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Derech HaTeva

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■ Dedication ■

We dedicate this year's Derech HaTeva journal in memory of Dr. Michael Applebaum whose life was taken in a terrorist attack in Jerusalem on September 9, 2003.

Dr. Applebaum, a father of six, the director of the Shaare Zedek Medical Center's Department of Emergency Medicine, founder of the Terem Emergency Clinic in Jerusalem, and teacher at Midreshet Moriah Seminary for Women, was mourned by millions. His medical expertise combined with Torah values benefitted both Jewish and secular communities worldwide.

■ Thank You ■

We would like to extend our gratitude to the Office of the Dean and to the Ivan Tillem fund for their generous support.

We would like to thank Dr. Harvey Babich for his time, patience, and enthusiasm that helped to make this journal a success.



“ובטובו מחדש בכל יום תמיד מעשה בראשית”



“And in His goodness G-d renews
daily, perpetually, the work of creation.”

(Siddur)

■ Table of Contents ■

A MODERN AILMENT?	9	Diana Benmergui
COMMUNICATION DISORDERS IN TANACH AND IN JUDAISM	12	Sarah Epstein
THE MENTALLY ILL IN HALACHA	15	Tamar Epstein
JEWISH WOMEN, TAHARAT HAMISHPACHAH AND PERSONAL HEALTH	17	Frida Fridman
PAIN: A MULTI-SENSORY EXPERIENCE	20	Tova Gavrilova
THE ANTHROPIC PRINCIPLE	23	Ariella Goldstein
A QUESTION OF THE HEART	26	Yael Grunseid
BIOTECHNOLOGY AND THE JEWISH IMPERATIVE: TO HEAL AND TO CREATE	29	Adina Katzman
NOAH AND THE DINOSAURS? SOME SCIENTIFIC THEORIES ON THE FLOOD	34	Malkie Krupka
DIVINE DENTISTRY	39	Diane Liebman
ANTHRAX IN BIBLICAL EGYPT	42	Dana Lotan
SEIZE THE MOMENT: OCCURANCES OF SEIZURES IN BIBLICAL AND TALMUDIC TIMES	45	Eliza Moskowitz
THE IMPORTANCE OF SLEEP	51	Helen A. Nissim
THE VACCINATION TIGHTROPE	55	Leyna Pressman
THE MADNESS OF KING SAUL	59	Avigayil Rosen
MIDWIFERY: ADVANCEMENT OF PRESENT-DAY PRACTICE AND PUBLIC PERSPECTIVE	65	Aviva Shafner
STEM CELLS: A HALACHIC PERSPECTIVE	68	Rachel Thaler
THIRSTY FOR TORAH; THIRSTY FOR WATER	72	Dr. H. Babich

A Modern Ailment?

Diana Benmergui

The Talmud (Abodah Zarah 28a) discusses criteria allowing one to violate the Sabbath to treat an illness. An important criterion is the nature of the illness, whether it is internal or external. In the times of the Talmud, an internal illness, usually involving some soft part of the body, was considered more dangerous and therefore may be treated even on the Sabbath. In light of this distinction, the Talmud questions whether an illness to teeth would be categorized as an internal illness and therefore treatable on the Sabbath. Perhaps, since teeth are hard, for such an illness one could not violate the Sabbath. To resolve this quandary, the Talmud relates that Rabbi Yochanan suffered from *tzafdinah*, a disease in the area of his teeth, and was willing to treat himself on the Sabbath. Although this indicates that an illness with teeth is considered an internal illness, the Talmud rejects this proof, stating that *tzafdinah* is different than other teeth ailments as that it starts in the mouth but progresses to the intestines, an internal disease.

What is this disease called *tzafdinah*? Rach (Rabbeinu Chananel), in his commentary on Yoma 84a, explains *tzafdinah* as pain in the teeth. Similarly, Rashi (Rabbi Shlomo ben Yitzchak) understands the disease to affect the area of the teeth and identifies it as "*misgue*" [1], which refers to the modern "*muguet*," French for thrush [2]. The difficulty with this interpretation is that the modern medical description of thrush does not correspond to the Talmud's description of *tzafdinah*. The Talmud mentions that bleeding gums caused by eating is the most common symptom of *tzafdinah*. Furthermore, as mentioned earlier, *tzafdinah* eventually spreads to the intestines. With regards to its etiology, the Talmud implicates eating very cold wheat foods, very hot barley foods, and the remnants of fish hash and flour. Finally, the Talmud cites three possible remedies. The first consists of yeast water, olive oil and salt; the sec-

ond, yeast itself, olive oil and salt; and the third, geese fat smeared with a goose feather. One scholar, who reported that none of those remedies were effective, instead recommended taking the pits from olives which are one-third unripe, burning them in fire on a new rake, and applying the ashes to the area of the disease.

In contrast to the Talmud's descriptions of *tzafdinah*, modern medicine describes the disease of thrush quite differently. Thrush is a fungal infection of the mouth caused by an overgrowth of the yeast, *Candida albicans*. Microorganisms are normal inhabitants of the human body, both on its external surfaces and internally. The human microbiota serve various functions, including stimulation of the immune system, synthesis of essential vitamins, and protection against harmful viruses and pathogenic bacteria. While some bacteria are essential to human health, others cause disease. Our immune system maintains the proper balance between those microbes that are beneficial and those that are detrimental to human health. When the immune system is weakened by illness, stress, drugs, such as prednisone or other corticosteroids, and immunosuppressive medications, this delicate balance is disturbed and could lead to overgrowth of deleterious microbes, such as *C. albicans* [1], the causative agent of oral thrush [3]. The infection causes creamy, white lesions to form, usually on the tongue and inside of the cheeks, but may spread to the palate, gums, tonsils and throat. [4]. Oral thrush may affect anyone but it is most common among infants and toddlers [5]. Thrush is treated with antifungal medications including, nystatin, clotrimazole, miconazole, and gentin violet [6]. Thus, oral thrush does not correspond to the Talmud's description of *tzafdinah*. Aside from discrepancies in its causes and treatments, the primary symptom of bleeding gums is not a major symptom of thrush. Furthermore, since thrush is mostly found in infants and

toddlers, it is unlikely that Rabbi Yochanan would have suffered from this ailment.

In light of this disparity, modern translations of the Talmud identify a disease more similar to *tzafdinah*, known as scurvy [7]. Scurvy is a disease more popularly dated back to the 1700's, but as this article suggests, may have existed as early as the times of the Talmud, about twelve centuries before its accepted discovery [8]. Scurvy is a condition caused by a lack of vitamin C [9]. Vitamin C allows for hydroxylation of the amino acids, proline and lysine, in collagen, which is a cementing protein essential for connective tissue, tendons, ligaments, bones, cartilage, and dentin, the major portion of teeth. When the body lacks vitamin C, the hypohydroxylation of proline and lysine results in a lower melting temperature of the collagen fibers, causing breakdown of the protein which reduces the levels of collagen in the body. When the capillaries lose the "glue" that holds them together, their walls break down and hemorrhaging occurs in cells throughout the body. The effects of this malfunction in the body lead to the various symptoms of scurvy [10]. Initial symptoms of scurvy include fatigue, progressive bodily weakness, and swollen and tender joints [11]. Prolonged vitamin C deficiency eventually leads to spongy and inflamed gums, which bleed easily, making scurvy known as a "bleeding disease" [11]. Scurvy is easily treated by vitamin C intake through the consumption of citrus fruits, such as oranges, lemons, limes and grapefruits, and fresh vegetables. The severity of the case dictates how much vitamin C is needed [13]. Thus, it appears that although the primary symptom of scurvy is bleeding of the gums, since the causes of and remedies for scurvy do not correspond to those of *tzafdinah*, the similarity between the Talmud's description of *tzafdinah* and the modern description of scurvy remains weak.

Whether the Talmud's *tzafdinah* is thrush, scurvy, or some other disease involving teeth may lead to a practical difference in Jewish law, or Halakhah. As mentioned earlier, the Talmud considers internal illnesses to be more serious than other illnesses. Based on the Talmud, both the Tur

(Orah Hayyim, 328:3,5) and the Shulhan Aruk (Orah Hayyim, 328:3-5), formulated the following Halakhah: to treat an internal illness, starting from the teeth and inwards, one may violate the Sabbath even without being told to do so by an expert or the sick person. However, to treat an illness that is not internal, one must first be told that the treatment is necessary from either a doctor or from the sick person. Although the Talmud was unsure of whether illness to teeth should be categorized as internal or not, the formulated law does consider it as such. The Rosh (Rabbeinu Asher ben Yechiel), in his commentary to Abodah Zarah (2:8),

explains that since the Talmud was unable to find any evidence to resolve its dilemma, the rabbis applied the principle of "*safek nefashot l'hakel*," meaning that we are lenient regarding a doubt of life. Thus, the Halakhah allows one to violate the Sabbath to treat an illness to teeth like any other internal illness. Seemingly, there is no practical difference between *tzafdinah* and any other tooth disease. Indeed, the Magen Avraham, in his glosses to the Shulhan Aruk (Orah Hayyim, 328:2) writes that the Halakhah

applies to *tzafdinah* or any other illness to teeth equally. However, the *Pri Megaddim*, in his comments to the *Magen Avraham* [14], points out an exception to the regular Halakhah with regards to *tzafdinah*. For other teeth diseases, if a doctor or the sick person specifically says that treatment is unnecessary on the Sabbath, we listen. However, if one is suffering from *tzafdinah*, we ignore any recommendations to withhold treatment. The *Pri Megaddim* explains that this exception stems from the rabbinic tradition that *tzafdinah* is a fatal disease which must always be treated. In light of this distinction between *tzafdinah* and other teeth ailments, it becomes crucial to determine which modern medical disease corresponds to *tzafdinah*. However, since we cannot sufficiently correlate any modern disease to the descriptions of the Talmud, it seems that we cannot apply this exception to any contemporary teeth disease.

In-depth analysis of two periodontal diseases through the Talmud and practical Halakhah testifies to an apparent relationship between science and Halakhah. What may seem to

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be a novel discovery today is likely to have been discussed several generations earlier, either under a name we no longer use for the modern version or through ancient principles which apply to all

aspects of our daily lives. Therefore, it is not surprising to find contemporary diseases discussed within our longstanding Talmud. ■

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Communication Disorders in Tanach and in Judaism

Sarah Epstein

When G-d reveals Himself to Moshe through the burning bush, G-d commands Moshe to go to Pharaoh and tell him to free the enslaved Jewish people. Perhaps Moshe's most heavily discussed expression of hesitancy is when he says, (Exodus 4:10) "Please, my Lord, I am not a man of words, not since yesterday nor since the day before yesterday, nor since You first spoke to Your servant, for I am heavy of mouth and heavy of speech." The verses imply that Moshe had a communication disorder. This theory is supported by numerous incidents throughout Moshe's life where he acted out through non-verbal means, rather than verbally expressing his frustration. For example, *Chumash* relates a story of Moshe witnessing an Egyptian beating a Jewish slave and Moshe responding by killing the Egyptian. Moshe's temperament is further seen when he sees the Jews worshipping the golden calf and responds by smashing the tablets, as well as when he becomes angry with the Jewish people and hits, rather than speaks to, the rock as G-d commanded him. As a result, Moshe is told that he will not be leading the Jewish nation into the Land of Israel [1].

The exact nature of Moshe's communication disorder has sparked much debate among scholars in both Rabbinic and modern times. Perhaps the best-known explanation appears in the *Shmot Rabbah* (1:26), which relates a story of how Moshe tried on Pharaoh's crown, an action that was perceived to symbolize that Moshe would overthrow Pharaoh. To determine if Moshe should be put to death, Pharaoh devised a test. He put two bowls in front of Moshe, one holding his crown and the other holding hot coals. If Moshe would take the crown, he would be killed, but if he took the hot coals he would be availed of any suspicion. Moshe grabbed the burning coals and put them in his mouth, causing his tongue, and possibly other parts of his

mouth, to be burned, resulting in permanent speech impediments.

Another view of Moshe's communication disorder focuses on his description of being both *kvad peh* (heavy of mouth) and *kvad lashon* (heavy of lips). When used elsewhere in the *Tanach*, the word "*peh*" is always used in reference to the physical mouth, while the word "*lashon*" is used for language. Moshe's reference to being heavy of mouth implies that he may have had a physical deformity. Moreover, Moshe refers to his lips as being uncircumcised. Throughout the Torah, the lack of circumcision is referred to as a physical defect. Furthermore, Moshe's mother, Yocheved, "looked at him and saw that he was good" (Exodus 2:2) and subsequently hid him for three months. Usually, when the Torah tells of a child being born, it does not say that the mother looked him over. Why are we told that she hid him, despite seeing that he was good? Perhaps Yocheved hid him because of some physical defect, but she looked at him and knew he was worth saving. Uncircumcised lips could be referring to a congenital disorder known as cleft lip, which is accompanied by a cleft palate in two thirds of cases [2]. This condition is the fourth most frequent major birth defect, according to the American Cleft Palate-Craniofacial Association. This defect is more common in males, except for the presence of only a cleft palate which occurs equally in both genders. Cleft lip and/or palate occur when the palatine processes do not fuse properly to form the palate, which separates the oral and nasal cavities (this process takes place *in utero* during the first trimester). When this physical abnormality exists, the person is not able to pronounce certain sounds correctly due to a lack of intraoral pressure [3]. If Moshe in fact had a cleft lip, he would have been disqualified from serving as a *Kohain*, therefore causing the status to be granted to the family of his brother, Aharon [2].

Moshe was not the only prophet to have a speech disorder. When Moshe said that he is "heavy of tongue," he could be referring to a stutter. *Me'am Loez* comments on Amos 1:1 that, "According to the sages, he was called Amos because he was 'heavy laden' in speech. He found speaking difficult." The *Midrash Rabbah* on *Kohelet* (1:2) discusses how *Kohelet* received its name, and digresses to discuss meanings of other biblical names, stating that Amos was called so because he was "*Amus bilshono*," which is translated as heavy of tongue. Another disorder that makes speech difficult is stuttering, which is also known as dysfluency, and is characterized by a speaker repeating syllables or words while trying to produce speech. Dysfluency appears more in males than females by a ratio of three to one and usually surfaces between the ages of two and seven [5]. While an etiology for stuttering has not been isolated, biological, psychological, and environmental factors have all been suggested as contributing to dysfluency. Many say that Moshe had a stutter, which may have resulted from the story relayed in the *Midrash* [4]. People who stutter often fear situations in which they are forced to speak; therefore, Moshe having a stutter would go along with his resistance in terms of speaking to Pharaoh.

Another place in *Tanach* where one can find a communication disorder is in *Sefer Shoftim*. Shortly after Yiftach *HaGiladi* defeated the nation of Amon, he became involved in a dispute with the tribe of Ephraim. As a result, Yiftach assembled the Gileadites and waged a civil war on the Ephratites. Further, Yiftach advised the Gileadites to ask anyone who attempted to cross the Jordan River to say a code word, "*shibolet*." If the person mispronounced the code word as "*sibolet*," the Gileadites would know that this individual was from the tribe of Ephraim and would then kill him (Judges 12:1-6). Apparently, a speech disorder prevented members of this tribe from pronouncing the "sh" sound, which is a postalveolar fricative. In other words, the "sh" sound is created by the blade of the tongue approximating the postalveolar ridge area, creating a narrow constriction through which the air stream must pass. If some physical abnormality exists then the sound will not be produced properly. This kind of speech disorder is referred to as a phonological disorder, where the speaker has difficulty producing certain phonemes, the most basic units of sound [3]. The *Tanach* records that as a result of this speech defect, 42,000 people from the tribe of

Ephraim were killed (Judges 12:6). That a certain speech defect was known to be present in members of the tribe of Ephraim parallels the belief that certain communication disorders are hereditary.

Further references to impaired communication appear in the Rabbinic literature. The third Mishna in the first chapter of *Masechet Eduyot* relates the dispute of how much drawn water renders a *mikva* (ritual bath) unusable. Hillel says "a full *hin*" (a certain measurement). The author of the Mishna "interrupts" and comments that one should state an opinion in his Rabbi's language. Various commentators, including Rambam and the Gr'a discuss the significance of this statement. They make reference to the fact that a *hin* is not a Mishnaic measure and that Hillel said a full *hin*, the word "full" being unnecessary. According to these commentators, Hillel's rabbis, Shemaya and Avtalyon, were unable to pronounce the "h" sound, which is a glottal sound and, like the "sh" sound, is a fricative. To produce the "h" sound, the restriction of airflow takes place at the glottis or at the opening to the larynx [3]. Shemaya and Avtalyon were converts, so it is possible that their original language or dialect did not make use of the "h" sound and they could not produce the sound. Therefore, they said a "full *hin*" so that the students would not mistake "*in*," which was how they pronounced the word, for "*ein*" and would therefore think they were saying, "*Ein mayim shoavin poslin et hamikva*," meaning that drawn water does not render a *mikva* unusable, which is an incorrect statement. Therefore, saying a "full *in*" would allow the students to know that they were referring to "*hin*" the unit of liquid measurement, rather than "*ein*," which is a word of negation.

As has been illustrated above, personalities throughout Jewish history have had deficiencies in verbal communications that have had some degree of ramifications. Even today, communication disorders have ramifications within Judaism. In Judaism, speech serves another integral function of our daily lives: prayer. Prayer does not only include what is said in synagogue, but also the blessings that are said before and after eating, as well as other blessing and prayers said in various situations and on special occasions. However, is someone who is unable to speak able to fulfill his obligation to say these prayers in other ways? One possibility is that the person should mentally reflect on these benedictions. However, the Talmud states that thought is inferior to speech

and therefore cannot serve as a replacement. Another possibility is the concept of *shomea keoneh*, which states that hearing someone else recite the blessing is equivalent to saying it. While it could be said that this only applies to one who can satisfy the obligation by reciting the prayer himself, the *Shaagat Aryeh* writes that listening to someone else serves as an acceptable alternative. To prove his point, he cites the case of a slave who is half-freed by his Jewish master. Normally, when a slave was freed, he would not only be a free man legally, but he would also become a Jew. However, the slave who is half-freed has a problem. He cannot fulfill his commandment to hear the *shofar* by blowing it himself because he is not a full Jew; therefore he must listen to someone else blow the *shofar*. From this case, the *Shaagat Aryeh* concludes that one who is unable to speak can listen to someone else recite the prayers and fulfill his obligation that way. Once we have determined that a mute can satisfy his obligation of prayer by listening to another person, we must ask if such a person is required at all in these commandments. The *Shaagat Aryeh* says that a mute is obligated in this area, while the Radbaz states that a person who cannot execute a commandment in the normal way is not required in those commandments. However, certain instances exist where a mute

person is not included in the obligation, such as the laws pertaining to a rebellious son. Moreover, a mute is not allowed to testify in a Jewish court because testimony must be given verbally [6].

Verbal communication plays an important role in our daily lives. We use words to express wants and needs, to convey ideas, as well as other communicative functions. A wide variety of communication disorders exist within the general population. These disorders can affect speech (the ability of the speech mechanism to function in producing a spoken language) or language (the set of symbols, both verbal and non-verbal, that have a common meaning for the group who shares them), and often both. Because of the importance of communication in everyday life, people with communication disorders require intervention in order to communicate more effectively. Various personalities throughout Jewish history have had communication disorders which in certain instances, resulted in significant consequences. Since Judaism places an emphasis on saying blessings and prayers at various times, in addition to requiring speaking for certain legal functions, certain issues must be addressed regarding a person who is unable to speak. The special role that speech plays in Judaism as well as life in general, requires that speech be used both effectively and properly. ■

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The Mentally Ill In Halacha

Tamar Epstein

In *Atkins versus Virginia*, the Supreme Court recently restricted the death penalty to criminals of normal intelligence, thereby exonerating nearly ten percent of people on death row. The Court was prompted by the "evolving standards of decency" to recognize that the mentally retarded can not anticipate the results of their actions and should, therefore, not be judged as rigorously as people of normal intelligence [1]. This controversial decision raises challenging questions about the legal rights of mentally deficient people and their general status in society. As always, it is interesting to look at the Torah's perspective on this seemingly new issue and to understand the *halachic* approach to the mentally ill and their rights, responsibilities and roles in a Torah society.

In Jewish law "*shoteh*" is used to describe a mentally retarded and/or a mentally ill person. The first *halachic* reference to a *shoteh* is found in *Chagiga* 3b. The *Gemara* states: "Who is a deranged person? One who goes out alone at night; and one who lodges in a cemetery; and one who rends his garment." There is an Aamoraic dispute between Rav Huna and Rabbi Yochanan regarding this *Braisa*. Rav Huna requires a person to exhibit all three behaviors to be considered a *shoteh*, whereas Rabbi Yochanan asserts that a person qualifies as a *shoteh* if he performs only one of these actions in an irrational matter.[2] The *Gemara* then offers another stipulation from a *Braisa* that says, "Who is a deranged person? The one who destroys everything that we give to him" (*Chagiga* 4a).

In *Laws of Bearing Witness of the Mishne Torah* (*Halacha* 9,) Rambam rules that a *shoteh* is not a valid witness. In this context the Rambam describes a *shoteh* as "...not only one who walks around naked, who breaks things and throws stones, but anyone who is confused in his mind and whose mind is invariably mixed up with a

certain matter. Although with respect to other matters he converses to the point and asks pertinent questions..." An obvious question is why did the Rambam list his own examples of disturbed behavior instead of quoting the examples specified in the *Gemara*? The *Beis Yosef* (*Choshen Mishpat*) answers that the Rambam provides his own cases to demonstrate that the behaviors described in the *Gemara* are not absolute but rather serve as examples of irrational behavior. Although other *poskim*, *halachic* authorities, disagree with the *Beis Yosef*, the Rama *paskens*, rules, according to Rav Yosef Karo, and so the practical halacha follows the Rambam's opinion [3].

In *Iggros Moshe*, Rav Moshe Feinstein formulates a comprehensive analysis of Rambam's discussion about a *shoteh*. Rav Moshe explains that Rambam makes a clear distinction between two levels of severity in mental illness. In regards to most areas of *halacha* such as marriage and business, a person is only considered a *shoteh* if he exhibits the specific behaviors mentioned in the *Gemara* or if he cannot comprehend the significance of the action in question. For example, a mentally ill person can engage in commerce provided that he is aware of the consequences of his transactions. The Rambam's loose definition of a *shoteh*, therefore, only applies to a person's obligation in *mitzvos* and his right to give testimony. The Torah demonstrates heightened sensitivity to the mentally ill by exempting them from *mitzvos* which could easily add stress, aggravate their condition and prevent recovery. Rav Moshe explains that that there is a principle in *halacha* that a person cannot be obligated in certain *mitzvos* and exempt from others. Therefore, if irrational behavior in one area prevents a person from keeping certain *mitzvos*, then he is exempt from all *mitzvos*. Since a witness must be a *ben-chiyuv*, obligated in *mitzvos*, a *shoteh* may not

testify in court [3]. In all instances *Beis Din* has the authority to determine who is a *shoteh* and what restrictions apply to him [4].

A *shoteh* is not only freed from *mitzvos*, but he is also not held accountable for damaging property to the same degree as normal people. For example, if an ox of a *shoteh* goes an ox from a normal person, the *shoteh* is not required to pay the fee that would be demanded of a normal person (*Baba Kama* 4:4). Similarly, if a *shoteh's* ox injurs a person, or if a *shoteh* directly harms a fellow Jew, he is not required to compensate the victim (*Baba Kama* 87a). The *Mechilta*, under certain conditions, even extends this exemption from responsibility to murder (*Mechilta, Mishpatim* 4) [4].

The Torah provides a comprehensive model for integrating the mentally ill into society that is both compassionate and realistic.

Halacha is sensitive to the limitations of a *shoteh* and requires the community, and specifically *Beis Din*, to provide him with care and support. In an effort to maximize a *shoteh's* quality of life, the Torah exempts him from the *mitzvos*, but at the

same time allows him to integrate into society through commerce and marriage and other activities according to his abilities. *Halacha* appreciates the varying degrees of handicap and, therefore, offers a flexible system for *Beis Din* to apply case by case. The *halacha* is also sensitive to society's need for order and control. *Beis Din*, therefore, has the authority to prohibit the mentally ill from participating in business and marriage and other sorts of communal activities if the

individual can not assume those responsibilities. We must emulate the Torah's example and treat the mentally ill with the same degree of sensitivity and respect. ■

“The Torah provides a comprehensive model for integrating the mentally ill into society that is both compassionate and realistic.”

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Jewish Women, Taharat HaMishpachah, and Personal Health

Frida Fridman

Judaism views the physical relationship between husband and wife as special and holy. The monthly separation and reunion of husband and wife that is necessitated creates an astounding phenomenon. In contrast to the reality of life in the secular world, Torah-observant couples enjoy healthy and pleasurable relationships for not months or years but decades into a marriage [1]. In the *Pirkei DeRabbi Elazar* it states, "Each and every month, a woman renews herself by immersing in the *mikvah* and returns to her husband as dear to him as on the day of the wedding." Just as the moon renews itself each *Rosh Chodesh*, and all wait to see her, so a woman becomes renewed each month, and her husband awaits her and she is dear to him like a new wife." The rules of *Taharat HaMishpachah*, family purity, designed to sustain and preserve the original bond that began under the marriage canopy may do more than just that. Numerous articles have been published discussing the lower occurrence of gynecologic diseases, as well as higher life expectancy among Jewish women. Could the reason for this originate in the Biblical attitude towards personal hygiene during menstruation or is it genetic?

It states, "And if a woman has an issue, and her issue in her flesh be blood, she shall be seven days in separation..." (*Vayikra* 15:19), and later it adds, "But if she is cleansed of her issue then she shall number to herself seven days, and after that she shall be clean" (*Vayikra* 15:28). These passages are the origin for the laws of *Taharat HaMishpachah*, as well as an important part of contemporary obstetric preventive medicine.

From a medical perspective, research shows that, generally, a woman's vaginal discharge is mildly acidic and, therefore, antibacterial. In contrast, at the time of menses, the discharge is alkaline and it takes approximately seven days to regain normal pH. Thus, during this time the vagina lacks its natural defense against infection.

Furthermore, at the time of menstruation, the uterine lining has been shed and the entire uterine channel is susceptible to the entrance of bacteria. It takes seven days after the end of the period for the lining to regenerate [2]. Finally, a number of medical studies on the incidence of cervical cancer showed that the ratio of the malignancy in Jewish and non-Jewish women was calculated between 1/9 and 1/5 [3].

From a modern perspective, sexual contacts during menses or shortly after also emerge as a risk factor for the development of sexually transmitted diseases (STDs) such as chlamydial and gonococcal diseases, risk of transmission of human immunodeficiency virus (HIV) infection, and endometriosis, all of which may subsequently cause infertility [4]. Higher occurrence of chlamydial and gonococcal infections can be explained by loss of protective barrier, the cervical mucous plug during the menses. The presence of iron in the menstrual blood promotes the growth of gonococcal bacteria, which is a crucial determinant for ascending gonococcal infection [5]. The premenstrual peak of estrogen and progesterone facilitates the spread of ascending chlamydial infection [6]. Also, intercourse during menses with a partner of either sex and who is infected with HIV increases the risk of viral transmission tremendously [4]. Endometriosis, the presence of endometrial tissue in locations other than uterine lining, occurs more commonly in patients who have coitus during menses than in those who do not. The increase in endometriosis may be due to an increase in retrograde flow of menstrual discharge during orgasm or to decreased immune response. This condition is associated with 30-40% rate of infertility, twice that seen in the general population [4].

A study analyzing the prevalence of adenomyosis and endometriosis in an ultra-religious Jewish population showed that both diseases had lower incidences among Jewish women. The

diagnosis of the adenomyosis rests on histologic finding of endometrial glands and stroma within the myometrium. Although the cause of adenomyosis is unknown, it is primarily a disorder in mothers over 30 years of age. Endometriosis, as mentioned above, is abnormal endometrial tissue growth outside the endometrial cavity. The actual cause is unknown, but promiscuous behavior and ethnicity affect its prevalence. Adenomyosis among Jewish women and non-Jewish women was reported 26% and 56.5% respectively. Endometriosis in the ultra-orthodox Jewish population was recorded to have low incidence of 1.12%, and in the non-Jewish population depending on ethnicity endometriosis was reported 16%-46%. It is believed that there may be two possible explanations for the very low incidence among Jewish women – the effects related to the religious lifestyle of the study population and the genetic influence. The religious lifestyle, in general, promotes a healthy life. Thus, numerous studies have shown a positive correlation between religious belief and health. For example, in B'nei Brak, Israel's most religious and poorest city, life expectancy for women is 81.1 years [7].

Orthodox women obey the laws of *mikvah*, ritual immersion, and sexual relations are forbidden between the couple during her *niddah* period, when the woman is menstruating and seven days thereafter. It is believed that this abstention reduces the risk of the migration of endometrial tissue into the pelvis for two major reasons. First,

during sexual intercourse at or near the time of menses, the uterine contractions may enhance the migration of endometrial tissue into the pelvis. And second, this prevents retrograde menstrual flow and reduces the risk of viable endometrial cells passing through the fallopian tubes [8].

The genetic background of endometriosis has long been debated. It has been argued that the appearance of the disease is most consistent with a multifactorial etiology. And based on the above numbers it is clear that genetic make up has a major effect on the low incidence rate among Jewish women [8]. This genetically programmed immune response plays a significant role and may greatly influence the direction and magnitude of the body's reaction. Genetics are also believed to play a role in the lower occurrence of cervical cancer in Jewish women [3].

Thus, the rules of *Taharat HaMishpachah*, family purity designed

to sustain the original bond that began under the marriage canopy do more than just that. They are an integral part of contemporary obstetric preventive medicine. Following these easy laws, reduces the risk of STD, HIV, certain cancers, and infertility. Jewish people are truly fortunate because not only do we have these laws that so many studies proved to be beneficial, but also we have the genetic makeup that reinforces the benefit of keeping the laws. Rav Chalaftah declared: "How fortunate is the woman! How fortunate is the mother! How fortunate is the family of any woman who keeps the laws properly." (*Niddah* 4:1). ■

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Pain: A Multi-Sensory Experience

Tova Gavrilova

Physical pain is a concept almost every human being is familiar with. It's that sore muscle you get after a bad stretch, a nagging toothache that just won't go away, or a throbbing headache after a stressful day at work. The sensation of pain is usually associated with a cause and effect relationship: an external stimulus, such as a burn, activates our pain sensors and allows our brain to sense pain. Although pain has physiological origins, modern science is finding that pain is not a simple "knee-jerk" response to an external stimulus.

The means through which pain is relayed throughout our bodies involves many different pathways. Ascending pathways are those that lead from the sensory receptors in our skin and viscera towards the brain, whereas descending pathways are those that lead away from the brain towards the spinal cord and beyond. In short, these pathways are composed of different neurons located in the skin, spinal cord, medulla, thalamus and the cortex. Pain sensation is usually initiated by a physical event, such as a burn, that activates mechanical nociceptors, also known as first order neurons, at the periphery. These neurons then project the sensory information to the second order neurons in the spinal cord and medulla. The sensory information, in the form of an electrical impulse, is carried to the thalamus where third order neurons transmit the impulse to the cortex in the brain. Once the brain receives this information, it then adjusts our perception of this pain, acting directly on the spinal cord *visa vi* the descending pathway [1].

One of the aspects of pain that puzzles many scientists is that while pain seems to be a purely physical reaction to one's environment, it actually encompasses one's physical, mental and emotional state of being. Many of today's

medical doctors, especially those specializing in the treatment of physical pain, disagree as to whether pain should be treated as a physical malady or one that requires a psychological approach of treatment. The significance of this question is compounded by the fact that medical treatment of pain has its limits and patients are sometimes left with their painful symptoms not being sufficiently treated through medication and medical procedures, leaving doctors questioning whether a physical-psychological approach to pain will better serve their patients. In an attempt to answer the question of whether pain is a purely physical phenomenon, perhaps today's science would benefit by understanding how the Bible addresses pain.

In the Book of Genesis we find a midwife trying to comfort Rochel *Immeinu*, our mother, who is in labor, by telling her "Do not fear for this too is a son for you" (*Bereishis* 35:16). Why would Rochel be comforted by knowing that she is having a son? Apparently, in the ancient times and at the time of the Talmud, it was believed to be that the labor pangs for a girl were much more difficult than those for a boy. Therefore, by telling Rochel that she is having a boy the midwife is providing psychological comfort to help Rochel gain strength to overcome the pains of child labor [2].

The source of pain due to the degeneration of a physical organ can be traced back to our forefather Yitzchak. *Bereishis Rabbah* (65:9) describes how Yitzchak prayed for G-d to institute pain in this world as a means to atone for one's sins and thus alleviate the punishment in the World to Come. The *Medrash* goes on to say that G-d acquiesced to Yitzchak's request and established pain in this world. The difference between this pain and the physical pain that existed prior to Yitzchak's request is that now physical pain would

be possible due to the degeneration of a bodily organ, and in fact at this time we find Yitzchak losing his eyesight [3]. For the first time in the world's history the notion of pain is completely revolutionized – now pain becomes a sort of wake up call, to enable a person to gain introspection on his spiritual status and atone for his sins. Therefore, pain, although oftentimes originating as a physical sensation, by its very nature is meant to involve one's spiritual and emotional components.

Since pain is considered to be a combination of physical and emotional/psychological aspects of one's being, then the treatment must also address one's psychological and emotional senses. In fact, Maimonides, a famous Jewish scholar, philosopher and doctor, suggested that emotions can influence bodily function– an unprecedented view not only for his time but for most of twentieth century medicine. Proverbs also states that "...a merry heart doeth good like medicine" (17:22).

Modern science is finally beginning to catch up with Judaism's understanding of pain. A study was performed that measured pain tolerance throughout a population of ballet students and regular undergraduate college students. The study found that under the same physical conditions ballet dancers had an almost three times higher threshold for pain than the undergraduate students, meaning that it would take three times as much intensity of a painful stimulus in order for the ballet dancers to even feel the pain [4]. The researchers explored the possibility that perhaps the significant experience of physical pain that these dancers acquired during their years of ballet training has created their unusually high thresholds of pain. Therefore, it would be reasonable to postulate that their background in a physically demanding activity that often involves painful injuries has made them less sensitive to perceiving pain.

In an attempt to discover the relationship between pain perception and gender differences,

researchers conducted a study in which they measured the amount of morphine women required in order to achieve the same level of analgesia as men. The results indicated that women experienced more intense pain and required 30% more morphine to achieve a similar degree of analgesia as compared to men [5]. The findings of this study are significant in that they underline the fact that men and women have different degrees of pain tolerance. Perhaps the reason for this might

Many of today's medical doctors...are at disagreement as to whether pain should be treated as a physical malady or one that requires a psychological approach of treatment.

be the common societal expectation for men to have a stronger physical constitution and consequently either feel or exhibit less pain than women. Furthermore, research also indicates that men and women differ in the coping strategies necessary to overcome stressful situations with women often needing emotion-focus coping while men prefer sensory-focused coping [6].

One of the leading theorists on pain proposes a theory that can be used to explain why the sensation of pain is such a

drastically different experience for different people. He suggests that on its way to the brain, the sensory stimulus that is conveyed from the periphery and through the spinal chord mixes together with other neurochemical signals and while in the brain this signal also combines with the other neurosensory information present there. Therefore, the neurochemical message first triggered by the sensory stimulus is no longer the same discrete unit, but rather a product of one's emotions, memories, and current sensations. In short, by the time the person actually perceives pain it is no longer the pure product of the initial stimulus but the synthesis of every facet of one's sensory identity. The ultimate claim is that the brain utilizes all of the sensory input from the rest of the body in order to generate its own sensory experience. Since each person has his own memories as well as emotional and sensory input, this theory can explain how human beings can generate a wide gamut of pain sensations stemming from a single sensory stimulus [7].

In conclusion, the failure of a purely physical approach to treatment of pain is leading many health care professionals to question if pain is more than just an inherent response to one's envi-

ronment. Extensive research is now proving that the sensation of pain is more than a neurochemical response to a stimulus, rather it is a product of one's entire being. ■

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The Anthropropic Principle

Ariella Goldstein

That G-d created the world is an essential component of Jewish faith. This tenet, however, still leaves theists with a significant question: why did G-d create the world? This religious dilemma is usually separated from the scientific inquiry into the origin of the universe. However, recent scientific discoveries have offered tentative support of the anthropic principle, the theory that the world seems to have been created with the purpose of supporting human life. Furthermore, scientific consideration of the anthropic principle echoes the debate among major Jewish philosophers concerning the validity of an anthropocentric view.

It is a known fact that life on Earth is entirely dependent on the sun, whose heat and light are the principal source of all the energy on this planet. How this energy comes to be is therefore an integral part of most discussions of the anthropic principle. The nucleus of the hydrogen atom, one of the sun’s two types of atoms, contains only one kind of particle: a proton. However, due to the atmosphere inside the sun, its proton may convert into a neutron, which can in turn join with another proton to form a deuteron, a “composite particle” that, through a thermonuclear reaction, produces the energy behind the light and heat of the sun, without which life could not exist on Earth. Furthermore, the nuclear force that governs this reaction seems perfectly suited to enable life on Earth to flourish. Theoretically, if this nuclear force were even a few percent weaker, then a proton would not be able to combine with a neutron to form a deuteron. Consequently, the sun would not shine; it would be “a cold ball of inert gas” and therefore would not provide the light and heat essential for life on Earth. Conversely, it appears that if the nuclear force were only a few percent stronger, then not only would proton-neutron combinations be fostered, but protons would be able to join with other protons, a reaction that

would cause the sun to explode. Again, the exact nuclear force of nature seems to allow for life to exist on this planet. Indeed, “it is an extraordinary fact that the strength of the nuclear force just happens to be in the narrow range in which neither of these two catastrophes occur” [1].

Not only does the study of solar energy appear to verify the anthropic principle, but an examination of the Earth’s position relative to the sun can perhaps boast the same function. The “Goldilocks problem of climatology” is the name given by scientists to the remarkable “coincidence” that the Earth is “not too far nor too close” to the sun, thereby allowing for water and air on our planet. Both Venus and Mars most likely once contained surface water. However, the proximity of Venus to the sun would have caused its water to evaporate, and Mars’ distance from the sun would have led to the freezing of its surface water. Earth, however, is apparently located at the exact distance from the sun, such that its water will neither evaporate nor freeze, thereby providing for the possibility of life on our planet [1].

A similar evaluation can be made regarding Earth’s atmosphere. Proponents of the anthropic principle posit that if our planet were even slightly nearer to the sun, surface temperatures would exceed the boiling point of water, creating an atmosphere in which humans could not exist. Likewise, they argue that if the Earth were only slightly farther from the sun, then “the concentration of carbon dioxide in the atmosphere would become so high that ‘the atmosphere would not be breathable by human beings.’” It seems, then, that the world was intentionally designed to sustain life, as the Earth’s position in the solar system appears to be at the exact distance from the sun that would permit an atmosphere in which humans could breathe [1].

We have seen that there are several laws of nature that appear to be tailored to support life on

Earth such that if they varied even slightly, life on this planet would not be able to exist. Many scientists have also recently proposed that certain events occurred in the history of our planet that not only functioned to sustain an environment conducive to life, but that perhaps directly affected the ability of human beings to exist on this planet. One such occurrence is the extinction of the dinosaurs. While these supremely powerful reptiles ruled the Earth, it is unlikely that large mammals could exist; the carnivorous dinosaurs would have decimated all such creatures. The destruction of the dinosaurs consequently seems to be connected to the existence of humans. Furthermore, Nobel laureate Luis Alvarez's theory of the means by which the dinosaurs were destroyed - a meteor hit the Earth, wiping out the species - additionally reinforces the anthropic principle. The meteor, according to Alvarez's explanation, hit Earth with a force that decimated the dinosaurs, the species inhibiting human life, yet without such strength as to wipe out all life. Thus, the eradication of the dinosaurs via this meteor collision appears to be an event that occurred in an exact way to facilitate the existence of human beings [1].

Furthermore, the scientific discussion of the anthropic principle reflects the question regarding G-d's motivation in creating this world, which figures prominently into the ideology of many Jewish philosophers. In *Emunot ve'Deot*, Rav Saadya Gaon asserts that man "is the most essential part of Creation." Saadya's argument follows the reasoning that "it is the rule and habit of Nature to place the most excellent (part of anything) in the centre with things of less excellence surrounding it." Thus, in every fruit, the less significant edible portion surrounds the kernel, which is the integral section from whence other fruit may come. Additional proof, according to Saadya, is that the yolk, the part of the egg in which the chicken grows, is at the center of the egg. Other examples offered by Saadya are the placement of the heart in the middle of the chest and the location of the pupil in the center of the eye. Saadya continues this analysis with his assertion that as the other heavenly bodies surround the Earth, it is the center of the universe, and therefore is the focal point of the creation of the universe. He narrows this observation further by seeking the focus of Earth, which, he argues, is clearly humankind; "earth and water are both inanimate things; the beast we found to be lacking in Reason; there remained nothing superior but

Man." Therefore, Saadya concludes that humanity "is undoubtedly the ultimate object of Creation." He reinforces this conclusion by asserting that all acts of creation prior to that of humans were intended to support human life, "just like an architect who builds a palace, furnishes it, puts everything in order, and then invites the owner to occupy it" [2]. Although Saadya's argument is based on the Ptolemaic view that is no longer held by scientists, it is important to note the consonance between the modern scientific theory that the world seems to have been created in order to sustain human life and Saadya's belief that creation was focused on humankind.

Rambam, however, dismisses Saadya's arguments; he clearly asserts that G-d did not create the world for human beings. In Part III, chapter 13 of *Moreh Nevukhim*, Rambam begins his counterargument with his contention that G-d could have created humans without "all these preliminaries" [3]. This claim is based on an assumption of G-d's omnipotence - G-d of course has the power to create humanity as a species that could be independent of the creations of the first five days [4]. Rambam follows with his reasoning that if creation was focused on humanity and other species were created that humans could live without (e.g., humans could potentially have existed without fish or insects), then the creation of those species is purposeless, and surely G-d would not act in vain. In Part III, chapter 13 of *Moreh Nevukhim*, Rambam writes, "what is the utility for Him of all these things, which... exist for the sake of a thing that could have existed without all of them?" [3]. Rambam further questions: "if the universe exists for the sake of man, and man for the sake of serving G-d... what is the purpose of serving G-d, since He is perfect and does not need man's worship?" [4]. Therefore, Rambam asserts that creation was motivated by G-d's will, not by His desire to create human life. Rambam cites *Mishlei* 16:4, "*Kol Pa'al Hashem Lema'anehu*," as proof of his argument, as he translates the *pasuk* to mean "G-d made everything for His sake." In addition, Rambam argues that after each day of creation, G-d said, "it was good," which means that the day's creations "conformed to [His] purpose," and specifically did not say on any day that what He created was for another being. Furthermore, Rambam cautions that we should not be "misled" by the words in *Bereishit* 1:17-18, "To give light upon the Earth, and to rule over the day and over the night"; he warns us not to

interpret this *pasuk* to mean that the stars were created so that they could offer a world in which we are able to see, thereby indicating that the creation of the world was geared toward human life. Rather, we should understand that the stars serve this particular purpose, but that they were not necessarily created for this benefit they provide to humankind - they were created only due to G-d's will. While he believes that humans, due to our intellect, are "the most noble thing that has been generated from this [inferior] matter" on Earth, Rambam seems to clearly oppose the anthropic principle; he does not hold that the universe was created in order to sustain human life [3].

Recent scientific developments have led to the recognition that it appears as if the world was created in such a way that would best support human life. How does this reflect on Judaism's conception of the purpose of creation? In accordance with Saadya's position, the claim that the sun's components work in a manner that fosters human life would certainly appear to take man's superiority well beyond the boundaries of our planet. Likewise, the relation between the meteor that killed the dinosaurs and the subsequent opportunity for human life would also serve to reinforce Saadya's view. Even an analysis of the presence of water and suitable air on Earth is based on Earth's distance from the sun, suggesting a universal focus on humankind. While this pattern may seem to reinforce the gulf between Saadya's anthropocentrism and Rambam's view

that G-d created the world not to suit humans but His will, there is a significant common denominator between their philosophies. Both Rambam and Saadya argue that humankind is the superior species on Earth, and should act accordingly. Saadya believes that creation was directed toward humans because of our intellect, or "excellence [which] can... make [us] the recipient of commandments and prohibitions" [2]. Thus, G-d created the world in order for humans to obey His mitzvot; humanity's dominance results from our ability to follow Jewish law. In contrast, from Rambam's argument, we see that humans, as the only beings on this planet capable of reason, are uniquely able to come to "knowledge of G-d, both in its purely philosophic sense and in the sense of leading to man's moral life by means of *imitatio Dei*" [4]. Like Saadya, Rambam looks beyond the question of why G-d created the world in order to discover the purpose of human beings. In addition, while they disagree on humanity's prominence in the universe, and on what humanity's particular superiority requires of us, both Saadya's and Rambam's theories accept that humanity's intellect deems us the highest species on Earth, and that certain duties result from that position. Thus, while both science and Jewish philosophy contemplate G-d's reasons in creating the world, the focal point of Jewish philosophy's dealings with that question is what that answer means for the life of every Jew. ■

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A Question of the Heart

Yael Grunseid

“Create a pure heart within me oh G-d (Psalms 52)...” These moving words, composed by King David, have been recited by Jewish men, women, and children throughout the generations. Poetically, they refer to a figurative purification of the heart; they express man’s desperate plea for atonement and the forging of an untarnished bond with G-d. Ironically, in today’s world, this prayer has taken on quite a different meaning. No longer is this “pure heart” one of an intangible nature; rather, it is a literal concern for society at large. Heart disease has been ranked as the number one cause of death in the United States today [1]. Cardiac disease is more common today because current medical technology has brought about a dramatic increase in the average lifespan, making elderly people more vulnerable to diseases of the aging heart. Can we assume that cardiopathology exists exclusively as an illness of modern man, or can we detect traces of its existence at the dawn of human civilization as well? Let us explore and speculate about the possibilities of heart disease under the lens of our own ancient Judaic texts and historians.

The first mention of the heart as a physical organ in the Bible appears in the book of Genesis in conjunction with the patriarch Jacob. At the age of one hundred thirty, Jacob, who, has believed his son Joseph to be dead for twenty-two years, is suddenly confronted with shocking news. Genesis chapter 45, verse 26 states, “And they told him saying, ‘Joseph is still alive,’...” wherein Jacob’s immediate reaction is, “*Vayafeg Libo*” - his heart was affected - because he did not believe their words. The classical medieval exegetes the Ramban, Seforno, and Eben Ezra (who were also well-versed in the study of medicine) attempt to define this elusive phrase. The Eben Ezra connects the root of the word *Vayafeg* as it appears in Lamentations 2:18 in the phrase,

“*Al titni fugat lach*” - give yourself no respite. If the common root of the two words means “to rest,” then Jacob fainted due to a momentary resting, or slowing down of his heart. Ramban feels that the heart not only slowed, but completely stopped. This understanding of *Vayafeg* describes a condition similar to the current understanding of vaso vagal syncope. The vaso vagal reflex can occur when a person is subjected to great anxiety or emotional strain. The body reacts paradoxically by a slowing of the heartbeat and dilation of the blood vessels, which lead to a decrease of blood flow to the brain and a subsequent loss of consciousness. Once the individual faints, the supine position helps the return of blood flow to the brain and the regaining of consciousness. The shock of the moment would have spurred the onset of vaso vagal syncope. The next verse in Genesis continues, “However...when he saw the wagons that Joseph had sent to transport him, then the spirit of their father Jacob was revived.” After this fainting spell, Jacob awakened to the sight of the wagons, which calmed him and steadied his heart rate. Alternatively, Seforno explains *Vayafeg* to refer to a “rhythmic disturbance” of Jacob’s normal heartbeat, possibly precipitated by a rush of adrenaline secondary to emotional shock. This opinion would conjecture a brief episode of what is known today as cardiac arrhythmia, or sudden erratic heartbeat [2].

A similar case is found in Samuel I 4:13. Like Jacob, Eli is an elderly man of ninety-eight years reacting to shocking news. In contrast to the previous case though, Eli has been expecting catastrophic tidings, as the verse states, “*Vayechedad Libo*,” which Radak explains to mean, “His heart was pounding.” Upon confirmation of the tragedy he awaited, he fell off his chair and broke his neck. A pounding heart followed by a collapse is again reminiscent of a

cardiac arrhythmia. However, in this setting, the arrhythmia is more likely to be of a serious nature such as ventricular tachycardia or ventricular fibrillation followed by a cardiac arrest.

Another example of a more apparent heart condition is expressed in Samuel I 25:37. There appears the brief story of Nabal, a wealthy man who drinks and eats excessively (a risk factor for coronary artery disease). Despite his great wealth, Nabal refuses to give supplies to King David and his troops. David plans to punish him with death, but Nabal's wife dissuades him. When Nabal's wife informs him of David's averted plans, the verse states, "And his heart died within him and he became like a stone." Ten days later, Nabal dies. In this case, medical

historian J.O. Liebowitz suggests one possible theory. He proposes that Nabal's terror of King David sparked a myocardial infarction, or a clot that blocks circulation to sections of the heart. Thus the text, "his heart died within him-" a section of his heart literally died from lack of blood circulation. The term, "he became like a stone,"

can be understood as vascular shock, secondary to lack of perfusion (blood flow) to the extremities, which would result in *cold*, cyanotic dusky fingers and toes. It would not be unusual for death to occur after a large myocardial infarction from causes such as cardiac arrhythmia, or even rupture of the heart [3].

Not only is there a mention of heart disease in the Biblical period, but also in texts recorded during Talmudic times. In his historical work, *Antiquities*, Josephus describes the health decline of Herod the Great, ruler of Israel in the year 4 BCE. He speaks of Herod's illness that lasted "a few months," and describes, " a terrible desire to scratch... ulceration of the intestines with particularly terrible pains of the colon, and a transparent swelling of fluid around the feet...his breathing had a high pitch [he could only breath while sitting in an upright position]...it was extremely loathsome because of the disagreeable exhalation and frequency of gasping...He also had spasms in every limb"

(*Antiquities* 17:169). It is also notable to mention that "during the seventh decade of his life Herod aged greatly, became vacillator and indecisive, impatient of opposition ...ruthlessly severe and vindictively savage" [4]. One possible explanation for this conglomeration of symptoms could be cardio-renal failure secondary to hypertensive arteriosclerosis. Untreated hypertension is the most common cause of congestive heart failure (the inability of the heart to pump effectively) [5]. Years of high blood pressure can also cause damage to the arteries that bring nutrients to the brain, heart, and kidneys resulting in stroke, myocardial infarctions, and kidney failure [6]. Herod's change in mental status may have occurred as a result of cerebral vascular disease such as small strokes, or hypertensive encephalopathy (change in mental status from sudden attacks of heightened blood pressure, i.e. malignant hypertension). The swelling in his legs, shortness of breath, and orthopnea (difficulty breathing while lying flat) are all consistent with congestive heart failure (CHF). CHF is

"Heart disease has
been ranked as the
number one cause of
death in the
United States today."

also characterized by swelling of the liver and may explain Herod's abdominal symptoms. His itching and convulsive spasms are symptoms of uremia, or end stage renal failure as occurs in about ten percent of cases of uncontrolled hypertension. Others claim that Herod's symptoms were those of end stage type II diabetes mellitus [4]. Uncontrolled blood sugar can also be a mechanism through which damage to the arteries of the heart, brain, and kidneys can occur. A diagnosis of long standing diabetes could account for the mix of Herod's maladies as well.

Another reference to heart disease in Talmudic times is recorded in the Talmud itself. In the Jerusalem Talmud, there is mention of a certain Rabbi Yochanan who would don only his arm phylacteries and neglect to wear those of the head especially during the heat of the summer months. When asked about his unusual custom, he replied that, "his head was heavy from his heart." Dr. T.M. Gurwich explains this to be the first report of giant cell arteritis, characterized by

a headache in the temple region, and a fever that is possibly alluded to in the mention of summer heat [7].

The heart diseases mentioned in the above texts are compellingly consistent with diseases diagnosed in the medical field today.

Perhaps our earliest descriptions of modern-day symptom complexes don't date back to last century's Sir William Osler, but rather to the ancient days of the Bible. Who knows what King David really meant by "purification of the heart?" ■

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Biotechnology and the Jewish Imperative:

To Heal and To Create

Adina Katzman

The *halachic*, or the Judaic legal, process began in the Jewish year 2448 with the giving of the Written and Oral Law on Mount Sinai. Through the years, *halacha*, Jewish Law, continues to be studied and followed, and answers to specific cases are developed using known *halachic* methods and precedents. Science has undergone a revolution in the last hundred years. The discoveries produced by this revolution have drastically changed the world. It is with wonder and gratitude that many scientific discoveries and improvements are regarded. Biotechnology is but one area in which huge developments have occurred. Medical research and clinical procedures have dramatically improved through the development of the field of biotechnology. Stem cell research and potential therapy, cloning techniques, in vitro fertilization and post mortem sperm retrieval, are but some of the many biotechnological achievements. These techniques have the potential to assist, heal, and create life. The responsibility to assist, heal, and create, is part of the Jewish imperative. When Jews act upon this responsibility, it cannot be performed in accordance with human judgement alone, but must be conducted in accordance with Jewish Law. Rabbinic leaders develop responsa to questions regarding the permissibility of the biotechnological advancements of these modern times and respond to the challenge of science. This process ensures that the newfound abilities to assist, heal, and create, will be permitted only when they are in accordance with Divine Will. This article proposes to discuss some biotechnological advances that hold the potential to heal and create life, as well as some *halachic* responses to the implications of these noble endeavors.

STEM CELL RESEARCH

Stem cell research is a significant development in medical science, replete with numerous benefits. If successful, stem cell research will help scientists better understand early human development and will generate improvements in pharmacological studies [1]. Mainly, stem cell research has enormous therapeutic potential. Stem cells can be implanted into an ill individual to develop into healthy cells, thereby curing the individual [2]. Stem cells could ultimately be used as a preferred alternative to organ transplants, eliminating the prolonged waiting period for the currently inadequate supply of organs [1]. More research is necessary before these therapeutic techniques can be used clinically [2].

With regard to the *halachic* approach to stem cell research, one should be aware that Judaism has no problem with scientific advancement and the concept of "playing G-d", as long as it is all done in accordance with the Law of G-d. In fact, one of the goals of a Jew is to try to imitate G-d. One way of imitating G-d is by giving medical treatment and by healing [1]. It is, therefore, our prerogative as Torah Jews to take advantage of scientific advancements within a *halachic* framework.

Stem cells can be harvested from embryonic, fetal or adult sources. Embryonic stem cells can be obtained from embryos fertilized in vitro or from embryos produced by cloning. Harvesting stem cells from an embryo necessitates the destruction of the embryo, rendering it non-implantable. Embryos used for stem cell research are known as pre-implantation embryos, or pre-embryos. Since one must destroy the embryo in order to harvest the stem cells, we must answer the question - "what is the *halachic* status of a pre-embryo?" [2].

There are two positions taken in regard to the *halachic* status of the pre-embryo. One is that the pre-embryo has the status of a fetus *in utero*. The ramifications of this position are beyond the scope of this article. The second possibility is that a pre-embryo has the status of reproductive seed. Some significant rabbinical authorities have, in fact, determined that a pre-embryo does not have the status of a fetus in utero. The main reason for this is that a pre-embryo requires implantation into a uterus in order to become a human being [2]. According to this opinion, the status of a pre-embryo is that of reproductive seed that has been emitted. It is possible that the laws of *hashchatat zera*, the wasting of male seed, apply to a pre-embryo [2]. However, if the sperm is being harvested for fertility purposes with Rabbinic approval, there is no violation of *hashchatat zera*. In addition, most *halachic* authorities state that the law against the wasting of male seed does not apply post-fertilization [3]. Therefore, using a pre-embryo that is an excess embryo from IVF procedures should not be prohibited under the rule of *hashchatat zera* [2].

Another question that arises relates to the *halachic* permissibility of embryos created purposely for stem cell research. Since the male's seed will not ultimately end up in the creation of his child, is there any justification for him to give seed for the purpose of research? While the threshold of *pikuach nefesh* is likely not met by stem cell research, there may soon be clinical use for embryonic stem cells which might justify the prospective creation of embryos for stem cell harvesting.

SOMATIC CELL NUCLEAR TRANSFER

In 1997, the first mammal was cloned via the transfer of DNA from an adult somatic cell to an egg. The result of the clone was a healthy sheep named Dolly. The cloning technique is called somatic cell nuclear transfer. DNA is the unique genetic material contained in all cells of every individual. DNA encodes for the physical and psychological development of all humans. Most cellular DNA is found in the cell nucleus. This DNA is a unique combination of the DNA from both a mother and a father. In addition, there is a small amount of DNA that is also critical to normal growth and development that is found in the cell's mitochondria. This DNA is obtained solely from a mother. The cloning of Dolly took

place at the Roslin Institute in Scotland. An unfertilized egg from a female was to be used as the host. The nucleus with the nuclear DNA from the egg was removed. Mitochondrial DNA was left in the host egg. Mammary cells were obtained from an adult ewe. The mammary cells were put into laboratory conditions in which they lacked nutrients. The mammary cells responded to the nutrient deficient conditions by changing their DNA constitution to be totipotent. An electrical current was applied to the cells in order to fuse one mammary cell with the enucleated egg cell. This had the effect of sending the nuclear DNA from the mammary cell to the egg cell. The mitochondrial DNA may or may not have been sent. The electrical current caused the egg to act as though it had been fertilized and to begin the process of forming a fetus. The fertilized egg was left in the laboratory Petri dish until it became a blastocyte. The blastocyte, implanted into a female sheep, developed in utero into a healthy sheep, named Dolly. Dolly may or may not be a perfect clone of the sheep that donated the mammary cell, as a question remains as to whose mitochondrial DNA Dolly had. A perfect clone can be made for certain, only, if the egg and the mammary cell are obtained from the same individual [4].

There are numerous benefits to cloning technology. One benefit is the ability to correct defective DNA, thereby curing or preventing genetic diseases. For example, scientists could potentially be able to extract a cell from an individual with a genetic disease and genetically manipulate the DNA in that cell to correct the problem. This healthy cell could then be fused with a host enucleated egg from his wife and a genetically healthy clone of the husband can be created. Without this correction, some or all of the husband's children would express his genetic defect. Cloning technology is even better than in vitro fertilization in the sense that mammary cells are easier to manipulate in a laboratory than sperm cells or fertilized eggs [4].

Another important benefit of cloning is the ability to treat cancer and damaged tissues. While in the normal process of development, life begins with a totipotent cell and goes in the direction of differentiating to specialized cells, cloning technology is able to reprogram cells by directing specialized cells to become totipotent. Those reprogrammed cells will then be healthy and will specialize to become the cells that the body needs. An additional benefit of cloning technology is to

help patients who need organ transplants. If animal cells could be genetically manipulated via the cloning process, then the problem of immunological rejection could be avoided [4].

There are however some potential problems with cloning technology. Ian Wilmut, a scientist at the Roslin Institute, asserts that more study needs to be done before cloned cells should be used clinically. More experimentation is required to determine what problems would arise. One potential problem is the fact that adult cells carry environmental baggage more so than embryonic cells. These adult cells may cause the clone to be diseased or to have a shortened life span. In addition there are ethical issues that relate to the psychological and emotional ramifications of being cloned [4].

What are the *halachot* that come about in determining the permissibility or prohibition of human cloning? Below are some factors that might support the *halachic* permissibility of cloning. Cloning is not directly prohibited by the Torah and is, in addition, performed through acceptable biological principles. Man is supposed to make scientific discoveries, as mentioned above, and this is part of the ordinance of *v'kivshuha*, conquering the world (Genesis 1:28). In addition, cloning has the potential to heal, and we are commanded to heal under the commandment of *v'rappo y'rapeh*, and you should heal (Exodus 21:19). *Halachically*, cloning may even be more acceptable than artificial insemination or in vitro fertilization (IVF) because it does not constitute any problems of emitting sperm for waste, *hotza'at zera l'vatata* [4].

There are, however, some potential *halachic* problems with regard to cloning. The Talmud (*Nidda* 31a and *Kidushin* 30b) states that there are three partners in the creation of man – G-d, the husband, and the wife. It may be that G-d wants humans to be created only via sexual reproduction, and cloning technology violates that Divine Will. In addition, it may be Divine Will that every person has the right to have both a male father and a female mother and to be made up of a combination of their sex cells. Unlike IVF and artificial insemination, cloning may go against the natural manner of conduct, in that it does not require male seed, and that, in fact, it does not require any male cells at all. Male cells would only be required in the creation of a male clone; female clones can be produced using female cells alone [4].

Another *halachic* problem with cloning would be if cloning procedures presented a medical or psychological risk, which has not yet been determined. The concept of eugenics, or using cloning technology to create clones of a specific type, i.e. a particularly special, famous, or infamous person, is not per se a *halachic* problem. If there were a *halachic* problem with this situation, it would be that of bringing up an evil clone, and not that of creating a clone [4].

Would cloning be prohibited under the prohibition of *kishuf*, magic? Cloning would not be *kishuf* because it is a natural biological process that is successful, it is not used to create new species, and it is not necessarily used for evil [4]. In analyzing *kishuf*, the Meiri mentions that anything created in a scientifically accepted manner is not *kishuf*. Specifically, he notes that when it is known how to create human beings by means other than sexual reproduction, and the means to do so are scientifically valid, then such creation is not considered *kishuf*. It appears that this is an early reference to the possibility of cloning humans [7]. Moreover, *kishuf* may be allowed if there would be a medical benefit. Thus, although cloning does not fall under the realm of *kishuf*, even if it did, the medical benefits of cloning might outweigh the prohibition of *kishuf* [4].

This *halachic* discussion on cloning applies only to cloning that is used for medical purposes. Cloning for other reasons is a separate *halachic* discussion. There may be a serious problem with using cloning for non-medical purposes, i.e., as a common alternative way of having children without involving a man. It would seem that there is supposed to be a man and woman having and raising a child, and cloning is a method that does not require a male. Non-medical cloning may therefore be inappropriate [4].

Assuming that at some point humans begin to be cloned, what would be the *halachic* status of a clone? The question arises of whether a clone is a human or a golem. It is answered that a clone is a human as it is born through a human female's uterus, even though it is created without male seed and possibly without any male cells. A golem, on the other hand, is something that is created through *kabala*, Jewish mysticism, and is not born through a human female's uterus [4].

Another *halachic* issue is that the *mitzvah*, commandment, of *p'ru u'revu*, the requirement to procreate (Genesis 1:28), may not be fulfilled through cloning, as there is no male seed involved

in creation of the clone. Cloning may, however, fulfill the rabbinical law of *l'shevet*, to produce children and thereby populate the world (*Yeshayahu* 45:18). An additional issue is *halachic* parenthood of a cloned child. The question arises of who the parents of the clone would be. This is significant for a number of reasons. If the clone is created with one woman supplying the egg and carrying the fetus, then if this woman is Jewish, her baby clone will be Jewish and this Jewish woman is the *halachic* mother of her baby clone. Who her *halachic* father is, remains uncertain. The mother's father or the mother herself may possibly be the *halachic* father, or the girl may have no *halachic* father. It would need to be determined whether cloning would be like a case of *gerut*, conversion, in which the child would have no *halachic* father [4].

In terms of the Jewish status of the child, it would have to be determined conclusively whether it is the donation of DNA to the child, or the physical delivery of the child, that constitutes *halachic* motherhood. This would apply in a case where one woman involved is Jewish and one is not. It is also not known whether two close female relatives would be allowed to jointly create a clone. It is not known whether a boy clone created using a *Kohen* or *Levi's* somatic cell, would be a *Kohen* or *Levi*. *Kehuna* or *Leviya* may need to be transmitted via male seed or sexual relations. Another question would whether or not a widowed woman with only a clone-child would be considered childless and therefore have *yibum* (the *mitzvah* to marry a childless brother's widow) performed. It is not known whether a married woman can create a clone using the donor cell of a man that is not her husband [4].

POST MORTEM SPERM RETRIEVAL

Biotechnology has made it possible for a woman to obtain and use her husband's sperm after his death. This is done through post mortem sperm retrieval and post mortem artificial insemination. Spermatozoa can be procured after the death of a male and placed in a spermatozoa freezer bank. At any point the spermatozoa can be thawed and injected into donor oocytes with the potential to create a child [8]. The first retrieval of post-mortem sperm was in 1980 [9, 10]. The first live child created via post-mortem sperm retrieval was born on March 17, 1999. The spermatozoa had been in a freezer for five years, and it

had been taken from the male 30 hours after his death [11].

A number of *halachic* issues arise in the case of post mortem sperm retrieval. One is the prohibition of *nivul ha-met*, desecrating the dead. It would seem inappropriate to disgrace a dead body by removing its sperm. *Nivul ha-met* is a type of *halachic* damage and is not allowed. Rav Moshe Feinstein writes that a biopsy performed on a corpse in a proper way does not fall under the issue of *nivul ha-met* because it is done on the living as well. It could be argued that the same rules apply in the case of post mortem sperm retrieval. There is another prohibition of *hana'a min ha-met*, benefiting from a dead person. While *hana'a min ha-met* is prohibited, as procreation is a G-d given commandment, fulfilling it through a corpse would not be a case of *hana'a min ha-met*. A father must consent to the creation of his child. However, this consent does not need to be explicit. As long as it is known that this is what the man would have wanted, it is as though his consent was posthumously acquired [12]. It should be noted that not all *halachic* authorities permit post-mortem sperm retrieval.

In the creation of a child after his father's death, there remains uncertainty as to whether the child is the *halachic* son of the man from whose sperm he was made. Uncertainty, as to who his *halachic* father is, is different than the case of a prostitute's child in which the father is unknown and questions remain as to who the child's close relatives are. A child with an unknown father is limited with regards to who he may marry, whereas those limitations do not apply to a child with uncertain paternity [12].

Is it ethically fair to create another heir after a father's death to further divide the inheritance of the existing heirs? It would seem that it is fair, as the number of people amongst whom the inheritance is divided, is not the decision of the heirs. Is it a problem of *ma'arit ayin*, misleading appearances, for a widow to become pregnant and bear a child? Although it may seem immoral, there seems to be no *halachic* prohibition against it. Another argument in favor of post mortem sperm retrieval would be the *halachic* acknowledgement of the strong desire within mankind to have a child [12].

Does post mortem sperm retrieval fulfill the *mitzva* of *p'ru u'revu* for the dead man? The answer depends on whether the *mitzva's* fulfillment depends on an action of the man. It would

seem that the *mitzva* is fulfilled through the existence of the child, and it does not make a difference whether the man performed any action at all. There are a number of examples which indicate that this particular *mitzva* is fulfilled when a child exists and is not dependent on whether the male performed an action. According to the *Minchas Chinuch*, the *mitzva* of *p'ru u'revu* is fulfilled when the child is born. Thus, even after death a man can fulfill this *mitzva*; whether or not the sperm was taken before he died. All of these arguments, however, do not necessarily mean that post mortem sperm retrieval is permitted. One must have explicit or implicit consent from the male, and a *halachic* authority must be consulted to

determine the permissibility of post mortem sperm retrieval [12].

The discussion about biotechnology and *halacha* is an ongoing process. As science progresses, *halacha* is taken into consideration. The future will most likely reveal many more interesting questions in this realm. G-d's plan includes these scientific developments, as well as the increased Jewish studies that occur as more issues require evaluation. None of the answers stated in this article should be taken as conclusive. While this paper contains a brief synopsis of some of the myriad of opinions and issues, a competent *halachic* authority must always be consulted for definitive answers. ■

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Noah and the Dinosaurs?

Some Scientific Theories on the Flood

Malkie Krupka

Because of its far-reaching impacts on many fields of science, the *mabul*, or flood, of Genesis (chapters 6-8) is a much-discussed topic, both amongst scientists and Torah scholars. Analyses of the *mabul* take into account current scientific knowledge, historical documentation of its occurrence, and study of the Torah with its commentaries.

From even a cursory reading of the relevant areas of the Torah, it is clear that the *mabul* was a catastrophic event. According to classical Jewish sources, the *mabul* occurred approximately four thousand years ago. Consequently, we would expect to find similarly striking data across the scientific fields. The presence or absence of the expected data has led to several very different theories of the place and scope of the *mabul*.

The first of these theories is heavily favored by eighteenth and nineteenth century commentators on the Torah such as Rabbi Meir Leibush, otherwise known as the Malbim (1809-1879), and Rabbi Naftali Tzvi Yehuda Berlin, also known as the Netziv (1817-1893). Additional support is from Rabbi Ovadia Sforno (1475-1550) in his commentary on the Torah. According to their theory, the *mabul* was not just a flood of water that came and went in roughly a year. These commentaries state that before the *mabul*, unlike the seasons experienced now, there was a continual springtime (Malbim 8:22, for example). The changing seasons that we experience now are due to the 23.5 degree tilt of the Earth in respect to its orbit around the sun. This 23.5 degree tilt causes the focus of the sun's energy to fluctuate between the Tropic of Cancer and the Tropic of Capricorn, located respectively 23.5 degrees latitude north and south of the equator. These commentaries propose that before the *mabul* no such tilt existed (Malbim 8:22). Because it is this tilt that causes the temperature and length of daylight to vary throughout the year [1-2], in such a situation

"each night and day everywhere on the Earth would always be 12 hours long and there would be no seasons" [3].

Additionally, the Midrash states that prior to the *mabul* all land masses were connected. According to the most current geological theory referred to as plate tectonics, there was a point in time when the land masses, which we know today as the seven continents, were interlocked to form one large contiguous mass of land. The theory of plate tectonics asserts that the outermost crust of the Earth is composed of a series of plates that slowly move. It is therefore possible for the continents to initially have been interconnected and subsequently to have separated, a phenomenon known as continental drift, to form the current geography of the Earth. According to the commentaries, other differences in the Earth before the *mabul* include the absence of many mountains present today and a more robust soil, in which planting was only necessary once every forty years [4].

Dr. Yaacov Hanoka draws a parallel between the rapid changes described in Judaic texts and what is known about the end of the age of the dinosaurs, which probably resulted from the impact of an asteroid on Earth. The asteroid that struck this planet in the Yucatan Peninsula in Mexico and ended the dinosaur age produced an explosion "equivalent to one hundred trillion tons of TNT" [5]. The resulting depression, nicknamed the "crater of doom," was known by local Mayan tribes as the Chicxulub Crater. It "is approximately 180 kilometers in diameter and is surrounded by a circular fault 240 kilometers in diameter, apparently produced when the crust reverberated with the shock of the impact" [5]. The asteroid impacted in a sulfur-rich area [6], causing billions of tons of materials rich in sulfur to form a cloud covering Earth and blocking sun rays, resulting in total darkness for several months. Other

catastrophic events included earthquakes, calculated at one hundred thousand times more powerful than anything witnessed in recorded history, and enormous tsunamis (or, seismic sea waves), possibly several kilometers high [4]. Because the crust of the Earth varies in thickness between ten to seventy-two kilometers, the asteroid could very likely have blasted its way through the outermost crust of the earth and into the mantle. The impact of the asteroid, explains Dr. Hanoka, was probably the cause of the sudden and immediate death of the dinosaurs, as well as most other zoological and botanical life forms [4].

In addition to the asteroid that impacted on the Yucatan Peninsula, evidence of a second asteroid impact in the Indian Ocean was found through the detection of microtektites. Microtektites are glassy round solids, approximately one millimeter in size, formed by the heat produced by the impact of an asteroid on Earth. The locations at which these two asteroids impacted are near the Tropic of Cancer and the Tropic of Capricorn, respectively. It is possible that the dual impact at 23.5 degrees latitude north and south of the equator, resulted in the 23.5 degree tilt of the Earth [4]. Recent data shows that during the era of the dinosaurs the temperatures on Earth were warmer than today, particularly in the north and south poles [5]. Perhaps, according to this theory, the warmth on the poles of the Earth was a result of there being no tilt to the planet's rotation.

The *Talmud Bavli*, in *Brachos* 59a and *Rosh Hashanah* 11b, mentions that two extraterrestrial forces were brought into play in the time of the *mabul*. Perhaps this is a reference to the above-mentioned two asteroids that impacted the Earth. Dr. Hanoka suggests that during the forty days of the *mabul*, these two asteroids simultaneously struck the Earth, one in the Yucatan Peninsula and the other in the Indian Ocean. These impacts, in addition to the water that flooded the land, killed all life outside of Noah's ark, including the dinosaurs. Additionally, the force of these impacts was significant enough to separate the one contiguous land mass into separate units. The separated land units then moved, because of the underlying plates of the Earth, to form the continents that exist today. The impacts of the asteroids were also the cause for the tilting of the Earth on its axis, which in turn caused the major changes in Earth described by the commentaries [4]. Lastly, the devastation in the ability of the Earth to produce food may be

attributed to the huge amounts of sulfur deposited upon its soil [7].

The theory that the *mabul* took place at the end of the age of the dinosaurs superceded Dr. Hanoka. The Netziv, in his commentary on the *mabul* (Genesis 7:23), suggests that the creatures known as dinosaurs existed prior to the *mabul*, but were subsequently destroyed. The *Midrash Shemot Rabbah* reveals that not only were the people before the *mabul* corrupt, i.e., involved in inappropriate relationships, but the animals too interbred outside their species (Chapter 30). The dinosaurs, suggests the Netziv, were the hybrid offspring of such inappropriate interbreeding. Because they were not a natural creation, the dinosaurs were not taken onto the ark by Noah, therefore, ceased to exist after the *mabul*.

There is, however, one very obvious problem. According to this understanding, the extinction of the dinosaurs occurred approximately sixty five million years ago, a significantly different estimate from that of four thousand years made by Jewish sources. A possible answer to this dilemma relates to inconsistencies inherent in the scientific dating methodologies. Current methods of dating use radioactive isotopes. Overtime, these relatively unstable elements convert to isotopes of another element that has an equal atomic weight. The rate of this decay, measured by the given element's half-life, or the time it would take half of the original element to decay into the daughter product, varies per element. Scientists can calculate the amount of the parent element that decayed, by using the ratio between the remaining daughter element and other elements present in the material. This ratio and the known half-life of the element can be used to estimate the age of the material of interest.

Two important examples of such radioactive elements are carbon 14 and potassium 40. Carbon 14, produced in the upper atmosphere of the Earth by the interaction of cosmic rays with nitrogen 14, has a half-life of 5,730 years. This radioactive carbon combines with oxygen to form carbon dioxide, a gas that eventually enters most living organisms. When an organism dies and the carbon dioxide is no longer exchanged between the organism and its surrounding environment, carbon 14 within the organism undergoes radioactive decay to revert back to nitrogen 14. The original ratio of radioactive carbon 14 to its non-radioactive counterpart, carbon 12, can be established by measuring the ratio of the two carbon

isotopes in the organism. Based on this ratio, the amount of carbon 14 that has decayed can be calculated. This data can be used to directly determine when the organism died. Whereas the carbon 14/12 system is used to date organic matter, the potassium-argon system is used to date inorganic material. Potassium 40, a radioactive element with a half life of 1.3 billion years, is found in most rock-forming minerals. Potassium 40 decays to form argon 40, which as a noble gas is extremely stable. By measuring the ratio between potassium 40 and argon 40 in a given rock sample, the date of the formation of that rock can be approximated [8].

Both of these dating techniques rely on two assumptions. The first assumption is that the ratio of the two elements being measured always starts as a known constant. The second assumption is that decay occurred in a closed system that was impermeable to extreme conditions. These methods fail to account for the fluctuating amounts of elements or the effect of extremely elevated temperatures and other environmental factors on the rate of radioactive decay. In other words, these methodologies rely on the uniformitarian assumption that the state of nature has always been as we perceive it to be now [4].

These assumptions are key to aligning a four thousand year old *mabul* with a destruction that is dated at sixty five million years ago. The *mabul*, as it is described in Jewish sources, is precisely the sort of catastrophic event that is not accounted for by the uniformitarian assumption. In regard to carbon 14 dating, the lack of tilt in the Earth's rotation around the Sun may mean that a different ratio existed between carbon 12 and carbon 14 from what exists today. Organisms that died both before and during the *mabul* would, therefore, have had a different ratio of these two elements in their bodies when they died. Because the original starting ratio in these creatures is unknown, the total amount of decayed carbon 14 can not be calculated [9]. In potassium-argon dating, temperatures above a few hundred degrees centigrade would cause the argon 40 gas to evaporate from the rock sample at a more rapid rate than normal. Such evaporation violates the assumption of uniform decay and forces the conclusion of an age much younger than the actual age of the rock. In the other direction, the injection of argon from another source into the system can force a recording of an age significantly higher than the true age. In fact, such an occurrence

was recorded in volcanic rock from a volcano in the Hawaiian Islands, known to have formed in 1801, yet measured through the potassium-argon dating technique to be about three billion years old. Thus, the very nature of the *mabul* as it is described, presents a scenario for which current dating techniques are not reliable [4].

Nonetheless, it remains problematic to date the worldwide *mabul* to four thousand years ago. Studies indicate that immediately after, perhaps within hours, of the impact of the asteroid(s) upon the Earth, enormous wildfires broke out, which aided in the complete destruction of the dinosaurs [5]. The evidence for the wildfires is large amounts of carbon remnants. The only possible way that the remnants can be formed is from destruction by fire. However, according to the *mabul* theory, the Earth at this time was covered in large amounts of water, and remained that way for the greater part of a year. In such a case the spreading of fires would have been all but impossible. The recent study by Kring and Durda also attributes the abundance of microtektites on the Tropic of Capricorn to rebounding debris from a single asteroid in the Yucatan Peninsula. If this is true, then only one asteroid, and not two as suggested by the Midrash regarding the flood, struck the Earth during the destruction of the dinosaurs.

The histories of China and other nations of the Far East also prove difficult. The Chinese claim to have documentation of their history dating back as far as seven thousand years ago, long before the proposed date of the *mabul*. Additionally, though there are multiple flood legends in ancient literature (many traced to Mesopotamia, the region where Noah lived and where the ark eventually landed after the flood,) none have been traced to China [10]. Furthermore, while remarkable linguistic studies have traced the origins of languages from as far away as India, back to the Mesopotamian area [11], the origin of the Chinese language has not been similarly traced.

Mesopotamia is an area bordered by the Tigris and Euphrates rivers. Interestingly, a regional flood that deposited large amounts of sedimentary rock in the area has been traced to five thousand years ago, roughly the time of the *mabul* [12]. As noted above, many flood legends, most notably The Epic of Gilgamesh, are also traced to the Mesopotamian region at about the time of the *mabul*. Can the language of the Torah be reconciled with a regional flood? Perhaps.

The word used by the Torah to describe the extent of the *mabul* is the word *aretz*. This same word is used throughout the telling of the creation, in which the word *aretz* clearly refers to the entire Earth. However, in many places in Torah the word *aretz* does not refer to the Earth in its entirety, but rather to a specific piece of land. This interpretation opens the door to a second theory – that the scope of the *mabul* was not the entire Earth. Examples of such verses are Genesis 27:46, where *aretz* means the Land of Israel, and Genesis 42:9 where it means the land of Egypt.

Additionally, chapter 11 of the *Midrash Pirkay D'Rebbe Eliezer* lists ten kings who ruled over the whole *aretz*. While one of these kings was Nimrod, who in the events following the *mabul* united what was seemingly the whole world to build the tower of Babel, another king was Alexander the Great. He lived in the fourth century B.C.E., and is known to have not ruled over the entire Earth. Rather, the extent of his kingdom spanned from Egypt and the Mesopotamian area to central Asia, including parts of India.

There are other Jewish sources that generate thought on the scope of the *mabul*. According to Rabbi Yochanan, the *mabul* did not rain on Israel (*Zevachim* 113a). Similarly, it seems from the *Midrash* that the Mediterranean Sea sustained life during the time of the flood (*Bereishis Rabba* 32:19). Additionally, in *Bereishis* 6:4, before the *mabul* occurred, the Torah relates a race called the *nifilim*. Later, in *Bamidbar* 13:33, when the spies bring back their report to the Jews in the desert, the presence of the same *nifilim* is mentioned. Rashi notes that these were descendants of the original *nifilim* from before the Flood. Furthermore, the ark landed on Mt. Ararat, a mountain about 17,000 feet above sea level. However, Mt. Ararat is not the tallest mountain in the world; Mt. Everest, most notably, stands at around 29,000 feet. Mt Ararat is however the

tallest mountain in Mesopotamia.

The *Torah Temimah*, the commentary of Rabbi Baruch HaLevi Epstein (1860 - 1942), supports the view of a regional flood. "Regarding Babylonia receiving more rain than any other land in the world and being drowned by the flood...Babylon was therefore called *Shinar*, because all the creatures that perished in the flood were tossed there" [10].

The regional theory neatly solves several problematic questions in regard to the Flood. The dimensions of the ark seem too small to house the full complement of animal life. However if the Flood was only regional, only animals unique to the Mesopotamian area would need to be saved. Similarly, water levels on the Earth today would be sufficient for a regional flood, though not a universal one [10].

There are, however, difficulties in the theory of a regional flood. From the discussion about Israel being exempt from the waters of the Flood it seems that even according to the opinion of Rabbi Yochanan, all life was eradicated from the

Land of Israel (*Zevachim* 113a-b). The *Torah Temimah* quoted by Dr. Kaveh does not seem to suggest that there was human life besides for Noah and those in his ark. Another commentary that allows for the idea of a regional flood, the *Da'as Z'Kaynim*, explicitly emphasizes that while the scope of the *mabul* may have been limited geographically, it necessarily encompassed the entire human population on the Earth. From the text itself it would also seem that all human life descended from Noah. Why else would it be Noah who is allowed to eat meat and who is commanded what will come to be known as the seven Noahide laws which seemingly apply to all of mankind? If the literature of the Flood claims that it affected all of mankind, then the challenges presented by the Chinese remain difficult.

Additionally, other commentaries attribute the survival of the *nifilim* to either the lineage

“According to this understanding, the extinction of the dinosaurs occurred approximately sixty five million years ago, a significantly different estimate from that of four thousand years made by Jewish sources.”

of the wife of Noah or to Og, another known survivor of the flood. Another difficulty is the substance of G-d's oath to Noah. While G-d promises Noah that there will never be another *mabul*, there have been many regional floods since that time. What then is the import of G-d's promise to Noah?

A combination of the above theories can lead to a third hypothesis, that of a regional flood during the time of the destruction of the dinosaurs. This theory is supported by the fact that very little of the carbon remnants discovered lie within the Mesopotamian region. Thus it is possible that Mesopotamia, because it was

covered in the Flood waters, was protected from the wildfires that affected the rest of the world. While such a theory is still challenged by the claims of the Chinese and the doubt of the number of asteroids in question, it avoids the clash with the proof for wildfires.

As more is known about our origins and the origins of our planet, we will come to understand more deeply the teachings of the sages. Hopefully, as more information becomes available on the subject of Noah's Flood, we will be able to more fully comprehend the facts relayed to us by the Torah and the messages conveyed within. ■

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Divine Dentistry

Diane Liebman

Contrary to popular belief, prosthodontics is not a recently discovered field of dentistry. In fact, people have been practicing prosthodontics since Biblical times. Although most advancements in the area, both diagnostic and procedural, are of late, the basics are from ancient ideas.

Aesthetics have always been important to people and to be missing a tooth was always considered an embarrassment, especially for women. Actually, Talmudic writings do not even mention tooth replacement in regard to men since it was purely for cosmetic reasons [1].

Historically, dentists produced artificial teeth, however these teeth presented a problem according to the Jewish Law. In the Talmudic tractate *Shabbos* (64b-65a), there is discussion of the prohibitions of carrying on the *Shabbos* day in violation of the Biblical command forbidding "work." Various objects forbidden to be carried or worn by a woman in a public place are listed, and included is the false tooth: "As for an artificial tooth, (or) a gold tooth, Rabbi permits it but the Sages forbid it." In their debate, the psychological side to the denture-wearing female was also taken into account. One opinion was that due to the value of the gold, the woman may be tempted to remove it and show it off to her friends, thereby violating the commandment. Another opinion was that as it is embarrassing to need a false tooth, it is not necessary to worry about her showing it off. A concern though, was that due to this embarrassment the woman may remove the tooth from her mouth and hold it in her hand to hide it. If the tooth was made of silver, it is not as problematic since it is not as valuable as gold, so the woman would not remove it to show it off. Also, it is considered indistinguishable from the other teeth in the woman's mouth so she would not be concerned with other people possibly noticing. However, the law regarding

an artificial tooth made of wood was not discussed [2].

In the *Yerushalmi, Shabbos* 6:5, it is written as "an artificial tooth and a gold tooth". The gold tooth is forbidden to be worn in public on *Shabbos* because if it were to fall out, the owner would surely pick it up (i.e. carry it), due to its value. If an artificial tooth were to fall out, it too would be picked up because the woman would be too embarrassed to go back to its maker and ask for another one to be made [3].

Apparently, there were different ways of producing artificial teeth. Some were made of wood, while others of gold and some of silver. It depended on the need of the individual, the purpose of the treatment, and the financial situation of the individual.

Commentators have attempted to determine the meaning of the phrase "artificial tooth." The word *toseves*, translated as "artificial" may be derived from the root meaning "foreign," possibly indicating wood or ivory. Or, it might come from the root meaning "cover" denoting a crown [3]. Rabbi Ovadiah of Bartanura, a commentator on the Mishna, replaces the "*Saf*" with a "*Shin*", as is acceptable in the Aramaic language, and refers to the prostheses as "*tosheves*" instead of "*toseves*". This word now has the meaning of "positioned/placed." He explains the artificial tooth as "positioned resting on the cheek in the place of the tooth she lost" [4].

The "artificial tooth" was probably generally made of an inexpensive material, wood or ivory, constructed by a *nagra*, which may be interpreted as a carpenter or similar artisan, whose fees were affordable for the commoner. Possession of a gold tooth does not appear to have been very unusual, though definitely considered a luxury worth showing off. Silver was probably also used in the formation of some prosthetic devices [3].

If needed because of a missing tooth, whether congenitally or due to its falling out or its extraction, the artificial tooth was usually made of wood. If, however, its purpose was to cover a tooth, due to breakage, it was usually made of gold or silver.

According to Rabbi Ovadiah and Maimonides, in their commentaries on the Mishnah, a discolored tooth, due to decay, was covered with gold to conceal the defect, either as a complete covering or in the form of a crown [4].

Fast-forwarding in time to the Holocaust, a question arose regarding the gold teeth of corpses. According to Jewish Law, it is forbidden to derive any benefit from a corpse. When the Kovno Ghetto residents came out of their hiding places, they saw skeletons of bodies burnt by the Nazis. False gold teeth were also found and so the people asked Rav Efrayim Oshri if they could derive benefit from them. In his answer he distinguished between two types of false teeth. One may not derive benefit from those that are permanently attached acting as coverings to existing teeth. However, from those that have replaced teeth and are removable, one may derive benefit [5].

Another instance where prosthodontics presents an issue according to Jewish law involves a bodily immersion, *tevilah*, in a ritual bath, a *mikvah*, which must be performed at certain times. The entire body must be in contact with the water. One must therefore, remove any physical barrier, *chatzitzah*, that may hinder the ritual bath. Fixed prostheses and braces are not considered to be a *chatzitzah* and so one is permitted to perform the *tevilah* with them. Removable dentures and orthodontic appliances must be removed.

Permanent and temporary fillings are okay, but if they cause discomfort or dysfunction, or could fall out, one must have them fixed [6]. Practically, this is a complicated issue involving the specifics of the individual situation, such as for how long the dental fixture has been in and the positioning of it [9-11].

In the past 20 years, prosthodontics have come a long way. Dental implants are no longer made of gold, silver, or wood. They are made of various materials. Titanium is most often used due to its compatibility with human tissues [6]. "The tiny titanium posts, acting as tooth root substitutes, are inserted into the jawbone where the teeth are missing. The bone bonds with the titanium, creating a strong foundation for artificial teeth. Small posts which protrude through the gums are then attached to the implant. These posts provide stable anchors for artificial replacement teeth, or crowns" [8]. Today, after

receiving dental implants, they would not be noticeable. The process can take several months but once completed, the person has strong and natural looking teeth [7].

In the past, "a denture was a false tooth inserted in a woman's mouth in a temporary fashion, kept in place by pressure from the other teeth." The proximal tooth friction kept the replacement from moving. However, this force was reduced rather quickly thereby rendering the replacement only temporary [4]. The dentures of today are much stronger and can last a lifetime [7].

Despite the fact that it is the recent discoveries which dentists will consider relevant, they must still recognize the important contributions of their ancestors who provided the basis for many, if not all, of these findings. ■

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Anthrax in Biblical Egypt

Dana Lotan

One of the most meaningful principles in the Jewish faith is *Giluy Schina*, the revelation of the presence of G-d, or *Hashem*, to the public. *Hashem* reveals His greatness to Jews as a kindness to them, such as by bestowing health, as well as to motivate a dedication and love for Judaism. *Hashem's* splendor is manifested to the public, such as through the wonders of nature, to prove how only He controls the world. On Passover, Jews read verses from the *Hagaddah*, a pamphlet assembled by Rabbis in regard to the Jews' emancipation from slavery in Egypt. The *Hagaddah* states, "*Ubemarah gadol ze Giluy Schina*," which means, "And with great awesomeness – this is the revelation of the Divine Presence" [1]. According to the renowned Jewish scholar, the Malbim, the similarity between the Hebrew word "*marah*" or "awesomeness" and the Hebrew word "*mareh*" or "appearance," indicates that the method *Hashem* uses to reveal His sovereignty to the public is through a great physical phenomenon.

But what is this great appearance? *Hashem* reveals himself by *derech hateva*, the way of nature. This method involves the use of elements in nature and science, such as processes in biology, chemistry, and physics. These tools of science are *Hashem's* army – by utilizing the extraordinary processes in nature, *Hashem* is able to spread His glory to the public. For example, *Hashem's* prominence was with no question evident when He split the sea for the Jews or when He caused water to pour out of a large stone to provide the dehydrated Jews with much needed fluids in their journey through the sweltering desert.

Yet one must understand that *Hashem* does not only reveal Himself through massive miracles. Other processes in nature, such as rain, may seem simple to the naked eye, but when studied intently, even these processes are remarkable.

Hashem recognizes this and therefore also uses "simple" nature to reveal Himself and impress the public. Of the ten plagues that were cast on the Egyptians before the Jews were freed from slavery, the sixth plague, boils, or *schin*, may at first seem simple to an individual. One might believe that this was just a plague that caused all the Egyptians great discomfort by attacking their skin. However, many scholars believe that the boils were actually an anthrax infection. Anthrax is a highly infectious disease that is caused by exposure to spores of the bacterium, *Bacillus anthracis* [2]. This plague is a perfect example of how *Hashem* incorporated seemingly simple processes in nature and science to reveal His greatness to the public. The life cycle of the anthrax bacteria is far from average – it is a precise and planned process of the bacteria attacking its host. The fact that a microscopic bacterium caused countless numbers of Egyptians to be ill for days reveals *Hashem's* presence.

One must first understand how it is possible for the plague of boils to be considered anthrax. A stimulating discussion arose between biblical scholars, physicians, and scientists on this point. One such scholar, Philologos, used vernacular to argue in support of boils as an anthrax infection. In Greek, boils are defined as coal, because like the appearance of coal rocks, boils appear as small, reddish-black, and glowing lesions on the skin. The cutaneous form of anthrax, transmitted through a cut or abrasion of the skin, attacks the body much like boils do – by causing small, shiny, dark lesions on the skin. An anthrax infection is first evident when the infected person develops a skin papule that ulcerates, called an *eschar* [2]. For this reason, in Greek, even anthrax is defined as coal rocks, as well as in Hebrew, anthrax is defined as *gahélet*, which also means coal rocks, both alluding to boils on the skin [3]. Furthermore, anthrax is a highly

contagious disease, mostly attacking animals such as sheep, goats, and cattle. Anthrax is transmitted to humans by direct contact with these animals and their products. The fifth plague in Egypt, cattle pest, or *dever*, quickly killed all of the Egyptian's cattle. Many scholars believe that such a vast and rapid killing of animals was only possible by an outbreak of anthrax, even more so because scientists believe *B. anthracis* originated in Egypt. Moreover, the nature of *B. anthracis* spores allows them to be dormant, yet viable, in soil and animal products for years, making the sixth plague of boils, in which humans were affected, all the more likely to be an anthrax infection.

Since anthrax is known to spread most effectively by animals, it is important to note that the other areas of the Torah, or Bible, allude to anthrax. For instance, the Biblical law instructs one who has touched a dead animal to purify himself. Purification must be attained by such measures as visiting the *Kohen*, or priest, washing one's clothing, and destroying one's utensils. Although this mode of purification was for spiritual defilement, a side hygienic benefit is evident if the animal died of an anthrax infection which could easily spread to the individual who touched it. Moreover, one is prohibited of selling leather sandals by wrongfully claiming the leather is from a dead animal as opposed to a slaughtered animal. This is because the dead animal may have been attacked by a venomous snake that could have left a poison, probably anthrax spores, on the leather later made into sandals [4]. These points show that even the Bible supports the idea that anthrax mostly infects animals, and thus the Egyptians may have acquired the infection through their cattle that *Hashem* infected with anthrax in the fifth plague.

The biology of *B. anthracis* perfectly matches the course of the sixth plague as described by the Bible, which further supports the idea that the boils were indeed anthrax [5]. The Bible states: "Take to you handfuls of ashes of the furnace and let Moses sprinkle it toward the heaven in the sight of the Pharaoh. And it shall become small dust in all the land of Egypt, and shall be a

boil breaking forth with blains upon man, and upon beast, throughout all the land of Egypt" [6]. This verse shows that the plague was airborne. It originated by the spreading of "dust" in the air and then caused a severe skin condition in the animals and people. The pulmonary form of anthrax fits the Bible's description of its outspread and effect. Anthrax spores may be airborne, spread fast, affect animals and people, and cause severe skin irritations like the "dust" thrown by Moses. This idea is further explained by other statements in the bible such as: "The Lord will smite thee with botch of Egypt, and with emerods, and with the scab, and with the itch, where of thou canst not be healed" [7], and "The Lord shall smite thee in the knees and in the legs, with a sore botch that cannot be healed, from the sole of thy foot unto the top of thy head" [8]. From these Biblical statements, one can understand the details of the sixth plague, which perfectly match the clinical symptoms and natural life of *B. anthracis* [9].

These proofs lead one to believe that anthrax may have been the sixth plague of boils. The power of nature and science to reveal *Hashem's* glory is evident in the whole of Egypt being infected with a

minute, not even visible bacteria. A part of nature that seems so simple, such as *B. anthracis*, has dangerous consequences that can cause an epidemic like the one in Egypt. Rather than being plain, the natural life cycle of the anthrax bacteria is quite amazing. For example, the appearance of boils on infected persons is a result of anthrax toxins. *B. anthracis* possesses exotoxins, which are proteins such as EF, LF, and PA, that are released onto the host's tissues. These exotoxins travel between the tissues of the body and cause the symptoms of an anthrax infection. Exotoxins are actually among the most lethal substances known. Interesting, these toxins are encoded by plasmids transmitted to the bacterium. Plasmids are small, circular, double-stranded DNA molecules in bacteria that can transfer certain genetic material between bacteria. Toxins help the bacteria better establish itself in the host and aid in its resistance to defenses from the host. In an infection with *B. anthracis*,

"The fact that a microscopic bacterium caused countless numbers of Egyptians to be ill for days reveals Hashem's presence."

the effects of the exotoxins are localized edema, high toxicity levels, and death of target cells and the host. The presence of these toxins will also eventually cause the symptoms of an anthrax infection to become visible. Although anthrax may be cutaneous, pulmonary, or gastrointestinal, the appearance of boils of the Egyptians was most likely a result of exotoxins found for a cutaneous infection of *B. anthracis*.

The amazing biology of *B. anthracis* shows how the nature and science of microbiology

helped Hashem spread His *Giluy Schina*. By *derech hateva*, Hashem was able to use His army of biology, chemistry, and physics to spread His greatness. Even seemingly unthreatening or passive occurrences in nature are actually all phenomenon. If there were no intricate, well thought out details of the life cycle of *B. anthracis*, for example, then the widespread infection of the Egyptians would not have been possible, and thus *Giluy Schina* would never have taken place. ■

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Seize the Moment:

Occurrences of Seizures in Biblical and Talmudic Times

Eliza Moskowitz

The historical accounts of a disease not only provide insight into the past, but may shed light on modern day medical dilemmas. Although our sacred Torah is by no means a medical manual, it provides a tremendous amount of information concerning numerous diseases and disorders, including seizures. A seizure is defined as a "paroxysmal event due to abnormal, excessive, hypersynchronous discharges from an aggregate of central nervous system (CNS) neurons" [1]. Approximately 5-10% of the world population will suffer from a seizure at least once in their lifetime [1, 2].

Seizures occur as a result of abnormalities in the balance of neuronal inhibition and excitation throughout the CNS. Given the many properties that simultaneously aid in the control and organization of neuronal excitability, it is not surprising that there are likewise a multitude of events that can agitate the homeostatic environment that exists within the human brain. These events represent the various causes of seizure disorders, including epilepsy and delirium tremens [1].

Nonspecific changes such as headache, mood alterations, lethargy, and accidental jerking may occur periodically before an impending seizure [3]. In many patients, visual, auditory, or olfactory auras may signal an impending seizure [1]. Seizures sometimes can occur at a particular time (i.e., during sleep) or can be due to emotional or psychological stresses or provocations, such as lack of sleep, missed meals, or drug/alcohol use. In some patients, seizures are provoked by specific stimuli, such as loud music or flashing lights [3].

The etiology of the seizure can help in providing a proper treatment plan. Seizures can be idiopathic in nature, in which case no specific cause can be identified. In contrast, symptomatic seizures have definitive, identifiable, causes, such as epilepsy, metabolic disorders, including hyper- and hypoglycemia, uremia, and those precipitated by sudden

alcohol or drug withdrawal, genetic abnormalities, acute trauma (especially if the dura mater was penetrated), vascular disorders (especially among the elderly), infectious diseases (including bacterial meningitis and encephalitis, as well as other infections of the CNS), and tumors or other space-occupying lesions. In developing an effective plan of treatment, knowledge of the specific type of seizure is essential [1].

The pathophysiologic mechanisms in the development of seizures are not, at yet, well delineated. Yet, experiments have shown that there is usually a "seizure initiation phase," in which minimal seizure activity begins in a discrete region of the cerebral cortex, followed by a "seizure propagation phase," during which activity spreads to neighboring regions. The initiation phase is characterized by: 1) an influx of calcium and sodium ions into the cell and the ensuing generation of repetitive action potentials and 2) hypersynchronization resulting from the hyperpolarization by $\bar{\alpha}$ -aminobutyric acid (GABA) receptors. This hypersynchronization may inhibit dipolar neurons or may activate the hyperpolarized neurons. Normally, this propagation of hyperactivity is prevented by a group of cells, the inhibitory neurons. However, in the event of a seizure, there is a loss of inhibition factors, and thus, seizure activity ensues [1]. Again, it is important to emphasize, that our understanding of epileptogenesis still remains far from complete, and the essential question of *why* alterations in excitability or neuronal circuits cause a paroxysmal disorder such as epilepsy remains yet unanswered.

EPILEPSY

Epilepsy represents only one of many forms of seizure disorders. Epilepsy was originally defined by the physician Hughling Jackson, who is credited as being one of the founders of modern neurology. Jackson, in 1873, described epilepsy as

"episodic disorders of the nervous system arising from the excessively synchronous and sustained discharge of a group of nerve cells" [4]. The meaning of the word "seizure" must be carefully differentiated from that of epilepsy, which describes a specific state of illness in which a person suffers from *recurrent* seizures due to a chronic, underlying physiological disorder, as opposed to a single seizure, or even recurrent seizures, due to rectifiable conditions. When discussing these two conditions, it is important to note that an individual who suffered one or more seizures does not necessarily have the actual, neurological disorder termed "epilepsy" [1]. Similarly, in Jewish law, there is a "threshold requirement" in order to deem a person epileptic: some rabbis rule that a single episode is sufficient to deem a person epileptic, while others require three episodes [5].

As, at some point, one out of every 200 people suffers from epilepsy [1, 6]; it is one of the most commonly studied neurologic diseases, from both medical and psychosocial standpoints. It is therefore not surprising that epilepsy is also one of the oldest clinical pathologies to have been recognized as a specific disease [6].

There are two basic types of epileptic seizures: generalized and partial, distinguished primarily by whether or not the patient experiences a loss of consciousness [7]. Generalized seizures include tonic-clonic (grand mal) and generalized absence (petit mal) seizures. Grand mal seizures are characterized by a sudden loss of consciousness [3]. The patient becomes rigid, falls to the ground, and respiratory arrest ensues. This so-called "tonic phase" usually lasts for less than a minute and is followed by a "clonic phase" during which there is muscular jerking typically lasting for 2-3 minutes [1, 7]. During the seizure, the lips or tongue may be bitten and urinary and/or fecal incontinence may occur [1]. Confusion, disorientation, nausea, muscle soreness, and headache are all common complaints following these seizures. Petit mal seizures are characterized by a loss of consciousness and an abrupt onset and termination [3]. Attacks may even occur during conversation, in which case the patient may stop midsentence only for a moment. The neurological impairment is so brief that many times even the patient may be unaware that he is suffering from a generalized seizure [3] and, in many cases, has no memory of the event [8].

Partial seizures may be partial simple (focal) or complex (psychomotor), and electroencephalographic manifestations indicate that such

seizures affect only a restricted part of a single cerebral hemisphere [1]. Manifestations vary based on the affected area. In focal seizures consciousness is preserved, while in psychomotor seizures it is impaired [3].

Optimal treatment of epilepsy is attained via a variety of antiepileptic drugs. Drugs currently available act, via a variety of mechanisms, to block the initiation or spread of seizures [1, 9]. Such drugs have pleiotropic effects, affecting not only the CNS, but other systems of the body as well [1]. Mechanisms of drug action include increasing the bioavailability of GABA (valproic acid, gabapentin, and tiagabine), and inhibition of calcium ion channels (phenytoin) [9].

Talmudic sages recognized that epileptics frequently suffered from seizures often after various provocations [10]. Being that epilepsy was a disease well-recognized in Talmudic times, what was believed to be the optimal therapeutic treatment of the condition is elucidated in the Talmud [11, 12]. Recognized to be of medical value in the treatment of epilepsy is the "*kemaya*" or amulet. Amulets, worn on a chain or as a ring, were prescribed for the treatment of epilepsy and for the prevention of epilepsy among those who feared they may develop the illness [11, 12, 13].

Three instances of individuals who exhibited epileptic symptoms similar to those described in today's medical literature can be found in the Torah. The prophets, Yechezkel (Ezekiel) and Bilam (Balaam), as well as King Shaul (Saul), are all believed by some to have suffered from various forms of epilepsy according to some historians and Torah scholars [13, 14, 15].

YECHESKEL - TEMPORAL LOBE EPILEPSY (TLE)

Patients with temporal lobe epilepsy exhibit a multitude of very specific symptoms including, but not limited to, hypergraphia, aggression, pedantic speech, and psychosis [5, 14, 16]. Hypergraphia, or compulsive writing, is of particular importance in providing a diagnosis of TLE, as it is rarely seen in other disease forms [17]. Indeed, the book of Yechezkel, authored by its namesake, demonstrates repetitive hypergraphia: it is the fourth longest book in the entire Tanach, more than twice the length of *Sefer Vayikra*, and nearly as long as the entire *Sefer Bereishis* [14]. The fact that Yechezkel tours his readers around every aspect and angle of the *Beis Hamikdash*, many believe, is indicative of

hyperphagia [14]. He also demonstrates focal neurologic symptoms consistent with a diagnosis of epilepsy [5, 16], including multiple episodes of fainting spells [14, 18-21] and mutism [14, 22-24]. The occurrence of TLE over 2,600 years ago is helpful in providing a basis for the current belief that TLE represents a common endpoint for a multitude of genetic factors acting in concert [14].

SHAUL - CHOLI NOFEL

"Choli nofel," or falling sickness, is the Torah's term for epilepsy. Hence King Shaul, according to the great Torah scholar and medieval physician Maimonides, is thought to have suffered from epilepsy [15]. "And [Shaul] fell (*vayipol*)...that entire day and night [25] – this "*nefila*," or "falling" may be descriptive of epilepsy. The book of *Shmuel Aleph* further describes Shaul's uncontrolled violent behavior, caused by an "evil spirit" sent from G-d and which took possession of the king from time to time. "Behold now, an evil spirit from G-d is tormenting you," Shaul is told by his own servants [26]. Two chapters later he is told, "and it happened the next day that an evil spirit from G-d rushed upon Shaul, and he raved incoherently within his house" [27]. Some sort of evil spirit precipitated his seizures and violent behavior which, in part, is consistent with the Talmudic analysis [28, 29] that demons played a part in the causation of epileptic seizures and other seizure disorders [28-30]. The violence Shaul exhibited along with his seizures is also consistent with the medical literature, for violence is often associated with various forms of epilepsy [31].

BILAAM - NAFAL VE'ILUI AYNAYIM

Bilaam, the prophet who attempted to curse the Nation of Israel during the course of their 40-year desert sojourn, also may have suffered from epilepsy [13]. Indeed, modern commentators conclude that slight syntactic changes in the verses preceding Bilaam's prophecy indicate that G-d would only appear to Bilaam when he was in a state of seizure (a state Bilaam refers to as "*nofeil veilui aynayim*" – fallen with open eyes) [32].

DELIRIUM TREMENS

After the human brain has been exposed on a number of occasions to large quantities of alcohol, a rapid reduction of intake can create withdrawal

symptoms, including, but not limited to, increases in pulse, temperature, and respiratory rates, anxiety, and tremors or jittering [1]. About 5% of alcoholics experience "rum fits," or withdrawal seizures, which are generalized (grand or petit mal) seizures [1, 10] occurring within 12 - 48 hours of the cessation of alcoholic consumption [10].

Delirium tremens is a disorder that can induce a seizure secondary to excess alcohol exposure followed by sudden alcohol withdrawal. This definition includes mental confusion, fluctuating levels of consciousness, severe agitation, convulsions and hyperactivity of the autonomic nervous system [1], lasting for several months in some individuals [33]. Seizures (which occur within the first few days of acute alcohol withdrawal) and delirium tremens will affect up to 10% of alcoholic individuals [1, 3, 34]. Underlying medical and/or psychiatric disorders and evidence of brain damage complicate this condition; thus identification and treatment of underlying disorders should be undertaken before attempts are made to resolve this complex neurological disorder [1].

TALMUD

In the Talmud, the condition known as "*kordiakos*" may refer to withdrawal seizures occurring throughout the course of delirium tremens, secondary to alcoholic addiction [13, 35]. Prominent physicians [36] agree that this term serves as one of the earliest references to delirium tremens. Today, the prevalence of delirium tremens remains relatively high. In one study, intoxication was detected in the immediate history of 49% of 560 consecutive patients brought to the Emergency Department of a hospital in Helsinki after suffering a seizure. The seizures preceded delirium tremens in a significant number of the patients [34].

Delirium was well known to the ancients and was differentiated from the greater category of generalized madness or insanity. Hippocrates himself wrote of "*carphologia*," a condition in which an acutely febrile patient would search his bed for hallucinated objects. The ancient physician Galen was also aware of the debilitating nature of this disorder [36]. The syndrome or disease termed "*kordiakos*" is discussed in the Talmud as well [37]. The aforementioned condition is marked by sudden onset, in which the victim often describes being overcome or "seized" by it. The patient is also described as unable to speak, like one whose throat had been slit. The patient subsequently enters

a state of confusion and experiences dizziness and/or vertigo [36].

There seem to be a significant number of instances in the Talmud which allude to delirium tremens [37], as well as references in the corresponding commentaries [38, 39] to consider the disorder, "*kordiakos*," to be one of the earliest descriptions of delirium tremens. Heavy wine consumption, apparently, was common. Descriptions of the various degrees of drunkenness, the moral dangers involved, and the long-term physiological effects of excessive drinking are much described throughout the Talmud. *Kordiakos*, however, is the *only* condition in the entire Talmud that links acute neuropsychiatric illness with wine. Furthermore, that *kordiakos* and wine specifically are associated helps to infer that delirium tremens is the specific neurologic condition being described [36]. Additionally, the physician and great Torah scholar, Maimonides [38], in his commentary on the Talmud, actually defines "*kordiakos*" as a form of epilepsy, substantiating that the condition was a form of delirium tremens.

Interestingly, the word "*kordiakos*" is Greek in origin and resembles the Greek root word for cardiac [40], a link that may support the connection between cardiovascular disorders and a risk for delirium tremens. This is in concert with current medical findings, as Fiellin *et al.* report that an elevated systolic blood pressure (>145 mmHg) in combination with heavy alcoholic consumption and its abrupt and sudden discontinuation are associated with an increased risk of delirium tremens [4].

Treatment of the patient who has suffered from delirium tremens is complex and varies from patient to patient depending on both his medical and psychiatric states at the time of initiation of treatment [1, 40, 41]. The physician's first priority is to stabilize the patient, treating cardiac arrhythmias, respiratory depression and/or changes in blood pressure. These conditions, either induced by the withdrawal seizure or having occurred independently, must be dealt with before initiation of treatment for alcoholic addiction. If fatigued, the patient should be instructed to lie on his side to avoid complications from aspiration and/or vomiting. After dealing with the possible "withdrawal symptoms,"

the practitioner can attempt to gradually reduce alcoholic intake by the patient. The clinician must ensure that his patient receives adequate nutrition and rest while attempting to discontinue alcoholic consumption. One must recognize that the removal of alcohol, a CNS depressant, from the diet of an individual with an alcoholic addiction must be performed in a gradual manner [1]. Alcoholic intake should be titrated down slowly day-by-day and replaced (temporarily) by a CNS depressant drug; the most popular depressants are the benzodiazepines [1, 42-44]. It is important to keep in mind that due to the complexity of the disorder and its causes, treatment is often very complex as well [1, 41].

Optimal treatment for delirium tremens, as elucidated in the Mishna, was also achieved via gradual discontinuation of alcoholic consumption – first by the ingestion of highly diluted wine, followed by cessation of alcoholic beverages altogether. This treatment served to "transition" the patient to recovery, rather than abruptly curtailing or discontinuing consumption, which often causes significant withdrawal symptoms [1].

Epilepsy and delirium tremens are two examples of neuropathologic disorders in which seizures occur, affecting a significant number of individuals worldwide. These conditions have been documented, observed, studied, and treated for centuries. While modern advances in medicine and cutting-edge technology provide practitioners with the tools to better treat the individuals suffering from these illnesses, many Torah scholars dating back to Talmudic times, have documented similar symptoms and treatments as well. Although there have been significant breakthroughs and advances in the treatment of epilepsy and delirium tremens, it is interesting to note that in Biblical times those "afflicted" were often individuals who were thought to possess higher levels of holiness and intelligence, as well as stronger connections with G-d and with people. In modern times, despite all our advancements, individuals afflicted with seizures still have a certain "societal stigma" attached to them. A seizure is not defined as a disease – rather as a symptom of an underlying condition [45]. ■

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The Importance of Sleep

Helen A. Nissim

Sleep is a prerequisite for humans to function productively. People spend a large portion of their lives sleeping and do not often realize that sleep is crucial for their welfare. Research has shown that without sufficient sleep, people do not perform at their optimal level, as sleep is needed for the brain to store new information. This research has implications for a wide variety of people, from students who must memorize vast amounts of information, to businessmen who frequently analyze new data. Those who think that staying awake late into the night will allow them to remember more information are wrong, as the lack of sleep is counterproductive to the absorption of new information. Sleep has also been shown to lead to longevity, to have an effect on health, and to have a positive influence on day-to-day behavior and emotional well-being.

In *Eruvin* 65a Rav Yehuda says that night was created for sleeping. The Ramchal says that G-d saw it fit to separate the day into two portions, one half that people would devote to work and the other that would be used for rest. The Ramchal explains that during sleep a person's strength is restored, both to the body and to the soul, so that the next day the person awakens refreshed [1]. Torah sources are in agreement with current research, indicating that sleep is a crucial component in achieving an optimal performance level.

Sleep is comprised of five recurring stages, each with its own significance. Dr. S. Ancoli-Israel, Ph.D., likened the different stages of sleep to the words used in the Torah describing the various types of sleep. In Isaiah 5:27, the word, *yanum*, is used to denote light sleep or slumber, which is akin to stage one sleep, which is short and lasts approximately 5 minutes. During this time the sleeper may undergo sensory experiences that bear a resemblance to hallucinations. The next, stage two sleep, lasts for about 20 minutes and is differentiated from the other stages by bursts of

quick rhythmic brain wave activity, known as "sleep spindles" [2]. This stage is likened to situations when the Torah utilizes the words, *yashen* and *shena*, as in *Parshat Vayeitze* (28:16), to describe Jacob's awakening from sleep upon realizing G-d's presence. Ancoli-Israel explains that the words, *yashen* and *shena*, refer to conscious thought that becomes unconscious, which is a way to describe stage 2 sleep. Stage 3 sleep is a transitional phase that leads to the deep sleep of stage 4. Sleep stages 3 and 4 have durations of approximately 30 minutes. Jonah's deep sleep on the ship as it tossed *dangerously at sea is described by the word, radum* [3]. Following the fourth stage, one returns to stage 3 and subsequently to stage 2 sleep. At this point one enters rapid eye movement (REM) sleep, during which the pattern of brain waves resembles those in stage 1 sleep. However, stage 5 sleep differs from stage 1 sleep due to the presence of periodic eye movement, irregular breathing, and increased heart rate. It is during REM that dreams occur [2]. The word, *tardema*, describes the stage of sleep in which dreaming occurs [3], as noted in Job 33:15: "In a dream, a vision of the night, when a deep sleep falls over people..." [4]. Thus, the current research noting that sleep is comprised of several stages is consistent with various Biblical terminologies relate the different types of sleep. This article will now illustrate the importance of the sleep stages as a collective whole.

Much is known of the detrimental effect of a lack of sleep on daily activities. Studies with children and adolescents related their lack of sufficient sleep to their poor school grades, daytime fatigue, and difficulties concentrating in class [5]. Furthermore, subjects deprived of REM sleep for two to seven nights exhibited symptoms of irritability, anxiety, and an inability to concentrate [6]. Although insufficient sleep can be detrimental to one's daily life, nonetheless many do

not realize they have a deficit of sleep. In a study performed at the University of Pennsylvania School of Medicine, the researchers found that people who have fewer than 6 hours of sleep every night may amass a "sleep debt," i.e., an accumulation of missed hours of sleep, that disrupts day-to-day cognitive abilities. Such chronically sleep-deprived individuals stated that they felt only somewhat tired, even when their execution on psychological testing was at its worst. H. Van Dongen, Ph.D., Assistant Professor of Sleep and Chronobiology, Department of Psychiatry of the University of Pennsylvania, said, "routine nightly sleep for fewer than six hours results in cognitive performance deficits, even if we feel we have adapted to it" [7]. Peak performance levels in daily functions are only attainable with proper amounts of sleep.

Nowadays, an important part of a person's daily function that requires adequate sleep is driving. According to Cornell University psychologist and sleep specialist, Dr. J. Maas, 100,000 traffic accidents per year in the United States result from drivers falling asleep at the wheel. Annually, these accidents claim some

1,500 lives. Sleep disorders and sleep deprivation cost the American economy at least \$150 billion a year [8]. Lack of sufficient sleep may be harmful not only to one's self it can even be fatal to others.

The Rambam in his *Mishna Torah* (*Daot* 4:4) says that 8 hours is the appropriate amount of sleep. The 8 hours should be prior to dawn so that one rises with the sun [9]. In certain situations the Torah regards sleep as being necessary for function, while also emphasizing that excessive sleep is not recommended. In Proverbs 6:9 it says, "How long will you recline, O sluggard? When will you arise from your sleep." On this phrase the Alshich comments that a lazy person remains in bed and rests, even after awakened [10]. In *Kiddushin* 49b it says that a worker sleeps more than a master. Priests working in the temple could not sleep during their shift (*Tamid* 28a) and the High Priest was not allowed to sleep on the night prior to *Yom Kippur* (*Yoma* 1:1) [11]. Although

some vocations required one to sleep less, others needed the person to sleep more. A worker who works during the day is not allowed to keep busy during the night (*Choshen Mishpat, Hilchot Poalim* 337). An example of such a scenario was brought in the *Gemara Yerushalmi* (*Demai* 7:3): There was a schoolteacher who, because of staying up late at night, was as weak as a sick person. He was told not to severely limit his sleep, as it was detrimental both to his health and to his teaching ability [12]. Torah sources view sleep as having a direct correlation with daytime activities and placed sleep as a functional activity, not a misusage of time.

Both in present day research and in the

Torah, sleep is understood to affect health. Sleep debt has a damaging impact on endocrine function and carbohydrate metabolism [13]. Sleep may also alter the immune response [14]. *Gemara Berachot* 57b elucidates 6 indications that a sick person will soon be well; one of those listed is sleep. Indeed, sleep is thought to be so important for the sick person that *Shabbat* can be broken to aid in initiating sleep. The *Mishna Berura* explains that although it is normally for-

"The Ramchal explains that during sleep a person's strength is restored, both to the body and to the soul, so that the next day the person awakens refreshed."

bidden on *Shabbat* to put water into a vessel with holes for the purpose of creating a soothing sound, it is permitted on *Shabbat* if it will help a sick person sleep [15]. Furthermore, although not allowed to extinguish a lamp on *Shabbat*, one is permitted if a seriously ill person will be capable, as a result, to fall asleep [16]. Judaism views sleep as a highly important event, an occurrence that has lifesaving properties and therefore one is permitted to break *Shabbat* to help a person initiate sleep. According to sleep research, sleep debt can cause a waning in one's health. Similarly as noted in Torah sources, a person whose health is not up to par would benefit from sleep.

Another significant function of sleep is its effect on the ability to retain information. In a study of the importance of sleep for the consolidation of information, Gais *et al.* [17] found that progress in a visual discrimination task was connected to the participant's sleep. Their study con-

cluded that the first few stages of sleep were paramount in the consolidation of memories, but that memory consolidation was best after a whole night's sleep. A similar study at the Massachusetts Mental Health Center found that people who learned a particular task did not advance their performance when tested later that same day, but did after a night of sleep. To determine whether a night of sleep was the cause of the improvement, the investigator trained 24 people in the same visual discrimination task. Half the subjects went to sleep on the first night, while the remaining half did not. On the second and third nights both groups were permitted to sleep. On the fourth night both groups were tested with the same visual discrimination task. Those who slept on the first night did better on the task than on the first day. Regardless of the two nights of sleep that were allotted, the other group showed no improvement. Apparently, the first night's sleep initiated the process of memory consolidation. Robert Stickgold, a Harvard Medical School assistant professor of psychiatry, said, "It seems that memories normally wash out of the brain unless some process nails them down. My suspicion is... that sleep is one of those things that does the nailing down" [18].

In Genesis *Rabbah* 9:6, Rabbi Simeon ben Eleazar interpreted: "And, behold, it was very good," to mean that sleep was good. He continued to explain that a man sometimes sleeps a little and then rises to study Torah. Presumably, sleep is beneficial because it allows the student to be sufficiently attentive to study throughout the day [3]. The person who stays up late into the night reviewing information for a next day's presentation or examination, would be advised to better utilize the time sleeping.

Various studies have evaluated the effects of sleep deprivation on longevity. In one laboratory animal study, rats died after being fully deprived of sleep for 11-32 days. While it was not clear how sleep deprivation directly caused the rats' deaths, it was evident that sleep deprivation resulted in uncontrolled regulation of body temperature, emaciation, and overgrowth of bacteria in their bodies. Interestingly, if given the

chance to sleep prior to their apparent death, the bodily changes resulting from sleep deprivation were reversed. Although for ethical reasons, such studies on rats could not have been performed on human, related sleep studies with humans have also elucidated the importance of sleep for survival [19].

Jewish sources deem it impossible for a person to go without sleep for more than 3 days. In *Nedarim* 15a it says that if a person makes an oath not to sleep for 3 days, he is lashed and the oath is not binding. The Ran explains that since it is impossible to go without sleep for 3 days, the man made a useless oath and so was lashed for taking the name of G-d in vain [20]. Purposeful sleep deprivation is viewed negatively and therefore a person is not allowed to aspire to do without sleep.

In a study done by Dew *et al.* [21], poor sleep was linked to earlier death in older adults. Electroencephalogram monitors were utilized to observe sleep patterns in 185 healthy adults between the ages of 60 and 90. Initially, data was collected between 1981 and 1997. In 2001, new data was collected to determine which of the study participants passed away. The 66 adults who died were those who, in earlier studies, had lain awake for long periods and had abnormally high or low amounts of REM sleep. The effect of old age on sleep quality is mentioned in Shabbat 152a: "even the chipping of a bird wakes [an aged person] from his sleep" [22]. Interventions that aid in sleep initiation and sleep quality in old age might not only add to the quality of life but prolong life as well.

While certain aspects of the effects of sleep deprivation on human function have not yet been evaluated, it is evident that sleep deprivation has an adverse affect on an individual's lifestyle. The effect of sleep deprivation encompasses many aspects of life, leading to poor recall of information, health issues, and automobile accidents. Jewish sources recognize the importance of sleep and emphasize the necessity for incorporating a sufficient amount of sleep into one's lifestyle. In striving for a long and rewarding life at a level of optimal performance, an individual should make sleep a top priority. ■

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The Vaccination Tightrope

Leyna Pressman

The Bible commands, "You shall not stand aside while your fellow's blood is shed" (Leviticus 19:16). The Talmud (*Sanhedrin* 73a) teaches that this requires one to expend effort and money, if necessary, to save a person in danger. One may logically extend this to the prevention of sickness. One way of accomplishing this involves the use of vaccinations, particularly during an epidemic [1]. The question that might arise is: how far must a person go to save another? Can one risk his own life? The obligation to save someone may be restricted to a situation where the gain is more likely to occur than the loss [2]. Does this concern apply to vaccinations? Further, it would appear that immunization is part of a Biblical-directed preventive health program. The Code of Jewish Law (*Shulchan Aruch, Yoreh Deah* 116) cites the responsibility one has to take actions to prevent disease. The text presents a scenario in which a town is stricken with a plague and the residents are urged to avoid contracting it. In addition there is a discussion about one who survived a plague. That person is not commanded to leave his town if the same plague strikes again, as he is assumed to now have immunity to the plague. From these sources, vaccination may be considered part of one's obligation in guarding his, and his community's, health [1].

This surely would be applicable during the spread of smallpox. Smallpox is a serious, possibly fatal, disease caused by a contagious virus. Death can occur in up to 30% of cases. Many survivors have permanent scars and some are left blind [3]. The causative agent, a variola virus, is a member of the pox family. Although the smallpox virus surfaced among the human population thousands of years ago, as recently as 1967 it afflicted between ten and fifteen million people, causing an estimated two million deaths. This disease was not confined to one or two countries, but it affected people in forty-three countries

[4]. In 1980 the World Health Organization (WHO) declared the eradication of smallpox, which was arguably one of the greatest accomplishments of the Twentieth century. For a disease to be eradicated, certain conditions must be met. The vaccine must be: (1) A stable vaccine, defined as a vaccine not requiring refrigeration and, therefore, suitable in Third-World countries where refrigeration may not be possible. A freeze-dried vaccine was developed that only required rehydration before usage. (2) An efficient vaccine. The smallpox vaccine was administered with a multi-prong syringe (bifurcated needle) that drew blood. This ensured injection of the vaccine, using less of the vaccine material [4]. (3) Easily portable. Traveling by foot to administer the vaccine, it was brought to difficult, hard-to-reach areas. (4) Non-zoonotic, meaning that there is no animal reservoir for the virus. As the virus did not infect animals, when there were no more human hosts for the virus to infect, it had no animal reservoir in which to hide.

The WHO was able to develop a vaccine that fit these criteria, thus leading to the eradication of smallpox over twenty years ago. Now the virus can only be found in the laboratories of Center for Disease Control (CDC) in Atlanta, GA, and in similar laboratories in Siberia, Russia. So is there anything to worry about? Is it at all significant if the virus still exists in some freezer of a laboratory somewhere? Since the scare with anthrax and September 11th, 2001, many scientists have been thinking about what would happen if such a sample fell into the hands of terrorists. The fear of bio-terrorism is currently a major concern. In the United States no one has been vaccinated for smallpox since 1972 and in the rest of the world since 1977. Thus, exposure to the virus would be severe. To prepare for the possibility of bio-terrorism and to supplement the existing stockpile of smallpox vaccine, since

2001 the United States has purchased smallpox vaccines from Great Britain.

Due to the presence of potential risks, people are hesitant to receive the vaccine. The vaccine in widespread use was derived from the viral strain called "vaccinia," which is genetically distinct from variola and cowpox. Just as Edward Jenner, who synthesized the first vaccine using cowpox virus, did, current vaccinators chose the vaccinia strain because it provided immunity with fewer and less severe side-effects [4]. The majority of adverse side-effects resulting from the smallpox vaccine are not life threatening and subside without treatment [1]. Such side-effects include redness and soreness at the injection site, enlargement and soreness of glands located in the armpits, and a low fever. Previously, however, one of every 1,000 people vaccinated for the first time experienced adverse side-effects that were serious, although not life-threatening, and required medical attention. Such reactions included a vaccinia rash, an outbreak of sores initially limited to one area but that eventually spread to other areas of the body through the blood, and sometimes to other people through contact. More seriously, rubbing the eyes can lead to blindness, though washing one's hands after touching the vaccination site can prevent such outcomes. In addition, toxic or allergic rashes can occur, albeit rarely, in response to the vaccine. In the past, potential life-threatening cases affected 14-52 people per one million vaccinated. Upon experiencing a life-threatening reaction, immediate medical attention was needed. One condition, termed a progressive vaccinia, was manifested as a continuous skin infection, causing tissue destruction and frequently leading to death. Postvaccinal encephalitis, or inflammation of the brain, was another life-threatening reaction. Past reports have shown that about 1 or 2 people, out of one million people vaccinated, died as a result of the vaccination. Furthermore, specific sub-populations (e.g., the elderly) may be at a heightened risk [3]. Although the odds of developing a serious health hazard are rather small, in 1972 the United States stopped administering the smallpox vaccine because the risk of an adverse health

effect outweighed the risk of acquiring the smallpox virus.

As part of the United States' bio-terrorism readiness program, heart-related complications due to the smallpox vaccine have been noted. Although the symptoms are usually mild, a few deaths have resulted. Therefore, the CDC recommended that those individuals with three out of five of the heart disease factors should not be vaccinated. These heart disease factors are: high cholesterol, high blood pressure, diabetes, cigarette smoking, and family history of heart disease. Also, the American Heart Association suggested that those vaccinated be cognizant of any symptoms of heart-related problems, including chest pain or discomfort, shortness of breath, palpitations, ankle swelling, and/or fatigue [5].

In the face of a possible bio-terrorist attack with the smallpox virus as the weapon, which risk is greater, the virus or the vaccine? Some Jews oppose vaccination because of the command in the Bible, "Walk simply before the L-rd your G-d," which is interpreted to mean, "Walk with Him in simplicity and anticipate His support, and do not delve into the future." In halacha (Jewish Law), there is the concept of "*shev v'al taaseh*" (i.e., sit and do not act) versus "*maaseh*" (i.e., action). Usually, when both the outcomes of the action and the inaction have significant negative results, we tend to select the inaction. This rationalization is comprehensible when the risks are equal.

However, if the risk associated with the disease is greater than the risk of the vaccination, the *maaseh* is the more frequent choice. Rabbi Yisroel Lipshutz, the *Tiferes Yisroel*, ruled in the 19th century that the smallpox vaccine was permitted, regardless of the risk of dying. This ruling was set forth when contagious diseases, such as smallpox, were common. His decision was applicable when smallpox was still a murderous disease and the threat of the disease outweighed the risk of the vaccination. What about our current situation, when people are at less or equal risk of dying from the disease as they are from the immunization [1]?

G-d does not want people to put themselves in unnecessary danger. This can be seen in the Bible (Deuteronomy 4:15) and the Book of Prophets (Joshua 23:11) where it is written:

"Jewish Law
would not
put anyone
in unnecessary
danger."

"*V'nishmartem mi'od l'nofshoseichem*" (You shall greatly beware for your souls). The *B'oeer Ha'inyan*, a commentator on the Book of Prophets, says that this command was stated when the Children of Israel were passing the *nezek* (danger) so that they should beware of it [9]. We see from here that Jewish Law would not put anyone in unnecessary danger. Therefore, any actions necessary to reduce the risks connected with vaccination would be required. Furthermore, once the danger of disease falls to a sufficiently low level, the risks of vaccination may be too high. Yet, we still must be cognizant of the risk of the re-emergence of smallpox which may justify a renewed policy of vaccination. An example of risk assessment can be seen in connection with poliomyelitis. The United States switched from the oral Sabin vaccine (which used a live but attenuated virus), to the safer but less effective Salk vaccine (which used an inactive virus). Apparently, the health risk from the oral vaccine was equivalent to the risk of acquiring poliomyelitis [1]. Back mutations of the attenuated virus, which have the potential to cause disease, contributed to the risk of the oral vaccine and demanded that it be replaced with the vaccine with the inactive virus [6].

One is essentially making a risk-benefit assessment when deciding whether or not to be vaccinated. It is necessary to compare the incidence and seriousness of the disease with the dangers associated with the vaccination. Of course the ideal vaccine would totally protect without adverse side-effects. Unfortunately, the ideal is often very unlikely and difficult, if not impossible, to achieve. A larger risk is accepted with the vaccination when the disease is dangerous. This risk-benefit analysis was applied to the smallpox vaccine when the risk of acquiring the disease was very serious [1]. This assessment may be similar to the analysis made by someone who sees his fellow in danger and wants to save him.

The decision to receive the smallpox vaccine is difficult to make while the risk of the disease is currently unknown. The side-effects from the immunization, accepted when the disease was widespread, are being reexamined [1]. We know from studying the history of the American Indians

that the introduction of a new or, as in our case, eradicated disease can have destructive capabilities. The Europeans transmitted microbial and viral diseases, including smallpox, to the Native Americans who had not been previously exposed and had no prior immunity. The results were devastating [6]. Today, people weigh the risk of a bio-terrorist attack against the risk of vaccination. Without more information from the government though, we are not able to make a proper risk-benefit assessment [1].

Since presently there is no credible expectation of a smallpox outbreak, the United States government is not recommending immunization of the general public. Widespread vaccination would not be the preferable course of action at this time, especially due to the fact that protection from the disease can be achieved soon after exposure to the virus. In spite of this, the government is recommending vaccination of the healthcare first responders. Undoubtedly, this is a preventative measure [1]. This is not the first time such a precautionary measure has been implemented. American and British troops were vaccinated prior to the Gulf War as part of the preparation for Operation Desert Storm [8].

Israel also took this precautionary step, in 2002, when it was feared that Saddam Hussein would unleash a biological attack using the smallpox virus. In response to that possibility, 1,500 health workers were vaccinated with the smallpox vaccine. Their concern for bio-terrorism led them to include soldiers and other emergency-responding personnel in receiving the vaccination [7]. In subsequent years, the Israeli government has immunized approximately 40,000 people, specifically those at the greatest risk of contracting smallpox if it were to be used as a biological weapon [1].

This is the situation as it currently exists. People concerned with the *halachic* implications of their actions must be aware of world events and of scientific/medical information, and need to consult Jewish Law/Rabbinic Sources for guidance. May we never face such an epidemic in which we have to implement these difficult decisions. ■

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The Madness of King Saul

Avigayil Rosen

King Saul is one of the most complex characters in the Bible. As the first king of Israel, he could well have set precedents for a successful monarchy. He seemed to be on the path towards greatness, but a few years into his monarchy he virtually stopped pursuing national enemies, such as the Philistines. Instead he focused his energies on the pursuit and assassination of his personal servant, son-in-law and the future king, David. What made Saul behave in such an anti-productive way? This question has been asked by generations of psychiatrists and Biblical scholars. However, in order to understand these answers we must first delve into the biography of Saul as presented in Samuel I. This analysis is divided into two sections: the early years, before "The evil spirit from the Lord" (16:14) came upon Saul, and then the later years.

THE EARLY YEARS

The story of Saul actually begins even before we are formally introduced to him. Samuel has served as a judge and a prophet to the people his whole life, eliminating the threat of the Amorites. However, now he is elderly, and the people come to his house in Ramah, and request that he appoint them a king "to judge us like all the nations" (7:5) and "to fight our wars" (7:20). Until this point, the nation of Israel was a federation of nation states supervised by prophet-judges such as Samuel. Normally, Samuel's children would've succeeded him, but the people found his children corrupt; they took bribes among other things. It seems clear that the people were looking for some kind of central government to better be able to defend themselves against the looming threat of the Philistines and other enemies, and avoid further recurrences of civil war, such as the one between the Benjaminites and the rest of the nation, which ended up killing a large chunk of the

Benjaminites. However, God and Samuel seem to be disinclined to acquiesce to this request. God has to prompt Samuel to give in to the people request and not take it as a personal rejection, but rather as a rejection of God Himself (7:7).

We are thereupon introduced to Saul as a "Goodly youth, and no man in Israel was better than him; he was head and shoulders above the rest of the nation" (9:2). He looked like a king - tall and handsome. Sent by his father to find a missing donkey, Saul meets Samuel on the way. Samuel speaks to Saul and anoints him as the ruler (*nagid* - not *melech*, king). Upon proceeding home, Saul, along with a band of traveling prophets, experiences a prophecy (Samuel I 9:10). Interestingly, when he returns home neglects to mention to his family that he was coronated, but rather he is still concerned about the missing donkey. His compassion and single-mindedness are revealed in his devotion to this donkey. Next is Saul's public coronation in front of all of Israel. At the time of his introduction to the people of Israel, Saul, out of humility, is missing. When he is located and introduced to the people, the crowd proclaims, "Long live the King" (10:24). On the eve of Saul's first battle as king, the people are apprehensive about accepting Saul's leadership in battle, so Samuel summons the people to Gilgal to reinstate Saul's kingship. Samuel rebukes the people for asking for a king, but he tells them that since they wanted a king they must accept everything that goes with it. On this note, the people go off to fight under Saul's leadership.

A year later, the nation is poised on the brink of war with the Philistines. Samuel instructs Saul to wait until he brings some sacrifices. When Samuel does not arrive at the appointed time, Saul, under popular pressure, brings the sacrifices himself without waiting for Samuel. When Samuel arrives, he strongly rebukes Saul and warns him that as a punishment

for not obeying G-d, he will be replaced by a new and more obedient king (Samuel I 13:13). Saul defends himself and says that he brought the sacrifice himself, because the people were nervous, thus showing Saul's insecurity with respect to popular opinion. Saul's son, Jonathan, is instrumental in winning this war, and the people are victorious over the Philistines. However, when Jonathan unwittingly disobeys his father's command, Saul is ready to put him to death for treason. But once again the people intervene and dissuade Saul from killing his son.

The next major battle is with the Amalekites. Saul is commanded not to spare anything in this battle, not even the livestock. Saul's troops have a complete victory. However, when Samuel comes to congratulate Saul he sees that the king of the Amalekites, Agag, and all the best livestock have not been destroyed. Saul admits to having had mercy on Agag and to acquiescing to the people's request to keep the livestock as booty. Saul believed that he had made the right decision (15:13). Samuel, however, is very disappointed by this attitude and tells Saul that as king he should trust his own opinions. Because Saul failed to fulfill the command of G-d, Samuel says, "God has torn the kingship of Israel from you and given to your peer who is better than you." Saul is heartbroken and begs Samuel to at least accompany him back to the people to bring sacrifices to God on account of their victory, and Samuel grants this request. This is the last time Saul will ever see Samuel alive.

THE LATER YEARS

Although Saul is still on the throne as monarch, Samuel chooses a new king, David, and the Divine spirit transfers from Saul to David. Subsequently, Saul becomes plagued with an "evil spirit from the Lord" (16:14). The precise meaning of the phrase, "evil spirit" is unclear and its interpretation is the subject of much debate. David plays the harp to Saul for comfort. A few years later, however, when young David kills the Philistine giant, Goliath, Saul appears to not recognize David, asking, "whose son is this?" (17:56). When Saul hears the women in the streets singing about David's superior victories against the Philistine's he is furious. Later, when David is playing for him, Saul tries to kill him with his spear, but misses. Saul realizes that God must be with David, and plots to get rid of what he per-

ceived to be his dangerous rival. He makes David captain of the army and promises him his daughter Michal in marriage, on the condition that he brings back 200 Philistine foreskins as a wedding gift. Saul admits to himself that this is all a plot to destroy David (18:21). We can imagine his frustration when David returned with the proscribed number of foreskins. David also finds favor in the eyes of Saul's servants, as well as Saul's own son Jonathan, who refuse to kill David on Saul's order. Jonathan advises David to flee from his father's wrath, and David does so. Eventually, David comes back and plays the harp for Saul again. In a *déjà vu* like scene, Saul again tries to kill him with his spear while he plays, but he misses again. David takes this as his sign to flee the palace forever.

Saul then begins the pursuit of David that will consume the rest of his life. He pursues David to his house, but David's wife, Michal, helps him escape (Samuel I 19:12). David goes to Samuel and Saul follows, only to fall down in a prophetic spell, allowing David time to escape (19:24). Jonathan informs David that Saul intends to kill him, pledges his brotherhood to David and urges him to flee (20:42). David flees, stopping to rest in the priest city of Nov. When Saul learns that the priests fed and sheltered David, he calls them treasonous and sentences the whole city to death, a decree that is carried out (22:19). The situation worsens as Saul gathers an army to fight David and pursues him across the country, instead of focusing on the looming threat of the Philistines. On two occasions David has the opportunity to kill Saul, but acts magnanimously and asks Saul not to pursue him anymore. Both times Saul cries, apologizes and even calls David "my son" (26:25). Saul acknowledges that David will be king, but begs him not to cut off Saul's progeny. Although it is clear that at some level Saul loves David, David realizes that Saul will never stop trying to kill him and therefore escapes to the Philistines.

At the end of Saul's life, on the eve of a big battle against the Philistines, Saul can no longer communicate with God. For reassurance that he will be able to win the war, Saul seeks out a witch to conjure up the ghost of Samuel. Samuel tells Saul that the kingship has been transferred to David and that Saul will die the next day in battle. Saul is stricken by this news from his old mentor. The next day in battle, after his sons are killed in battle, Saul asks his servant to kill him so that the

Philistines cant torture him, and when the servant refuses out of fear, Saul falls on his own sword and dies (Samuel I 31:4). Upon being told that Saul and his sons are dead, David kills the messengers and offers a lament in which he refers to Saul as "God's anointed" (Samuel II 1:16).

In order to understand Saul's saga, it is necessary to first define the "evil spirit" that afflicted him. There are a variety of approaches to this topic, and a few will be discussed in this paper.

CLASSICAL BIBLICAL COMMENTATORS

The Ibn Ezra interprets the evil spirit as "a spirit of trembling," and further notes that David's music delayed its onset. The *Davar Shmuel* calls the "evil spirit" a black spirit that fills one with wonderment, sadness, and worry. Rashi is not as precise, but defines the G-dly spirit as a spirit of strength. Perhaps we can extrapolate that the "evil spirit" is a spirit of weakness. Radak on that same verse interprets that he was not in his right mind. The *Tanchum Yerushalmi* there states "He was attacked by Evil spirit from bad humors of the black bile as a result of sadness and worry about what was going to happen to him when his kingdom was taken way from him, and the spirit of God, which had come upon him, had left him...and his calmness and pure humors left him and he was disturbed and angry and sorry. And this spoils the disposition and darkens the humors, defiles the soul and disturbs the brain and the spiritual powers, when the vapors of the black bile reach them, and they are attacked by attacks similar to the convulsions of an epileptic" [1].

Rashi (Mishna Sabbath 2:5) defines the "evil spirit" as a type of melancholy that is particularly felt in the dark. Rambam (Mishna Sabbath 2:5) defines "the evil spirit" as all melancholia, and later narrows this down to a defect in man's ability to discriminate (Mishna Erubin 4:1). The *Tanchum Yerushalmi* states in his guide to the *Mishna Torah*, The Sufficient Guide, describes the "evil spirit" as the following: "Vapors from the

black bile have ascended to the brain and any insanity [is] the 'evil spirit'...it means melancholy and insanity and epilepsy and similar brain diseases arising from burnt black bile"[1]. He suggests that David's harp playing alleviated Saul's suffering by purifying Saul's blood and clearing his brain of the vapors of the black bile

The consensus of the medieval biblical commentators is that this "evil spirit" that inflicted Saul was some sort of psychological malady. Now we will explore Saul's condition as theorized by some modern day thinkers.

NAIVETE

Rabbi Adin Steinsaltz paraphrases the Sages who said two things concerning Saul. Firstly, that he who is merciful to the cruel will end up being cruel to the merciful. This is obviously referring to the fact that Saul spared his archenemy, Agag, but later had the whole city of

Nov killed as well as trying to kill his son-in-law David. They also said that Saul had no blemish. This is harder to understand, but Steinsaltz understands this to mean that Saul was a naïve and simple man who became entangled in a web of events that defeated him. "Saul's simplicity of soul, his inability to vanquish his own heart and feelings for the sake of diplomacy and political reality, his very spontaneity of _expression, whether of

pity or anger are all...traits that destroyed Saul and brought to the throne of Israel the man more suited to the task." Saul was not perfect nor evil, but he was not suited to be king because of his naiveté [2].

PARANOIA

What is paranoia? Paranoid schizophrenia is defined as "primary delusions of the persecutory or grandiose type," while paranoia is "having fixed delusions, without hallucination, but with a prolonged course with little hope of recovery" [3]. Although some describe paranoia as an attenuated form of paranoid schizophrenia, all agree that traumatic life events can lead to

"The consensus of the medieval biblical commentators is that this "evil spirit" that inflicted Saul was some sort of psychological malady."

paranoia [3]. According to S.K. Littman, Saul's periods of seeming madness arose from manipulations in his environment to which the only possible reaction could be depression and paranoia and ultimately despair and suicide. The complete rejection by Samuel was comparable to rejection of a son by his father, for Saul respected and even loved Samuel and begged for his approval. Samuel's rejection of Saul "reflects his disappointment with the elders of Israel for having referred a king to his own two sons...while [he] reflected Divine disappointment on one hand, [he] probably also acted from better personal disappointment on the other." The second rejection came from one even more beloved to Saul – David his 'music therapist' and arms-bearer. "When the one he loved became the one he had the most reason to fear, then Saul's mind remained troubled to no end" [3]. Whether Littman's views on Samuel's motives are correct or not, he understands that the seeming rejection of the two people Saul loved and was closest to left him feeling very paranoid, and this paranoia led to his later behavior.

LEARNED HOPELESSNESS

Herman M. van Praag sees Saul as an insecure man. It was made clear to him from the beginning of his kingship that both God and Samuel disapproved of him – since he represented the Jews' rejection of Hashem. After the battle with the Amalekites, when Samuel and God officially rejected Saul, he had little left to hope for and yet he continued to wage war on behalf of Israel. Abandoned by God and Samuel, Saul felt despair. If one has no hope, despair grew and with it grew his anger and suspicion toward innocent victims. As Saul comes to realize that David's success came from the transfer of Divine blessing from himself to David, Saul's envy intensified. Yet, despite the years of chasing David, Saul failed to kill him because his pursuit was half-hearted. Many other monarchs throughout history have eliminated dangerous rivals without any effort, but Saul never really wanted to kill David. And yet, Saul persisted in chasing imaginary enemies instead of real national threats. Mental illness took over, leading him to blame all the failures of his life and his loss of hope on David. Despite his mental illness, Saul tried to stay true to his position as protector of Israel, and dies in battle against the Philistines [4].

Van Praag extends his discussion of Saul's loss of hope to the neurobiological consequences of losing hope [4]. In general, external events that influence our behavior have measurable changes in cortical activity. The brain is made up of about one hundred billion nerve cells from the CPU of the body. Nerve cells are made up of a cell body (which contains the nucleus), dendrites (fibers that conduct stimuli towards the cell body), and axons (fibers that conduct stimuli to its destination). A stimulus triggers the conduction of an impulse through many neurons. Between two neurons there is a space termed the synapse. Neurotransmitters are needed to allow for communication between neurons. Neurotransmitters released from the axon of one cell cross the synapse to act on a receptor located on the next neuron, thereby stimulating or terminating the impulse. One such neurotransmitter is called noradrenalin (NA) which is present in the upper brain stem, or the locus coeruleus, and plays a vital role in the response of organisms to different kinds of stressors. If an animal is exposed to a controlled stress, more NA is produced and utilized. But under extreme levels of stress, utilization rates may exceed the rate of production and NA levels are quickly depleted.

Van Praag concludes that NA depletion is probably involved in the "learned hopelessness syndrome" in which an animal is subjected to constant, uncontrolled stressors [4]. The animal eventually stops resisting and gives in to despair. But if the animal is supplied with tyrosine, an amino acid that is a source of NA, the animal does not deplete NA or show signs of learned hopelessness. Van Praag states that even though these studies on learned hopelessness were done on animals, it is not unreasonable to loosely apply them to humans. This is because 1) in humans, unavoidable stress often precedes depression 2) signs of NA disturbance have been shown in people with depression 3) antidepressants often increase NA availability in the brain.

Thus, depression caused by unavoidable stress and NA depletion are linked. There is interdependence between the function of brain cells and human emotions. As Van Praag concludes, "Experiences do influence the state of the brain and the state of our brain determines the way we experience" [4]. This was true for the despair of Saul as well. His "learned hopelessness" was caused by unavoidable stressors in his

life which led him to lose hope and ultimately do things he would not have otherwise done.

MANIC-DEPRESSION

S. Levin quotes A. R. Short saying, "The periods of intense gloom with occasional out-breaks of homicidal violence for no particular reason, as when he hurled his javelin at David...the delusion that people in general and David most of all were plotting against him, and the suicide at the end" [5]. Based on Short's analysis, Levin concludes that Saul suffered from manic depression. Manic-depression is now usually referred to as bipolar disorder. The Merck Manual in the entry on bipolar disorder, states that between episodes, people with bipolar disorder exhibit depressive moodiness and sometimes high-energy activity. There are two forms of the disorder. In bipolar I disorder is characterized by "full-fledged manic and major depressive episodes alternate." In Bipolar II disorder, "Depressive episodes alternate with hypomanias" which are relatively mild, nonpsychopathic periods [6].

It is possible that we could apply a diagnosis of Bipolar II disorder to Saul, but this diagnosis does not entirely agree with the description of Saul's behavior. For example, Bipolar disorder tends to have its onset early in life and Saul was perfectly normal until later in his life when disappointment set in [6].

ACROMEGALY

The Merck Manual defines Acromegaly as "excessive secretion of GH, nearly always due to a pituitary adenoma of the somatotrophs." Headaches are common along with coarsening of the facial features and soft tissue swelling of the hands and feet. The appearance changes [6].

According to Littman, Saul developed acromegaly in his late teens but only exhibited symptoms later in life. His headaches, caused by a pituitary tumor, were soothed by music. His appearance changed so that his servants concluded that an evil spirit entered him (I Samuel 16:15). The reason that Saul, the warrior, missed David with his spear at close range was because the pituitary tumor affected his vision. Littman actually diagnoses Saul with acromegalic gigantism prob-

ably because Saul is described as tall (I Samuel 9:2) [5]. However, this diagnosis seems unlikely since there is very little proof that Saul's appearance changed and because this would not account for his behavior.

EPILEPSY

Epilepsy is a seizure disorder in which there is "recurrent paroxysmal disorder of cerebral functions" [6]. It is characterized by "sudden brief attacks of altered consciousness, motor activity, sensory phenomena, or inappropriate behavior caused by excessive discharge of cerebral neurons...Seizures only beginning after age 25 can be secondary effects of cerebral trauma or tumors or cerebrovascular disease" [6].

Fred Rosner concludes that the phrase "and he fell" in the Bible often can refer to an epileptic seizure, as seen in Numbers 24:4 with the story of Balaam [7]. Therefore, when Saul went to Naïot and fell into a prophetic state (I Samuel 19:24), he may have experienced an epileptic seizure. Rosner infers that this seizure was not an isolated event. The so-called "evil spirit from the Lord" (I Samuel 16:14) refers to an epileptic condition, and Saul's later behavior can be explained as the result of the epilepsy [8]. The fact that Saul improved upon hearing David play music indicates that his illness had many remission periods which is characteristic of epilepsy. Rosner even suggests that the vision that Saul had of Samuel was a hallucination [8]. Kottek objects to this theory since it is not supported by the text [9].

It is clear that King Saul's behavior is has troubled scholars for generations. Many diverse theories have been offered including bipolar disorder, epilepsy, paranoia and more. However, what makes this complicated is that Saul's condition is referred to by the Bible as an "Evil spirit from the Lord." Perhaps we cannot discuss Saul's condition from a psychological perspective since it may have been strictly spiritual. On the other hand, as Van Praag explained, "Experiences do influence the brain and the state of our brain determines the way we experience" [4]. Even if we are not certain about Saul's medical diagnosis, an in depth analysis of his life from a medical point allows for a better understanding of who Saul was as a ruler of Israel. ■

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Midwifery:

Advancement of Present-Day Practice and Public Perspective

Aviva Shafner

Midwives have been assisting women in delivering their babies since the beginning of time. However, a midwife not only delivers babies, but also gives tremendous support, strength, and intimate guidance to a birthing woman. The word midwife in English literally means “with woman” [1]. A midwife’s primary job, then, is to care for the birthing mother and to provide support and encouragement [2]. While the general definition of a midwife remained static throughout history, the specific practices of midwifery have undergone many changes in terms of the status of the midwife, and the procedures and medications midwives use.

The role of the midwife can be studied not only through medical history, but also through the Torah. The first biblical reference to a midwife can be found in the text describing Rachel’s birth of Binyamin. A midwife reassures Rachel and calms her throughout her labor by telling her, “Do not fear for this one will also be a son for you” (*Bereishis* 35:17) [3]. Another instance in which the Torah discusses midwives is when Tamar gives birth to twins, and a midwife ties a string to the wrist of the baby that stuck its hand out first, so that it will be known that he is the first-born (*Bereishis* 38:28). In addition to these references, we also know of the most famous midwives in the Torah, Shifrah and Puah, who delivered all of the Jewish babies in Egypt. According to the *Gemara* (*Sotah* 11b), Shifrah was Yocheved, Moshe *Rabbeinu*’s mother, and Puah was either Miriam, Yocheved’s daughter, or Elisheva, Yocheved’s daughter-in-law. The names Shifrah and Puah refer to the different jobs they had, and there are various interpretations given to explain their practices. Shifrah, according to the *Kohel* *Rabbah* (7:1), comes from the word *shaphar*, to clean or wrap. Puah comes from the word *poah*, meaning that she would call out to the woman in labor and the baby would come out, or she would calm the cries of the birthing mother by

reciting prayers in her ears [4]. According to Rashi, Shifrah comes from the word *meshaperet*, because she would clean the babies and make them beautiful. Rashi also states that Puah comes from the word *poah* because she would soothe and calm the babies [5]. In addition, the *Baal ha-Turim* suggests that Shifrah comes from the word *shforferet*, which is a reed midwives used in order to revive a baby that seemed to be stillborn [6]. Thus, the Torah offers many examples that demonstrate the role of the ancient midwife.

Furthermore, midwives in ancient times were highly respected and considered to be extremely wise women. They practiced very natural and reliable techniques and utilized effective remedies. A midwife would visit a pregnant woman once a week and then on a daily basis as the pregnancy progressed. The purpose for this was to check her progress and to create a bond between them so the pregnant woman would be comfortable and learn to trust the midwife. Some of the midwife’s practices during the actual labor were to use different creams and herbs to lubricate the birth canal and thereby make delivery easier. The midwife also knew where to press in order to prevent the woman’s tissue from tearing, and the midwife would sometimes use her fingers to stop the umbilical cord from choking the baby. Depending on the midwife’s background, she would bring certain tools and potions with which to help in the delivery. After the birth, the midwife would take care of the baby and mother for at least one to two weeks. The midwife would swaddle the baby and stem the postnatal bleeding of the mother, and would give her different medications if she had a fever. The midwife would then advise the new mother on special foods that would ensure a healthy supply of milk for the baby [7].

Before the 17th century, midwifery and medicine were poorly regulated. Midwives were

usually trained by experience; most midwives learned their craft by accompanying their mothers to births, and received little formal training. By the 17th century however, midwives in England had to be licensed by the Bishop's court, and they had to supply letters of reference from women whose babies they had delivered [8]. Even with these added regulations, midwifery continued to flourish. By the Renaissance, midwives were able to place their hands on the woman's abdomen and tell the expected due date [7]. Even though midwifery was a highly respected profession, especially due to the increase in the average midwife's capabilities, it was considered merely as part of everyday life; it was work that simply needed to be done and midwives were there to do it [9]. Midwives were appreciated, but not considered exceptional.

Furthermore, during this period, Jewish midwives began to play a more prominent role in the field of birthing. Jewish midwives primarily differed from non-Jewish medical professionals in their unique practice of giving priority to the mother's life over the baby's during a difficult delivery. For this reason, Jewish midwives were preferred by Jewish and non-Jewish women alike.

For a Jewish midwife, a safe delivery was especially important because of its significance in the continuity of the Jewish people. Jewish midwives also felt the holiness of their task because they felt G-d was a partner in every birth. This added sense of purpose helped Jewish midwives to successfully deliver babies [7].

By the turn of the twentieth century, there was a major shift in the role of the midwife. With the advent of modern medicine, the process of birthing became classified in medical terms. As medical schools increasingly took over the birthing field, men began to deliver most of the babies, because women were not allowed to attend medical school [10]. Midwives were soon banned from practicing in hospitals because their remedies and traditions were considered outdated and possibly harmful in comparison to the techniques of the male doctors. This view of midwives led to England's Midwives Act of 1902, which mandated

that midwives had to be registered, and that they had to be trained by the supposedly superior male obstetricians. Doctors now strongly influenced the field of midwifery [8].

Once childbirth was transferred to hospitals, the midwife went from being a skilled and respected woman who worked in the community, to being a special type of nurse working on a low level in the hospital setting [7]. Lacking the experience only women could have, the male doctors who now dominated the field of obstetrics approached birthing from a technical point of view. Generally, male obstetricians saw childbirth as a cold, clinical occurrence instead of as something natural. These doctors took credit for the

increased survival of new mothers and new babies, when in reality these superior results were due to better sanitation, nutrition and disease management, which improved birthing outcomes. By the 1950's, most women were giving birth in hospitals, as a result of both the benefits of modern medicine and the pervasive belief that they could only deliver safely there. Consequently, at this time, Cesarean sections, large doses of pain medication and epidurals became commonplace. With the entrance of

birthing into hospitals, women lost the intimacy, comfort and support they were accustomed to receive when assisted by a midwife. Now they had many different people taking care of them, and they were not given a chance to form real connections with any one doctor or nurse. When it came time to deliver, nurses cared for the laboring woman until the critical point of delivery when the doctor would come in and take over, and thus the most vital part of labor was in the hands of someone who could not provide personal comfort [10].

Midwives started to make a slow comeback in the mid-1920's. As the traditional practice of midwifery was decreasing, a more medically based form of midwifery was evolving [11]. Midwives started going to school for formal medical training; "the creation of midwifery schools combined age-old techniques with modern nursing to create the more scientific practice of nurse-midwifery" [12]. In addition, they also began working

"Jewish midwives primarily differed from non-Jewish medical professionals in their unique practice of giving priority to the mother's life over the baby's during a difficult delivery."

primarily in hospitals and then, as time went on and their popularity and professional medical experience increased, they also moved back into the home. Since then, the field of midwifery has grown. The idea that birthing is a natural occurrence in a woman's life was revived. However, even with this growth, midwifery is still fighting for its place in society. For example, midwifery is still not legal in all states.

As the field of midwifery begins to regain its prominence, new options have become

available for pregnant women. Many women now choose to give birth in a hospital, where advanced medical assistance is available in case of any complications, but they also prefer to have a well-trained midwife at their delivery to provide more personal support and comfort. In fact, midwives deliver over two-thirds of the babies born in the world today. The enormous contributions of midwives' care have led them to become widely sought after and valued [2]. ■

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Stem Cells: A Halachic Perspective

Rachel Thaler

Although modern science has extended human life expectancy to 77.2 years [1], with all of our advances we still have not yet eliminated disease. In the United States alone there are currently 107,450 people on waiting lists for organ transplants, and in 2001, 25,746 Americans died waiting for one [2]. Parkinson's disease affects over one million people in the United States; one in every 200 people will develop Parkinson's disease in their lifetime; and one in every 100 people over 60 years of age will exhibit this disease [3]. Approximately 18.2 million Americans, 6.3% of the population, suffer from diabetes, which in the year 2000 ranked sixth in the leading cause of death, contributing to 213,062 deaths [4].

Imagine, for just a moment, if modern biotechnology could isolate stem cells from an individual suffering from Parkinson's disease, diabetes, Alzheimer's disease, or organ failure, and manipulate their differentiation to grow into replacement cells, tissues, or complete organs. These cells and organs could then be implanted into the ill individual, thereby potentially healing without the need for anti-rejection or immunosuppressant drugs. The potential for these incredible advancements is not beyond our reach, rather it lies within the realm of possible advances in stem cell research.

As stem cell research is still in its embryonic stages, it is an exciting new field of biotechnology, with much room for development, expansion and exploration. Along with the excitement that advances on biotechnology have generated, come some pressing moral issues, in particular, from where the human stem cells are obtained. How do we determine how far to "push the envelope" in this research? Couples with children suffering from leukemia, beta thalassemia, or Fanconi's anemia, have requested permission to undergo in vitro fertilization, in conjunction with

preimplantation genetic diagnosis, for selection of a suitable embryo to provide matched stem cells for transplantation into their ill children [5]. Who is to decide if it is moral or ethical to create human embryos solely for implantation of their cells into an existing, viable, albeit ill, child? Fortunately, as Jews we do not rely on our own subjective conceptions of right and wrong, rather when dealing with such issues attention is directed to our *chachamim*, sages, to decide what *halachah* (Jewish law) dictates in this situation. Although there are many complicated moral issues involved in stem cell research, this paper will focus on the *halachic* issues involved in the various sources of stem cells.

Before attempting to approach the issue from a *halachic* standpoint, the scientific facts need clarification. The stem cell seems to be the trump card of biomedical technology, but what is this incredible actuality called a stem cell? What makes it different from other cells? What exactly is involved in stem cell research?

All stem cells have two important distinguishing characteristics. First, they are unspecialized and therefore capable of renewing themselves for long periods of time through cell division. Secondly, under specific experimental conditions, these stem cells can be induced, or programmed, to become specific types of specialized cells.

Stem cells are defined in terms of their degree of developmental plasticity. Development begins with the fertilization of a haploid egg by a haploid sperm, to create the diploid zygote. For the initial four days of development, while traveling down the fallopian tube, it undergoes mitotic divisions to form a unit of many attached stem cells. These stem cells are totipotent, meaning that they still retain the capability to form any type of body cell in the mature adult. Potentially, each totipotent stem

cell of this mass could separate, replicate, and differentiate to form a complete human being.

On the fourth day of fetal development (at approximately the 16 cell stage) this mass of cells develops into the blastocyst. The blastocyst is composed of two layers of cells; the outer layer, which will eventually become the placenta, and the inner mass, now termed pluripotent stem cells. These pluripotent cells are totipotent minus except that they cannot exist without the placenta. As development continues, the pluripotent stem cells divide and differentiate into multipotent stem cells, which can only give rise to a limited range of cells within a specific tissue type. For example, multipotent blood stem cells can differentiate into platelets, white blood cells, or red blood cells, but not into muscle cells.

Once born, the human continues to develop and mature into an adult. The embryonic stem cells are replaced by a smaller population of adult stem cells. Adult stem cells are multipotent, found in the already differentiated tissue and exist to replace differentiated cells that have died or lost their ability to function.

Scientific experimentation has focused on determining how adult stem cells remain unspecialized and self-renewing for long periods of time and on identifying the chemical signals that induce these unspecialized stem cells to differentiate. It is generally accepted that embryonic stem cells have greater potential to grow and differentiate into functioning cells than adult stem cells which are generally limited in their potential and lifespan. For this reason embryonic, rather than adult, stem cells are used. Sources for embryonic stem cells include aborted fetuses and "surplus" embryos conceived in in vitro fertilization clinics. Whereas there are very few halachic objections to using stem cells derived from adult tissue, many problems arise when dealing with the derivation of stem cells from embryonic tissue. The Biblical verse (Leviticus 24:17) states, "And the man that smites any man shall surely be put to death," explicitly indicating that the killing of humans is forbidden. The question now is restated, at what point is a mass of cells awarded the status of human being, and further-

more, what is the moral status of an embryo.

To define the *halachic* status of an embryo we begin with a Talmudic discussion concerning the *trumah*. An unmarried daughter of a *Kohen* and a childless, widowed daughter of a *Kohen* are the only women who may eat from the *trumah*. What is the status of the daughter of a *Kohen* who married an Israelite but was widowed shortly after the consummation of the marriage. Being uncertain whether or not she is pregnant, can she eat from the *trumah*? Rav Chisdah rules that up to 40 days after the consummation of her marriage she may eat from the *trumah*. If not pregnant, then there is no problem for her to eat the *trumah* and if pregnant, the embryo is considered to be "*maya b'alma*" (mere water) for the first 40 days after conception. Therefore she can continue to eat *trumah* for a full 40 days after her marriage. We see from Rav Chisda's ruling that, with-

in the first 40 days of gestation the embryo does not have the same status as a more mature fetus, rather it has the more inferior moral status of "*maya b'alma*" (*Yerushalmi Yevamos* 69b). Another source for this distinction is in *Niddah* 30a, which states that an aborted fetus within the first 40 days of gestation is *maya b'alma* and, therefore, does not engender the female with the impurity of childbirth.

Although inferior to that of a more mature fetus (41 days of gestation and on), the actual moral status of a fetus under 40 days of gestation is still unclear and needs to be defined. *Havos Yair* explains that a pre-40 day old fetus is *maya b'alma* and apparently has the same status as the male and female gametes. Therefore, the prohibition of aborting a fetus, or "harvesting" it for use of its stem cells, may fall under the prohibition of *hashchatas zera levatala*, wastage of seminal seed [6]. However, Rav Yaakov Emden disagrees, noting that *hashchatas zera levatala* does not apply once implantation occurs. Once implanted the embryo is of greater status than *zera* [7]. Rabbi I. Unterman also argues for a more stringent status for embryos, as it is permissible to break the *Shabbos* to save even the earliest fetus [8, 9]. Thus, he argues, the destruction of even the earliest fetus is

"The stem cell seems to be the trump card of biomedical technology, but what is this incredible actuality called a stem cell?"

considered feticide, and not *hashchatas zera levatala*.

Embryonic stem cells are harvested from the gametal ridge tissue of a fetus aborted after 8 weeks (57 days) of development. This aborted fetus has passed the 40 day mark and is therefore no longer considered *maya balma*, rather it has the status of a mature fetus. Exodus 21:12 states, "He that smites a human so that he dies shall surely be put to death." Rashi explains that although we learn from Leviticus 24 :17 that the killing of another man is a capital offense, this verse in Exodus teaches that although killing a human is a capital offense, killing of an unborn child is not. *Tosafos (Yerushalmi Niddah 44a)* explains, on the basis of the Mishnah, that although the killing of this unborn fetus is not a capital offense it is a moral offense and thus is prohibited [10].

Rav M. Tendler notes that sometimes, although a certain act may be prohibited, the products of that act are permitted to be used [11]. For example, it is prohibited to crossbreed animals of different species [12]. Therefore, mating a horse with a donkey would not be permissible, yet the product of this mating, the mule, is permitted for usage. With regard to the use of already aborted fetuses for stem cell research, one might argue that although technically permissible, one should make a *geder* (a "fence" to prevent transgression of that which is prohibited) around abortion. Therefore, already aborted fetuses should not be used as a source for embryonic stem cells. However, Rav Tendler explains that being that in this specific case the aborted fetus will help advance research which eventually will help save lives, the ethical principle of *pikuach nefesh*, saving lives, overrides concerns for *gedarim*. Therefore, Rav Tendler concludes that "a fence that prevents the cure of fatal diseases must not be erected for then the loss is greater than the benefit" [11].

In conclusion, it is prohibited to specifi-

cally abort a fetus for subsequent use in stem cell research. This prohibition applies to both immature and mature fetuses; immature fetuses due to the prohibition of *hashchatas zera levatala* and mature fetuses due to the prohibition of feticide. However, once the fetus was already aborted, it is permissible for us to use the product of this prohibited act for stem cell research.

The other source for embryonic stem cells is "surplus" embryos, derived from eggs fertilized in vitro that have not been implanted into the mother's uterus. These embryos, although cultured along with many other embryos, were not implanted as implanting too many embryos into the mother can be potentially fatal to her. The moral status of these embryos is unclear. Some authorities hold that there are two prerequisites that an embryo must fulfill for it to have moral status in halachah. First, moral status is achieved only after the fetus has undergone 40 days of gestation and second, it must be implanted into the mother [11]. In the case of "surplus" embryos, there is no implantation as the embryo is merely growing on an artificial medium in a Petri dish. Secondly, as it was not implanted, it cannot develop into a viable fetus. Therefore, according to this opinion, both prerequisites for moral status have not been fulfilled and there is no halachic opposition either to disposing of them or to using them as a source for stem cells. Yet, there are contrary opinions suggesting that although these preimplanted "surplus" embryos do not have the same moral status as implanted fetuses, it is still prohibited to discard them because of the prohibition of *hashchatas zera levatala* [13].

Stem cell research holds many promises for the future of medicine. However, we must be wary and guard our excitement to ensure that our eagerness to advance scientifically does not conflict with *halacha* and thereby cause injury to our system of morals and ethics. ■

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Thirsty for Torah; Thirsty for Water

Dr. Harvey Babich

Rav Aryeh Kaplan, noting that everything in the spiritual world has a counterpart in the physical world, cited several sources showing “water” is the physical counterpart of Torah study [1]. For example, in *Taanis* (7a), R’ Chanina ben Pappa contrasted two verses in *Yeshaya*. On the verse, “Bring water to the thirsty” (*Yeshaya* 21:14), he expounded that water refers to Torah, i.e., a teacher should go to the student to teach Torah. On the other verse, “Everyone that is thirsty, go to water” (*Yeshaya* 55:1), he explained that the student also must go to the teacher to study Torah. In both verses, water is the symbol for Torah study. In *Avodah Zarah* (5b), R’ Yochanan, in the name of R’ Bannah, explained the verse, “Fortunate are you who sow upon all waters, who send forth the feet of the ox and the donkey” (*Yeshaya* 32:20) as follows. Fortunate is Israel for when they engage in studying Torah and in bestowing kindness, their evil inclination is delivered into their hands and they are not delivered into the hands of their evil inclination. Again, water is analogous to Torah study. Other Talmudic sources in which Torah study is symbolized by water include *Avodah Zarah* 19b, *Baba Kama* 17a and 82b, *Berachos* 56b, and *Chagigah* 14a. *Shir HaShirim Rabbah* contains numerous passages providing analogies between Torah study and water. “Just as water is a source of life for the world, as it says, ‘A fountain of gardens, a well of living waters’ (*Shir HaShirim* 4:15), so the Torah is a source of life for the world, as it says, ‘For they are life unto those that find them and health to all their flesh’ (*Mishlei* 4:22).” Rav Slifkin also notes parallels between Torah study and water in Nature’s Song [2].

Water is the most abundant chemical in life, comprising about 60-70% of the total body weight of most living organisms. Life cannot exist without water. As noted in *Yerushalmi Horayos* (3:48), “Water is cheap and wine is expensive, yet

the world can exist without wine, but not without water.” In *Bereshis* (2:5-7), we read, “All the bushes of the field had not yet come into being on the Earth and all the grass of the field had not yet grown, for G-d had not brought rain on the Earth.... Then a mist rose from the Earth and watered the face of the ground. G-d then formed man out of the dust of the ground and blew in his nostrils a soul of life.” Until G-d brought water to the Earth, no life was possible. Rav Kaplan cited the *midrash* (*Yerushalmi Shabbos* 2:6 (20a); *Bereshis Rabbah* 14:1) that man is a combination of “dust and water.” As long as man is alive, “water” is a most essential part of his being. Water is omitted when the Torah speaks of man’s death; “you are dust and to dust you shall return” (*Bereishis* 3:19) [2].

The association between life and water is of concern to cosmologists. Space probes sent to distant planets initially ascertain whether that planet ever had water, which would indicate the planet’s potential, at least at one time, to support life. Shortly after their formation, the Earth, Venus, and Mars had abundant supplies of water. Yet, today, surface waters occur only on the Earth. The Earth is sufficiently distant from the sun so that its surface waters neither evaporated nor decomposed, as occurred on Venus. If the Earth was a bit closer to the sun, its surface temperatures would exceed the boiling point of water, precluding the possibility of life. The Earth is sufficiently near the sun so its temperature remains high enough to prevent the oceans from freezing permanently, as happened on Mars. Therefore, of these three planets, the Earth alone is capable of supporting life. This idea that the Earth appears if it was specifically designed for the maintenance and well being of human beings is termed the anthropic principle [3].

Water is a nutrient. Although often overlooked as a nutrient, water has numerous vital

functions in the human body. It acts as a solvent, as a lubricant, and as a medium for transporting other nutrients and waste products, for temperature regulation, and for chemical transformations [4]. The *Shulchan Aruch (Orach Chaim, 204:7)* states that the blessing, *SheHaKol*, must be recited prior to drinking water to quench a thirst. The aspect of "to quench a thirst" may be the critical factor in prompting the recitation of this blessing. The *Mishnah Berurah* (#42) notes that the palate is not "pleased" by water per se, presumably, as water is odorless and tasteless. Thus, the question arises concerning the need to recite a bracha prior to drinking water. However, the *Mishnah Berurah* continues that one's palate is "pleased" when the consumption of water is prompted by the need to satisfy a thirst, thereby, necessitating the recitation of *SheHaKol*. Thirst is governed by changes sensed by the mouth and the brain (i.e., the thirst center is located in the portion of the brain, termed the hypothalamus). When the concentration of solutes in blood is too high, water is drawn from the salivary glands into the blood. The mouth then becomes dry and the person drinks to wet the mouth. Also, when brain cells detect that the blood is too concentrated, impulses are initiated to stimulate drinking behavior. [5].

The movement of water into and out of cells is termed osmotic flow, as this movement is dependent on the relative osmotic pressures of the environment and of the protoplasm. Plants, being non-mobile, cannot physically go to a water source; they manipulate their cytoplasmic composition so water flows naturally into their cells. Relative to the osmotic pressure of their protoplasm, plants live in hypo-osmotic environments and water moves from the external environment into their cells. If the environment would be hyper-osmotic, meaning that the environment has an osmotic pressure higher than that of the internal cell, water would move out of the cells into the environment, causing cellular plasmolysis. Plants cannot live in hyper-osmotic environments. Abimelech apparently, recognized this. After destroying the city of Shechem he "sowed it with salt" (*Shoftim* 9:45), thereby making the soil hyper-osmotic, thus killing the vineyards and depriving the Shechemites of their livelihood.

Water has several properties making it essential for life. Water is the best solvent; more substances dissolve in water than in any other liquid. It is in the watery milieu of the cytoplasm and nucleoplasm that all the cellular biochemical

reactions of a cell occur. These biochemical transformations, both catabolic and anabolic, provide the cell with properties of metabolism, repair, growth, and development. Water is the medium in which spiritual transformations also occur, as exemplified by the *mikveh* (see Rambam, *Moreh HaNevuchim* 2:30). To quote Rav Aryeh Kaplan [1] "...water itself represents the change and flow towards G-d's goal. When a person immerses himself in a mikveh, he immerses himself spiritually in the basic concept of change itself. Man's ego represents the element of his permanence and, therefore, when he is totally immersed in the concept of change, his ego is nullified. Thus, when he emerges from the *mikveh*, he is in a total state of renewal and rebirth." Apparently, water is the medium both for physicochemical and spiritual transformations.

The unique properties of water are related to the polarity of the water molecule and to the hydrogen bonding among neighboring water molecules. The many hydrogen bonds linking individual water molecules give water its property of being a temperature stabilizer. Water adsorbs a great deal of heat before its temperature increases. Conversely, water retains heat as its temperature falls slowly. Thus, the temperature of water does not change rapidly with accompanying changes in the ambient environment. For example, compare the responses of sand and seawater to temperature fluctuations on a hot, summer day. As the morning progresses, the temperature of sand at the beach quickly rises, whereas the temperature of seawater remains cool. Conversely, as the sun sets, the temperature of sand quickly decreases, whereas that of seawater remains warm. The large amount of water in a human being lessens the impact of sudden changes in environmental temperature and thereby helps to maintain the temperature homeostasis of the human body.

This property of water to resist quick changes in temperature may explain, in part, the concept of *mayim shalenu* (i.e., water kept overnight). During the month of *Nissan*, water used to knead the dough for matzah was drawn from wells. It was believed that during *Nissan*, as the sun's position was low on the horizon, underground waters were, to some extent, heated at night (*Pesachim* 94b). As warmth hastens yeast fermentation, well water drawn in the morning was not suitable for making matzah. Water used to knead dough for matzah must be cool. Thus, in *Pesachim* (42a), R' Yehudah said: A woman should

knead the dough for *matzah* only with well water that was drawn in the morning and subsequently kept overnight (*mayim shalenu*) in a vessel. As water only slowly releases heat, well water drawn in the morning required a time period of about 12 hours to lose its excess heat and, thus, to be suitable to make *matzah*.

Although well water drawn in the morning may be warmer than water stored in a vessel, the rationale for this temperature differential stated in *Pesachim* 94b (i.e., that at night the sun passes beneath the Earth and heats up the underground springs) is not scientifically valid. Rabbi Aryeh Carmel (cited in Slifkin [6]) offered another reason for water stored in a vessel to be cooler than well water drawn in the morning. During night, as the ambient air temperature cools rapidly, water stored within vessels also cools. However, because of the enormous heat capacity of the Earth, the underground water is insulated and, as water is a temperature stabilizer, the heat accumulated in well water slowly leaves. Thus, well water drawn in the morning is likely to be warmer than water stored in a vessel which was exposed to the cool night air.

A considerable amount of heat energy is required to change liquid water into a gas, or, we say that water has a high heat of vaporization. Because the transition of water from a liquid to a gas requires the input of much energy to break its many hydrogen bonds, evaporating water thereby cools surfaces. Organisms, including human beings, dispose of excess body heat through evaporative cooling (i.e., sweating) [7]. Three types of sweat are beneficial for the body: the sweat of toil, bathing, and illness (*Avos de Rabbi Natan* 41:4). Fever, or an abnormally high body temperature, is a systemic response that results from infection by invading microorganisms. Body temperature is regulated in the hypothalamus, the thermostat of the body. In response to pyrogens, chemicals secreted by injured tissue, white blood cells, and macrophages exposed to bacteria, the thermostat is reset upwards, causing the body to initiate heat-promoting mechanisms. A mild or moderate fever is an adaptive response that stimulates the liver and spleen to sequester iron and zinc, micronutrients needed for bacterial proliferation. The body temperature is maintained at the "fever setting" until natural body defenses reverse the disease process. The thermostat is then reset to a lower (i.e., the normal) level, causing heat-loss mechanisms to swing into action. Sweating

begins; physicians have long recognized this as a sign that the body temperature is falling and the patient is recovering [8]. Or, as simply stated by *Chazal*, "Perspiration is a good prognostic sign for sick patients" (*Berachos* 57b; *Bereshis Rabbah* 20).

Another aspect of the unique thermal properties of water is its anomalous behaviors. First, water contracts as it cools, being most dense at 4°C. Thereafter, water expands until the point at which it becomes ice (0°C). A second anomaly is that in the very act of freezing, sudden expansion takes place (consequently, ice, being less dense than aqueous water, floats!). These peculiarities unique to water are other examples of the anthropic principle. During a cold winter, the heavier 4°C water sinks to the bottom of the aquatic system, leaving the cooler and less dense waters at the surface. At 0°C, water forms ice, which is lighter than liquid water. Hence, ice floats on the surface of the aquatic system, permitting the preservation over the winter months of the aquatic life dwelling at the bottom of the ecosystem. [9]. For other liquids, progressively lowering their temperature causes corresponding increases in their densities, with freezing occurring from the bottom up.

Neighboring water molecules are constantly making and breaking their hydrogen bonds. Each hydrogen bond is individually weak, lasting only 10-11 seconds. However, the cumulative effect of large numbers of these bonds is enormous. For example, the hydrogen bonding among neighboring water molecules is responsible to the high surface tension of water, as exemplified by ability of small insects to walk on the surface of pond or lake water [7]. Therefore, liquid water is not composed of individual water molecules, independent of each other, but rather as a three dimensional complex of interacting, interconnected water molecules. This concept may have relevance to the halachic procedure called "hashaka" or "making contiguous." Through the procedure of hashaka, water that has contracted tumah may be cleansed on Yom Tov. The procedure is as follows. Tamei water is placed into a utensil, which is lowered into a mikveh to allow the water in the utensil to touch ever so slightly the mikveh water. When the two waters touch, hydrogen bonds instantaneously form, making the waters contiguous and forming a single entity of mikveh water, thereby removing the tumah from the water in the utensil (*Beitzah* 17b).

The Hebrew word for water – *mayim* – is in the plural form, perhaps indicating its existence

in multiple forms [a liquid (aqueous water), a solid (ice/snow), and a gas (water vapor)] and its transference between terrestrial and aquatic ecosystems and the atmosphere (Abarbanel, *Bereshtis* 1:2). The Talmudists recognized that water evaporation is crucial for the cycling of water through the biosphere. 97% of the Earth's water is in oceans, 2% is frozen in the polar ice caps, and 1% is in lakes, rivers, underground streams, and the atmosphere [10]. In *Taanis* (9b), R' Eliezer stated that the entire world drinks from the waters of the ocean, which is interpreted to mean that the biota obtains its "sweet" water from the water evaporated from the oceans and subsequently returned via precipitation to the Earth. R' Yehoshua questioned this concept of water cycling, as the waters of the ocean are salty, yet, the returning precipitation lacks a significant salt content. R' Eliezer answered that the waters become sweetened within the clouds. Apparently, R' Eliezer had an understanding of the evaporative process, realizing that water molecules alone, without their salts, leave the ocean surfaces.

References to the cycling of water through the biosphere are noted in *Koheles* (1:7): "All the rivers flow into the sea, yet, the sea is not full; to this place where the rivers flow, there they flow once more." The Ibn Ezra, as the *Midrash Lekach Tov*, explained this verse to mean that moisture rises from the oceans and is absorbed by the clouds, which, in turn, cause precipitation to descend to the Earth in an endless cycle. *Mayim* is

a palindrome, read the same backward or forward, perhaps, as suggested by G. Marks [11], to reflect the water cycle of repeated precipitation and evaporation.

Rav Yaakov Culi [12], in *MeAm Lo'ez* (translated by Rav Aryeh Kaplan, 1988), noted that sailors traveling on the ocean occasionally used a distillation method to desalinate seawater and make it potable. Realizing that vaporizing seawater left behind its salts, they boiled seawater in one vessel and collected and condensed the steam vapors in another vessel. This technique, termed distillation, apparently, had an impact on the halacha regarding the type of water ritually suitable for the blessing of *Al Netilas Yadayim* before eating. Water suitable for *Al Netilas Yadayim* is defined as water that is potentially drinkable, thus, disqualifying salty seawater. However, the potential to desalinate salt water and thereby make it drinkable was the basis for the Radbaz allowing the use of seawater for this blessing (see *Magen Avraham, Shulcan Aruch, Orach Chaim*, 160:12) (cited in *MeAm Lo'ez*, volume 1, page 221).

In summary, quoting Katz [10], "Water is a wonderful blessing. Although it is easy to take it for granted, we should never cease from appreciating it, for it is anything but simple. Its abundance, its unique atomic structure, and its versatility all point to the Great Intelligence that has showered us with this liquid far more precious than gold." ■

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