva had three floors; the top level in which Noah, his family, and selected animals (i.e., kosher domesticated birds) dwelled; the middle level in which the other animals were housed; and a basement level which functioned as a repository for waste, primarily animal excreta. Noah built a trapdoor in the second level, through which he shoveled the excreta to the third level (B'rayshis Rabboh 31:11). An obvious question is why Noah needed to keep the animal excreta aboard the toyva,

especially since it must have generated a strong odor! Why could not the third level have a built-in trap door to be used as an exit passageway for removal of the foul-smelling excreta? Apparently, keeping the animal refuse must have served a purpose. There are several possible answers. First, Noach, by profession, was a farmer and he understood the dynamics of plant life. Animals play a key role in the dispersal of seeds from many varieties of plants. For example, fleshy fruits, such as berries, provide food for mammals and birds; their seeds travel safely through the animal's digestive tract, being deposited in environments usually some distance from the parent plant. Perhaps, the excreta of the animals were saved as it was a vast reservoir for spores and seeds needed to replenish the vegetation in the post-mabbul world. Second, as a farmer, Noach understood the connection between soil fertility and crop production. The mabbul that HaShem brought not only eradicated all terrestrial life but also ruined the top layer of the earth. Rashi comments on Genesis 6:13, HaShem said, "I will destroy them with the land," for the topsoil to the depth of one foot was washed away. Noach may have wanted to save the animal excreta to use as fertilizer. Third, animal excreta is teeming with various microbiota - bacteria, fungi and yeasts, protozoa - and other simple life forms needed for maintaining the ecology of terrestrial and aquatic ecosystems. As these simpler life forms do not exist as male and female, but rather as asexual forms that reproduce by such mechanisms as binary fission, Noach would not have been commanded to take them into the tayvo (i.e., only a male and female of each "min" was taken into the tayvo). The Meshech Chochmah notes

that life forms which do not reproduce sexually were not brought aboard the tayvo. Fourth, the excreta may have been used to create the proper habitat for some of the simpler creatures. For example, decaying organic matter when mixed with soil is a suitable environment for some invertebrates, such as earthworms.

Before Noach, his family, and the animals entered the tayvo, Noach was commanded to stock the tayvo with food provisions, both for the humans and animals. "And as for you, take yourself of every food that is eaten and gather it in to yourself, that it shall be as food for you and them" (Genesis 6:21). Thus, Noach took branches for the elephants and hazubah (a shrubby plant) for the deer, as well as all kinds of seeds and shoots of the vine, fig, and olive for future planting (B'rayshis Rabboh 31:14). An obvious question is: What food did Noach take for the carnivores? Since Noach did not store meat for these animals, on what did they subsist during the 12 months aboard the tayvo? The Ibn Ezra suggests that when faced with a lack of meat, even carnivores - in order to survive - will eat specially prepared vegetarian foods. Although this appears unusual, a visit to a local pet food supply store revealed that one company, Nature's Recipe Company (Newport, KY), manufactures a special vegetarian formula product for dogs who are allergic to meat and meat-byproducts. Apparently, vegetarian food when "packaged properly" can fool carnivores into thinking they are eating meat.

The week before the start of the mabbul Noach took his family, the necessary provisions, the seven pairs of kosher domesticated animals and the one pair of domesticated nonkosher animals

onto the tayvo. At midday of the 17th of Cheshvan, 1656 (equivalent to October 27, 2106 B.C.E.) the mabbul commenced. On that day, the pairs of nonkosher wild animals entered into the tayvo. Only those animals that did not mate outside their min were able to board (MeAm Loez, Genesis 7:7-11; Malbim, Genesis 7:9). Once the provisions, animals, and human families were settled on the tayvo, responsibilities were assigned. Noach cared for the wild animals, Shem for the domesticated animals, Cham for the birds, and Yefes for the reptiles. Care for the other animals was equally shared. On the tayvo the animals retained their natural inclinations, food preferences, and behavioral patterns. An interesting conversation was recorded between Shem and Eliezer, Avraham's servant. Apparently, when they met years of later the mabbul, Eliezer questioned Shem about life aboard the tayvo. Shem replied that it was very hard and that during all 12 months in the tayvo the four men never got to close their eyes; the nocturnal animals required feeding at night, the diurnal animals during the daylight hours, and the crepuscular animals at dawn and nightfall. Shem also noted that the wild animals retained their ferociousness, which was exacerbated by the lack of meat. To calm these animals, HaShem produced a type of radiation, which both dulled the animals' cravings for meat and tranquilized them (MeAm Loez, Genesis 7:24). This tranquilization of the wild animals may be a form of tonic immobility (commonly termed animal hypnosis). Tonic immobility is a state of profound, but reversible, physical immobility and muscle hypertonicity and is characterized by the animal's lack of responsiveness to external stimuli. This general condition

of motor inhibition, or paralysis, may be associated with a cationic-like flexibility. Although there are many theories attempting to explain this phenomenon, the most popular idea is that tonic immobility represents an innate fear response prompted by adverse environmental events.<sup>8</sup> Radiation, or light waves, was used to tranquilize the animals and subdue their cravings for meat. Colored light of different wavelengths has the ability to mediate the functioning of the autonomic nervous system, which in turn regulates breathing, the heart rate, the functioning of the digestive tract, and the stress response.<sup>9</sup>

In addition to the rain, thermal fountains of the Great Deep opened, heating the floodwaters to boiling. Rabbi Avigdor Miller, (cited in Sanhedrin 108b, Artscroll edition), suggests that, in addition, volcanoes scattered around the globe also erupted and expelled molten lava. The opening of the underground hot springs, coupled with the molten lava, caused the water on the land to reach lethal temperatures. "Everything on dry land died" (Genesis 7:22). As the fish and other sea creatures did not mate outside their species, they were not included in the decree of destruction. To escape the elevated water temperatures, the fish escaped to the depths of the seas, where the waters remained cool (Ramban, Genesis 7:23). The rains lasted for 40 days and nights until the 28th of Kislev (December 8th) (MeAm Loez, Genesis 7:23-24), at which time torrents of floodwaters began and lasted for 150 days until the 29th of Iyar (MeAm Loez, Genesis 8:14). The intense heat generated from the thermal springs and the lava pouring from volcanoes increased both the turbulence

and volume of the waters.<sup>11</sup> That heat increases the turbulence of water is obvious from everyday cooking activities in the kitchen. What about the influence of heat on the volume of water? In both the solid (ice) and liquid (aqueous) states, water molecules are hydrogen bonded to each other. Heat energy influences the length of these attractive forces (i.e., the hydrogen bonds) that connect neighboring water molecules to each other. Aqueous water is most dense at 4°C. Increasing the temperature puts a stress on the hydrogen bonds causing them to lengthen or stretch, thereby increasing the volume of the water. When the temperature reaches 100°C, the stress is so great that the hydrogen bonds break liberating individual water molecules into the gaseous phase. The extreme heat generated from the thermal springs and volcanic eruptions supplied the heat energy that increased the turbulence and volume of the waters. During this time the floodwaters lifted the toyvo from the earth and, like any buoyant object, the toyvo floated.

The humans and animals remained on the toyvo for one full year. An interesting debate among the commentaries focuses on the invertebrates whose life span may be less than one year. For example, the life cycle of the fruit fly, *Drosophila melanogaster*, is from 12-14 days, with the adults surviving only several months. Based on Genesis 6:18, "But I will establish My covenant with you, and you shall enter the toyvo - you, your sons, your wife and your sons' wives with you," the Chasom Sofer suggests that HaShem promised that those that enter the toyvo will be the same that leave the toyvo. Thus, the pair of invertebrates that entered the toyvo was the same pair that left the toyvo one

year later. According to this opinion, animals did not die aboard the toyvo and a special miracle was required to increase the life span of the invertebrates. Conversely, there is the opinion (Robbi Y. P'ik) that animals did die aboard the toyvo. The adult invertebrates that entered the toyvo produced offspring, the adults died within the year, and it was their offspring that left the toyvo. Genesis 8:19 states: "Every living being, every creeping thing, every bird, everything that moves on earth, come out of the toyvo by their families." Thus, according to the last opinion, with regard to the invertebrates, the "family" (i.e., the pair) that entered was not necessarily the pair that left the toyvo (Sanhedrin 108b, Artscroll edition).

The floodwaters began to recede and on the 10th of Elul Noach sent the raven from the toyvo. Noach knew that in the short time since the mabbul ended no trees or vegetation could have sprouted on the mountaintops. Thus, rather than sending out a herbivore, Noach selected an omnivore that could survive on the dead carcasses presumably washed atop mountains.<sup>12</sup> Ravens eat anything. Their usual diet contains insects, seeds, berries, the eggs and young of other birds, occasionally small rodents, and carrion (the bodies of animals killed by creatures other than the raven). Legend has it that a raven's favorite food is the body of a dead man or of other dead animals and that a raven will go for the eyes of such a fallen creature. There may be a certain amount of truth in this legend as ravens do have a certain fondness for eating flesh. Dead bodies, however, take some time to decompose before birds, such as ravens, can easily tear the meat from the carcass. By going for softer tissues, like eyes, these

birds are more likely to get a quick meal.<sup>13</sup> Indeed, the raven released by Noah found a human corpse and began to devour it (MeAm Loez, Genesis 8:6-7). The raven returned and seven days later Noah sent out the dove. The commentaries suggest that Noah selected a dove because it would return to bond with its mate for life. There are various species of doves, the rock dove (*Columba livia*), the inca dove (*Columbina inca*), the common ground dove (*Columbina passerina*), the whitewinged dove (*Zenaidura macroura*), and the mourning dove (*Zenaidura macroura*),<sup>14</sup> and it is difficult to ascertain the specific species sent from the *toyva*. Dr. Y. Feliks<sup>15</sup> presents some insight into the behavior of doves and perhaps provides a clue to aid in determining the specific species of dove sent by Noah. He notes that it is usual to regard the family life of doves as being symbolic of loyalty and devotion. This is expressed in Erubin (100b), "If the Torah had not been given we would have learned conjugal chastity from the dove" and Rashi comments: "Because they do not cohabit except with their own mates." Feliks notes that this conjugal fidelity among doves is true of the wild doves, such as the dove of the rock, but not as regards the domestic dove, where conjugal life is not so exemplary. The dove returned, Noah waited another seven days, and the dove was sent out again. This time the dove returned with an olive branch. Doves eat seeds of weeds (e.g., croton, foxtail, smartweed, and ragweed) and of grasses and grains (e.g., corn, wheat, oats, barley, rye, and buckwheat) left on the ground after harvesting, and a few insects, snails, and slugs. Branches are not on the menu of the dove. However, a dove's nest is built of sticks.<sup>14</sup>

Thus, possibly, by carrying a branch the dove was indicating to Noah that the earth was once again inhabitable, as it was now preparing to build a nest. On the first of Tishrei the dove was sent out a third time but did not return, as the water was gone and the Earth was beginning to dry. By the 27th of Cheshvan, the Earth was completely dry (MeAm Loez, Genesis: 8:14).

The animals and humans left the *toyva*. The animals were commanded by HaShem to live "by their families," which has been interpreted to imply that the omnivores and herbivores initially lived separately, thereby allowing the animal kingdom to be repopulated. After one year, however, predator-prey relationships resumed.<sup>12</sup> The world that Noah and his family reentered was not the same world that they left (Genesis 8:22). Air quality was reduced, soil productivity lessened, and weather was altered from continual springtime to four distinct seasons (Sforno, Genesis 6:13; 8:22; Malbim, Genesis 8:22). The Earth was desolate; all trees and plant life were destroyed (Malbim, Genesis 9:1-3). Noah had a passion for agriculture and his initial task was to sow and plant. Hence, he gained the title "man of the earth" (Ramban, Genesis 9:20).

"The three sons of Noah who emerged from the *toyva* were Shem, Cham, and Yefes, and the descendants of these spread over the whole earth" (Genesis 9:18, 19). The human beings that leave the *toyva* are destined to be the progenitors of the human populations that subsequently fill the world. All the different races of human beings, therefore, trace their ancestry to these eight people. According to Jewish tradition, Cham and his wife are the forerunners of the dark-skinned races (B'royshis Rabbah 34:7). Current scientific thought

is that human skin color is a polygenic trait, controlled by between three and six gene pairs. Data are most consistent with a model for human skin color that involves three or four gene pairs. Polygenes control traits that vary continuously, with each gene having a small, but additive, effect on the overall phenotype. Assume that each gene pair consists of a dominant form (P) that controls the synthesis of a certain amount of pigment and of a recessive allelic form (p) that does not allow for pigment synthesis. The intensity of the skin coloration of an individual is a function of the number of P alleles in the genotype. For example, let's assume that human skin color is under the control of four pairs of polygenes. Then an individual with the genotype P1p1P2p2P3p3P4p4 would have darker skin coloration than a person with genotype P1p1P2p2P3p3P4p4. These skin color-determining polygenes are, most probably, on different pairs of homologous chromosomes, so that they segregate independently from each other during gametogenesis. Matings between two tetrahybrids (i.e., P1p1P2p2P3p3P4p4) theoretically could produce offspring ranging from albino (p1p1p2p2p3p3p4) to extremely dark-skinned children (P1P1P2P2P3P3P4P4).<sup>16</sup> Thus, if Cham and his wife were olive-skinned tetrahybrids for the genes that determine skin color, there is a 1/256 (0.4%) chance that a child would be born with the phenotype of extremely dark skin. This does not imply that Cham's descendants were only the dark-skinned races, as when two such tetrahybrids mate, the entire spectrum of skin color shades in their offspring is possible, with the distribution fitting a bell-shaped curve.

The human, animal, and plant populations that left the *toyva* produced

progeny, and the progeny produced progeny, subsequently scattering into various environments and occupying unique niches. Recent studies on the importance of the local environment in shaping how organisms change through time indicate that such changes occur more rapidly than previously thought. Studies with the European fruit fly and the stickleback fish have shown "that natural selection can cause a population to change very quickly and hint that speciation could [occur] very quickly."<sup>17</sup> Apparently, by the process of nat-

ural selection, the specific minim biodiversified – at a relatively rapid rate – to yield different genera and species. This biodiversity was hastened by separation of the continents, according to the principles of plate tectonics. These continental movements occurred at the time of the builders of the Tower.<sup>18</sup> Hints of this are noted in the Targum Yonasson's translation of Chavakuk 3:6: "[HaShem] appeared and shook the Earth and brought a mobbul on the people of the generation who dis-

obeyed Him. Also in a later instance when mankind sinned, He mixed the peoples and dismantled the ancient mountains." The many changes in the Earth and in mankind subsequent to the mobbul are most interesting. The reader is directed to the sefer by Rabbi David Brown,<sup>1</sup> in which these events are explained according to the Pirkey d'Rabbi Eliezer.

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