

Derech HaTeva דרך הטבע

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A PUBLICATION OF STERN COLLEGE FOR WOMEN YESHIVA UNIVERSITY

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DEDICATION & ACKNOWLEDGEMENTS

The vision of Rachel Sussman, ז"ל, for the advancement of science at Stern College for Women was evident through her support of the state-of-the-art Sussman Biology Laboratory and Laboratory Preparation Room. It is our honor to dedicate this issue of Derech HaTeva in her memory. Rachel Sussman served as a role model for the women of Stern College and her numerous acts of philanthropy are shining examples of the many contributions one can make to enhance and better the lives of others. Her dedication to the development of areas relating to both Torah and science parallels the vision of this publication and it is only fitting that the twelfth edition of Derech HaTeva serves as a medium for her name to live on.

We would like to take this opportunity to thank the Office of the Dean and the Office of Admissions at Stern College for Women for their support of this journal. Specific thanks to Dean Karen Bacon whose vision for the students at Stern College for Women made this journal possible.

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SINCERELY,

THE EDITORS:

Dalia Barenboim Nechama Citrin Miriam Merzel

P A S U K

כל עצמותי תאמרנה ה' מי כמוך...
(תהלים ל"ה)

All my limbs will say "God, who is like You..."
(Tehillim 35)

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MAKING MAN IN MAN'S IMAGE

SHIRA APFEL

In 1997, the world received the news that the first mammalian clone was born. Professor Ian Wilmut of Edinburgh University and his research team successfully created Dolly, a sheep born with an exact copy of its mother's genetic makeup. The process that Wilmut used to clone the sheep is known as a nuclear transfusion. In this process, the nucleus from an adult cell is inserted into an egg that has been emptied of its own nuclear genetic material; the egg, placed in a Petri dish with growth medium, is stimulated to divide, and thereafter is inserted in a womb, to develop as would any other embryo in a typical pregnancy. The result is an offspring that is an exact genetic replica of the donor of the original adult cell nucleus. This differs from typical reproduction or even from *in vitro* fertilization, both of which produce progeny who have inherited half of the genetic material from one parent and half of the genetic material from the other parent.

With this step forward in modern science, moralistic and ethical questions are raised throughout the world's cultures and religions. Judaism is no exception. In the Talmud in Kiddushim 30b it is taught that there are three partners in the creation of a human being: the mother, the father, and God. The use of cloning can very well change this equation, depending on who is the donor of the genetic material. However, while the Talmud delineated the proper and preferred method, as pointed out by Dr. Avraham Steinberg, there is no evidence that the equation mentioned in the Talmud is to teach that this way is an obligation; it may only have been a simple observation of the way of the world [1]. The creation of Eve is sometimes suggested as proof of Judaism's acceptance of cloning as a reproductive method. As stated in Genesis 2:21-22, "Hashem God cast a deep sleep upon the man and he slept; and He took one of his sides and He filled in flesh in its place. Then Hashem God fashioned the side that He had taken from the man into a woman..." From here it would appear that Professor Wilmut was not the first to clone a mammal, as God created Eve from adult cells extracted from Adam [2]! However, it is important to note that Eve's creation cannot be a proof in favor of human cloning from a Jewish perspective, as she was not a true clone of Adam [3]. Since Eve was a woman, by definition she had a different genetic makeup than Adam, as every male has a single X chromosome and a Y chromosome while, every female has two X chromosomes and no Y chromosome.

The most fundamental question asked from a Jewish perspec-

tive is whether the act of cloning a human being is permitted from a *halachic* standpoint. The author of the *Tiferes Yisroel* teaches the general rule that if there is no reason to forbid something, it is permitted; for the Torah has not enumerated all the permissible things, but rather has enumerated all of the forbidden things [1]. Being that the Torah did not list cloning outright as a forbidden act, it is up to the *halachic* authorities of today to determine if Jewish Law would forbid a human to be cloned. Dr. Steinberg explains that there are three qualifications that a new technology must have to be classified as a permissible act, rather than as a forbidden act that interferes with creation. The first qualification is that the action(s) involved in the new technology cannot be prohibited. The second is that the results

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cannot be prohibited, and the third is that the new technology is an improvement that benefits humans, with the derived benefit greater than a possible detriment [1].

While *halachic* authorities have determined that the act of nuclear transfusion is acceptable, the third qualification, that cloning must be a benefit to humans more than a burden, is yet to be decided, as this depends on the particular intent for each clone [1]. The most commonly cited prospective benefits of this technology are that it provides a means for infertile couples to have children, and that the technology can be used to grow transplant organs that immunologically match the recipient. The potential drawbacks and misuses, however, are serious. Genetic mutations that might arise in the donor nucleus would be passed to the clone, possibly resulting in congenital malformations or cancer. In fact, it has been observed that many cloned animals have developed significant health problems, including premature aging, and reduced lifespans, that did not plague the donor

animals [4]. Some have speculated that the availability of the technique might lead individuals to prefer to reproduce through the production of exact genetic copies of themselves rather than through normal sexual reproduction, thus forfeiting the sorting of genetic traits that is an inherent feature of sexual reproduction. Not only is this a danger to the offspring, as explained above, but this could also result in a loss of genetic variability among humans, and a weakening of the species through the loss of “hybrid vigor.” Others fear that the nightmarish story line of popular fictional accounts, such as the Boys from Brazil, where Hitler was cloned repeatedly, might become reality with modern despots and tyrants. One of the most hotly debated issues relates to the concern that individuals might create cloned humans for the sole purpose of harvesting their perfectly matched organs to prolong the life of the nuclear donor.

To address a few of these concerns, it is important to note that cloning does not compromise individuality. Many features are co-determined by the environment, not only by the genetic makeup of the individual. Therefore, the clone will not be absolutely identical to the nucleus donor. In fact, as mentioned above, Dolly herself was not exactly identical to her parent [1]. Additionally, being born a clone does not negate the person’s God-given free will. The clone, like all other people, will choose on his own to use his natural abilities [6]. A clone in essence is an identical twin to the parent, but in reality, will be even more different than identical twins, since the parent and clone matured in differing environments and circumstances. Identical twins, however, usually grow up together in the same household.

Assuming that the process of cloning is *halachically* permitted, a number of questions then arise as to how the clone will fit in to the current world order. For example, does the clone have the full status of “human,” or rather is he considered to be a *golem*, a being formed by man and given life by mystical means, with all the consequences that entails, such as the permission to kill a *golem* without the penalty of death by a *Beis Din* and the *golem’s* inability to be counted as a part of a *minyan*? It is clear that the clone has human status by all standards. Dr. John D. Loike and Rabbi Dr. Moshe D. Tendler explain that if a being has one of the following three criteria, he is considered a human. He must either be formed within or born from a human, express moral intelligence, and be capable of producing offspring with a human [2]. As the clone certainly meets the qualifications, the clone has the status of an ordinary human being [1, 2].

The most difficult question that arises with the possibility of nuclear transplantation is the question of the child’s father. The halachic mother is always determined to be the woman who physically gives birth to the baby [6, 7]. However, who is the father? Even in the “simple” case of a husband donating a nucleus to his own wife’s egg, it is unclear whether he is the halachic father of the child, as the father may need to be the donor of the fertilizing *sperm* itself, and not only the source of the genetic material [6]. The situation is even more

complex in considering the situation of a cloned woman. Who is the *halachic* father of a child who is the clone of a woman? The most recent donation of male genetic material to the child is the mother’s father, the child’s grandfather. A couple of possible answers have been proposed, the first, that the child has no father according to Jewish law, and second, that, assuming paternity belongs to the source of the child’s genetic material, and not the sperm donor, the maternal grandfather is the child’s halachic father [6]. Rav Shlomo Zalman Auerbach, zt”l, has ruled that in a case with no *halachic* father, the child’s status as to being a *Kohen*, *Levi*, or *Yisroel* is assigned according to the status of the maternal grandfather [7].

The paternity question becomes even more complicated with a little imagination. Suppose a married woman is the gracious hostess of carrying a clone for a man other than her husband. Then, there could be a possibility of a *mamzer* birth, a child born from a forbidden relationship and is under numerous restrictions in Jewish Law. However, *poskim*, those who decide upon questions that arise in halacha, have already ruled that in a case such as this one, the woman has not committed the act of adultery, and the child is not a *mamzer* [5]. A situation where there is uncertainty as to the religious status of the child can also arise. Suppose the hostess is a non-Jewish woman, or even the donor of the nucleus is a non-Jewish woman, is the baby then born a Jew [5]? Each of these situations is in actuality identical to the situation of any surrogate mother, and there is an extensive halachic literature that deals with this fascinating subject, but it lies beyond the scope of this review.

The list of hypothetical situations and the questions that arise are almost endless. In terms of inheritance, where would a clone fit in? For instance, would a male clone inherit like the rest of the children, assuming that it is the genetic material that makes the father-son bond? How would the *halacha* rule in a dispute over the inheritance of a clone and a child who was conceived naturally [5]?

Although most cultures view the prospect of cloning humans as an ethical dilemma, nevertheless, work in this area continues to progress. Numerous mammalian species have been successfully cloned and periodically reports emerge of efforts to clone humans, although most of these reports have so far proven false upon closer examination. Scientists are in agreement that much about the biological processes involved in cloning is still poorly understood, and the current success rate is low, with shortened life spans for those animals that were successfully cloned. In the secular literature it is the potential health risks to the clone that raises the greatest concerns. Do we have the right to artificially create imperfect life? As the scientists continue to improve their techniques and slowly progress towards the successful cloning of human beings, halachic authorities will need to continue to ponder the many halachic and ethical questions that arise. ■

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EMBRYOLOGICAL SEX DETERMINATION IN THE TALMUD AND MODERN SCIENCE

DALIA BARENBOIM

The gender of a child is typically understood to be determined at the moment of conception. The oocyte of the mother will always contribute an X chromosome to the zygote and the spermatozoan of the father will contribute either an X or a Y chromosome. The chromosomal combination of XX produces a female child, whereas XY codes for a male. As the embryo develops, the genes contained in this pair of sex chromosomes will prove critical in directing an intricate choreography of cellular events that will turn undifferentiated tissue into either female or male structures [1].

The scientifically-minded student of Talmud may thus be perplexed to encounter a most enigmatic discussion in *Gemara Berakhot* 60a. The discussion is based on the mishnaic statement that “If [a man’s] wife was pregnant and he said: ‘May it be [Your] will that she give birth to a male,’ this is a prayer in vain.” Rav Yosef challenges this mishnah, bringing proof from the verse in Genesis 30:21, which discusses the pregnancy of the matriarch Leah, where it is written, “Afterwards, she bore a daughter and she called her name Dinah.” The word *afterwards*, according to Rav Yosef, refers to *after* Leah rendered a judgment (“*din*”) concerning herself, saying, in the words of the *gemara*: “Twelve tribes are destined to emerge from Jacob. Six have already emerged from me and four from the maidservants. That is ten. If this one is a male, my sister Rachel will not even be like one of the maidservants.’ Immediately, [her fetus] was transformed into a daughter...” From this midrashic account a most fascinating debate pours forth, with one opinion in the *gemara* positing that a miracle done for our foremother is not relevant to our own lives; a second opinion then states that this was not simply a miracle done for our foremothers. Rather, one could say that the incident with Leah occurred in the first forty days of her pregnancy; from three until forty days following cohabitation, “a man should request mercy that [the embryo] should be a male.” In other words, sex is determined within the first forty days following conception, so a gender switch in this time would not require an interference in the natural order. This latter event is clearly presented in contradistinction to the former, thus placing it in the category of a natural event and thus permissible to pray for.

Even more interesting, a *baraita* is brought in *Gemara Niddah* 30b in which the sages debate whether it takes a female embryo the same amount of time as a male to develop into its gender. Rabbi Yishmael first brings evidence from the Torah that an embryo becomes

male within forty days and female within eighty days. One piece of evidence is that the Torah designated different periods of *tumah* and *tahara*, impurity and purity, following the birth of a male and a female child respectively, so that the embryo’s period of development is equal to the combined span of *tumah* and *tahara*, forty days for a male, and eighty days for a female. An alternative explanation is that the Torah uses the verb “she will give birth” in reference to the female, after already saying in Leviticus 12:2, “when a woman conceives and gives birth to a male child...” *Rashi* explains that Rabbi

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Yishmael derived his argument from this superfluous language; since the Torah used the additional verb in reference to the female, instead of just adding “and if it is a female child,” it is indicated that additional time is required for the development of the female. Either way, he is refuted by the other sages, who claim that both genders develop in forty days. They cite the evidence of a scientific experiment performed by Queen Cleopatra of Alexandria, in which she had a number of condemned maid-servants impregnated forty days before being put to death. After their execution, she had them dissected and showed that both male and female fetuses were evident. Rabbi Yishmael argues that this does not prove that female characteristics develop in forty days, since the women may have been impregnated before the experiment began. The sages respond that they were given abortive drugs, to which Rabbi Yishmael responds that this is not reliable because not all bodies respond to such drugs in the same manner. In an alternative version of this *baraita*, it is Rabbi Yishmael who

defends the experiment, while the sages find methodological problems in it and Abaye argues that, indeed, female fetuses after eighty days and male fetuses after forty one days were found to be at the same stage of gender development. The *gemara* concludes that males and females require the same amount of time to develop into their respective genders. These *baraitot* illustrate the Talmudic sensitivity to methodology in scientific experimentation and the complex nature of integrating scientific discoveries into the *halakhic* process.

What is clear through the sea of debate is that the *gemara* is unequivocal about a male embryo differentiating within about forty days. Indeed, until the beginning of the seventh week of pregnancy (about forty-two days), the genitalia are undifferentiated and thus essentially identical in both sexes. This is called the “indifferent state” of sexual development. In the fifth week, the embryonic connective tissue, known as the mesenchyme, develops a gonadal ridge into which epithelial gonadal cords then grow. These indifferent cords have an external cortex and an internal medulla. In the sixth week, primordial germ cells migrate from the wall of the umbilical vesicle to the gonadal ridges, enter the underlying mesenchyme, and are incorporated into the gonadal cords to eventually differentiate into either oocytes or spermatozoa. In the seventh week, in an embryo with XY chromosomes, the medulla (which in a female will regress) differentiates into testis and the cortex regresses. It is not until the tenth week in an embryo with XX chromosomes that there is visible histological evidence for the gonadal cortex differentiating into ovaries [1]. This means that the *gemara* is correct that males are differentiated in approximately forty or forty one days. Additionally, the delay in visibility of female genitalia until later in the process of differentiation sheds light upon the debate of the time span of female development [2].

The question remains, however, as to how exactly one may pray for a fetus to become a male until forty days. Although the genitalia have not yet differentiated to allow for phenotypic gender determination, genotypically the gender is determined at conception! If *chazal*, the sages of the Talmud, were aware of modern genetics, would they retract their permission to pray for a male until this point, calling it a prayer in vain? Perhaps, however, they would say that since the gender is not visible to the eye until this point, a gender switch on a chromosomal level will fall into the category of a hidden miracle, for which it is permissible to pray. The *Ramban*, Nachmanides, in his commentary to Exodus 13:16, draws a clear distinction be-

tween hidden and revealed miracles, stating that since the generations following the exodus and the sojourning of the Jewish people in the desert, revealed miracles are no longer performed for the nation. They are recorded in the Torah so that through them we may learn to perceive the hand of God in the hidden miracles which permeate our lives.

On a molecular level, there are various ways in which an embryo with XY chromosomes could erroneously develop female characteristics in the phenomenon known as sex reversal. The SRY, or sex-determining region of the Y chromosome, contains various genes which are crucial for male differentiation. One of these genes, the Wilm’s tumor-suppressing gene, or WT1, codes for the early stages of gonadal differentiation. In Fraser Syndrome, the RNA transcript of this gene is spliced incorrectly to exclude the nucleotides coding for the crucial triplet of the amino acids lysine, threonine, and serine. This leads to decreased expression of the SRY, which inhibits testicular differentiation and leads to sex-reversal [3]. The SRY also contains the gene coding for the gene promoter of the MIS gene, which codes for production of Mullerian-inhibiting substance, or MIS. MIS is the substance responsible for the release of androgenic steroids which induce masculinization of the external genitalia and differentiation of the Wolffian duct, the precursor of the vas deferens, seminal vesicles, and epididymis, as well as regression of the Mullerian duct, which is the precursor of the uterus, fallopian tubes, and upper vagina. In this manner as well, faulty SRY transcription can cause sex reversal. It is hypothesized that problems in SRY transcriptions are caused by problems in the binding of promoters caused by nucleosome phasing and superhelical density [4]. It is thus seen that many events on a molecular level are far from negligible. When praying until the time of differentiation for the child to be a male, far from engaging in a purely chauvinistic activity, perhaps we could be praying for the prevention of the rare but medically serious disruptions in molecular events that could lead an XY embryo to express the opposite characteristics.

More than anything, the issue of embryological development illustrates the importance of appreciating the hidden miracles which are the very fabric of the natural world. We are awed by the incomprehensible complexity of the cascade of events that leads to the development of a healthy child. Instead of praying for the openly miraculous, we are enjoined to humbly acknowledge the quiet whispers of God’s influence in every cell of our bodies. ■

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THE LIFE YOU SAVE COULD BE YOURS...OR YOUR CHILD'S: SCIENTIFIC AND *HALACHIC* APPROACHES TO MANDATING THE HPV VACCINE

AMANDA BIER

This manuscript discusses the health issues and the bioethical parameters, according to traditional Jewish law (*halacha*), of the human papillomavirus (HPV) immunization. HPV is a group of viruses that consists of more than one hundred different strains or types. Conclusions are based upon scientific and halachic information, as well as upon my personal opinion regarding the importance of HPV immunization and public health and safety. I take a stance regarding one of the most talked about modern medical spars: whether or not the HPV vaccine should be mandated in the United States.

Some things in life are clearly good or bad, but most are shades of gray. Cancer prevention, always definitively associated with goodness, has recently joined the multihued spectrum of grays. The popularization of cancer prevention is the modern prevalent target of medical, political, ethical and religious spars, and Merck's HPV vaccine is currently at the center of this controversy. American state requirements regarding immunization vaccines in the school systems, usually following Advisory Committee on Immunization Practices, have served as an impetus causing the American public to realize the severities of perilous diseases and viruses and support the administration of their respective preventive vaccines. Such herd vaccinations have become nationally compulsory, agreed-upon exceptions to people's religious and personal oppositions [1].

Sufficient evidence supports the recommendation of global immunization of the HPV vaccine among teenagers and young adults, both male and female. This vaccine has been shown to immunize against certain sexually transmitted strains of HPV. Research shows that "high risk" HPV may cause abnormal Pap tests and are linked to the development of cervical, anal, oropharyngeal and genital cancers and genital warts [2, 3]. HPV types 16 and 18 account for about 70% of all cervical cancer developments worldwide. Merck's HPV vaccine, gardasil, and GlaxoSmithKline's HPV vaccine, cervarix (not yet federally approved), have been verified to efficiently prevent cervical intraepithelial neoplasia grades two and three caused by HPV 16 and 18. The HPV vaccines are mainly popularized for preventing cervical cancer, the second most common cancer among women worldwide, solely responsible for 274,000 annual deaths\

It seems that those who are against federal endorsement of the HPV vaccine believe that recognizing the issue of teenage promiscuity is, in essence, sanctioning such conduct. Therefore, they oppose legislative enforcement of the HPV vaccination, fearing that immu-

nization from HPV diseases will deter teenagers from thinking twice before engaging in sexual promiscuousness. If not for this reason for opposing the vaccine, then perhaps parents have the perception that this vaccine is more risky than the disease it prevents [1].

Several Christian groups and councils, such as the Family Research Council, Focus on the Family, and Judicial Watch, have expressed their opposition to the HPV vaccine. Such groups assert that mandating the vaccine infringes upon constitutional and parental

It is important to remember that the risk of immunization is far lower than the risk of disease, and therefore it is *halachically* required for us to immunize ourselves against dangerous diseases such as HPV.

rights, and they report deaths claimed to have been caused by the vaccine. However, the HPV vaccine has only minor side effects and has been considered completely safe by the federal Centers for Disease Control and Prevention and the Food and Drug Administration. The vaccine does not contain thimerosal, a mercury-containing vaccine preservative, but rather virus-like particles that do not replicate or cause damage to the human body [4].

To maintain parental rights and autonomy over their children, states have incorporated an opt-in opt-out program regarding children being immunized by the HPV vaccine. An opt-in course requires an assenting effort by a parent, thereby omitting many children whose parents disregard the opportunity opt in. Conversely, vaccination rates among children whose parents have no real opposition to the vaccine are increased via an opt-out program, and parental autonomy is assuredly conserved. This, in part and parcel with their individual state legislative mandates regarding the mass receipt of the HPV immunization among teenagers and young adults, is expected to make

all parties, federal and private, happy. Opposition to this vaccine claims that even with this opting program the scales are still unbalanced because the alternative immunization from HPV diseases is bluntly abstinence, an unpopular substitute in the general population [1].

According to American law, the rights of the public health supersede that of the individual. HPV is transmittable and is therefore a public threat. *Parens patriae*, Latin for “father of the people,” is the legal term describing the state as the overall parent of the people. Under the *Parens Patriae* Doctrine, the state usurps the power to care for a person in need of medical protection and may enforce direct observed therapy (DOT), where a health care provider watches a patient take his medication [16,17]. While such a forced program infringes upon the patient’s constitutional right to personal liberty, the grounds upon which to deprive someone of his liberty includes refusal to care for a public health hazard. The state can force treatment upon a person if he refuses to treat himself and thus poses a threat to the public. This means that even if parents object to their children’s inoculation with the HPV vaccine, the state can overrule them on the grounds of both the *Parens Patriae* Doctrine and forced treatment via DOT because these children could pose a public health hazard if not vaccinated [16].

The Centers for Disease Control and Prevention report that 13% of American girls are sexually active by the age of fifteen, 43% by seventeen, and 70% by nineteen. The ramifications of underage promiscuity are statistically drastic and lead to the transmittance of sexually transmitted diseases (STDs) and HPV. The rate of adolescent school dropouts greatly increases at the age of thirteen, and the rates of sexual activity and teenage pregnancy are much higher among school dropouts than among those in school. Therefore, perhaps if students were to be vaccinated before the age of thirteen, many adolescents would be protected against HPV resulting from their probable promiscuousness [1, 2].

In recent studies, cancer-causing HPV strains have been found in half of oropharyngeal cancers, indicating that HPV infections affect regions beyond the genitalia and anal area. HPV is progressively being associated with oropharyngeal cancer [5]. While rates of cancers in the head and neck region, such as larynx, oral cavity and hypopharynx cancer have greatly declined since the 1970s, and more significantly since the 1980s, oropharyngeal and tonsillar cancer rates have increased [6, 7]. The oropharynx is the region of the pharynx that helps a person to talk, swallow, chew, breathe, and eat. More than 90% of the cases of oropharyngeal cancer are squamous cell cancers. Squamous cells are flat, scale-like cells that typically shape the lining of the oral cavity and throat. Squamous cell cancer starts off as a compilation of abnormal squamous cells [8]. Molecular evidence supports the theory that HPV is responsible for the origin and development of these squamous cell carcinomas of the head and neck. Epidemiological data supports the fundamental contributory

association between HPV and oropharyngeal cancers and could lead to imminent breakthroughs of new cancer prevention curricula concerning inoculations. The trustworthiness of the evidence of such epidemiological studies is emphasized and supported by the associations of high-risk sexual behavior, oral HPV infection, and HPV-16 exposure with oropharyngeal cancer. Exposure to HPV can precede the appearance of oropharyngeal cancer by ten years or more [1]. Men and women are both carriers of HPV, and therefore, in order to eradicate the genital HPV diseases, both males and females would need to receive the HPV inoculation.

There is evidence of HPV infections causing oropharyngeal cancer and furthermore, there is a question if HPV can be orally transmitted through saliva. Research performed by D’Souza and colleagues [14] gives credence to the reality and effectiveness of HPV viruses through oral transmission [15]. This detracts from the argument that the HPV vaccine only benefits those who are sexually active. This underscores the importance of people who are not sexually active receiving HPV vaccinations in addition to those who are sexually active. Based on this research, any person could spread HPV from performing such mundane activities as kissing a child or sharing an ice cream.

In Deuteronomy, the Torah clearly commands us: “And you shall beware greatly for your souls” [9], teaching us to guard our health. Asks HaRav Eliezer Chrysler in the name of the Ohr la’Tzadikim: why does the Torah say, “And you shall beware greatly to your souls” (“Tnafshoteichem”) instead of simply “your souls” (“nafshoteichem”)? HaRav Chrysler explains that the Torah is teaching us a great lesson. The Torah adds the Hebrew letter lamed, meaning “to,” or “for the sake of,” before “your souls” to teach us that we must care for our bodies for the sake of our souls. An ill body is unable to execute G-D’s will to the perfection of which a healthy body is capable. Our bodies are a loan, explains HaRav Chrysler, and we are borrowing them to fulfill G-D’s commandments. To fulfill our G-D-given duties, we must keep our bodies healthy. We are obligated to follow G-D’s mandate by taking precautionary steps to help ensure our protection and general wellbeing [10].

The Shulchan Aruch [11] emphasizes the obligation of actively preventing medical hazards. The Shulchan Aruch explains that a survivor of a town struck by a plague is not required to leave the town if the plague strikes again because he is now immune. Dr. Daniel Eisenberg says that Torah is pro-immunization as part of a precautionary medicinal curriculum, and therefore it is imperative to realize that even when a small risk of death exists, vaccination is not only permitted but halachically advised [12].

In the nineteenth century, Rabbi Yisroel Lipshutz, the *Tieferet Yisroel*, declared that the smallpox vaccine is permitted even though it carries the risk of death. In fact, Rabbi Lipshutz named Edward Jenner as a righteous gentile for having developed the vaccine and saving hundreds of thousands of lives as a result. Based on this story

and the above Judaic sources, Dr. Eisenberg explains that withholding immunization from our children because of the small risk of complications is “irrational.” It is important to remember that the risk of immunization is far lower than the risk of disease, and therefore it is *halachically* requisite for us to immunize ourselves against dangerous diseases such as HPV [12].

Oposing the administration of the HPV vaccination for our youth may go against the very Biblical commandment that suggests that we receive the vaccine. The Torah supports our taking action to protect ourselves from dangers. Torah supports the receipt of the tetanus shot, explains Dr. Daniel Eisenberg, because the possible reactions from the injection do not compare to the reactions one would inevitably suffer upon coming in contact with rusty metal without having been immunized beforehand. In other words, the benefits greatly outweigh the rare losses. Similarly, the Torah may support vaccinations, such as the federally officially declared “safe” HPV vaccine [4]. There are those who think that those Jews who abstain from allowing their adolescent children and/or themselves, if they are young adults, to be vaccinated by the HPV vaccine are essentially going against G-D’s commandment to safeguard our bodies [13]

The main purpose for the receipt of the HPV vaccination is to prevent the transmittance of vaginal and cervical cancer [1]. Therefore, it is evident that females should receive the HPV vaccine. However, since HPV can also cause anal, genital, and oropharyngeal cancers, it should be considered for males as well [5]. Recent evidence is only showing more negative effects of HPV infections and the benefits of the HPV vaccine. Therefore, perhaps in accordance

with Torah law, the HPV inoculation should be given to both males and females alike. We should no longer view the HPV vaccine as a women’s vaccine, because it greatly benefits males, too. Simply, Torah commands us to be safe rather than sorry [9-12]. Oral transmittance can affect all individuals regardless of their gender and sexual activity [14, 15]. It appears that we may therefore have the legal [13, 14] and Biblical [9-12] obligations to receive HPV vaccinations in case HPV viruses can, in fact, be orally transmitted.

In my opinion, we have in our hands the ability to eradicate a number of ferocious diseases that kill millions of people each year. I wonder how we can even consider abstaining from vaccinating our youth with the HPV vaccine on the grounds that its side effects could be more perilous than the reactions to the very diseases against which the inoculation vaccinates. I humbly question how we can even attempt to validate the concern that vaccinating our youth will encourage them to engage in sexual activities when their probable vulnerable promiscuity could result in even more hazardous disasters. How can we pose a possible threat to the health of the public by opposing HPV vaccinations? What if HPV infections can be orally transmitted? Perhaps we must understand that adolescents may be more inclined to engage in sexual activities if inoculated with the HPV vaccine, but at least they will be protected against such terminal diseases as cervical and vaginal cancer. I believe that if HPV infections can be orally transmitted, every human being, sexually active or not, is at risk, and everyone of us would have the obligation to be vaccinated just in case. *“And you shall beware greatly for your lives”* [9]. ■

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TO TEST OR NOT TO TEST – THE BRCA GENES EXPLORED

NECHAMA CITRIN

The combination of cancer of the breast and ovary in families, known as hereditary breast and ovarian cancer syndrome (HBOC), was first reported in the early 1970s [1]. The specific genetic abnormalities associated with this phenomenon have since been described, and the culprit genes known as BRCA1 and BRCA2 have been cloned [2,3]. The presence of either the BRCA1 or BRCA2 mutation indicates a life-time probability of developing breast cancer that may be as high as 80% and a life-time risk of developing ovarian cancer to be 30% [4]. Approximately 10% of the 240,000 women annually diagnosed with breast cancer in the United States have hereditary breast cancer. In these cases, there is a high preponderance of family members with breast and other cancers (particularly ovarian) in a pattern consistent with autosomal dominant transmission, earlier age at diagnosis, and often as a bilateral disease. Most cases of hereditary breast cancer are due to BRCA1 or BRCA2 mutations [7].

In 1990 chromosome 17q21 was identified as the location of a susceptibility gene for breast cancer, now known as BRCA1 [8]. The culprit gene was cloned, and this was followed by the identification and cloning of a second breast cancer susceptibility gene located on chromosome 13q, known as BRCA2 [9].

The normal biologic function of BRCA1 and BRCA2 is to maintain genome stability. They belong to the class of tumor suppressor genes and play an important role in preventing precancerous tissue damage. Additionally, these genes assist in the repair of damaged DNA. However, a mutation in either of these genes increases the risk for developing cancer and it has been illustrated that the inheritance of a BRCA gene mutation follows an autosomal dominant pattern with incomplete penetrance. Penetrance is the likelihood that the effect (phenotype) of a mutation (genotype) will be expressed, possibly resulting in a clinically apparent disease [12]. Incomplete penetrance means that although the mutated gene is present, it may or may not cause a deleterious phenotypic effect. Although breast cancer in the general population is overwhelmingly a disease of women, BRCA2 mutations are associated with a 6% lifetime risk of male breast cancer [6].

Certain “founder mutations” are known to exist in BRCA1 and BRCA2. These are ancient mutations that have occurred in specific ethnic populations many generations ago. These mutations persist within the population because their genotypic expression, i.e., the development of the disease, usually occurs after child-bearing

age, thus allowing the transmission to the next generation [10,11].

Two founder mutations of BRCA1 have been identified (185delAG and 5382insC) and one founder mutation of BRCA2 has been identified (6174delIT). One of these three mutations occurs in 2.5% of the Ashkenazic Jewish population, compared with 0.1% of the general population [5,10,11].

BRCA analysis is now commercially available using polymerase chain reaction (PCR) analysis of white blood cells.

In addition to the important medical issues that a diagnosis of gene mutation raises, there are important *halakhic* issues for the observant Jewish patient.

The search for a cancer-causing gene mutation should be performed when there is a personal or family history suggestive of a hereditary cancer syndrome [13]. A detailed family history is mandatory. Clinical features of hereditary cancer include early age of cancer onset, a specific pattern of multiple cancers (such as breast and ovarian cancers), and an increased number of cancer occurrences in family members.

Screening is defined as identifying cancer at the earliest possible stage, before clinical symptoms develop. Breast cancer screening generally includes breast self-examination, regular physical examinations by a health care professional and most importantly screening mammography. Screening guidelines for the general population recommend annual mammography after age 50 and possibly age 40 [14]. Such guidelines would not be appropriate for the BRCA positive patient, where earlier onset of disease often occurs before age 30.

Mammograms are less sensitive in younger pre-menopausal women and newer radiologic techniques, such as magnetic resonance imaging (M.R.I.) may be very helpful in high risk groups, such as BRCA positive patients [15].

The most effective (and radical) method of achieving protection

from developing breast cancer and avoiding breast cancer mortality is a bilateral prophylactic mastectomy. Many breast cancers are dependent on or sensitive to hormone stimulation. Therefore, prophylactic removal of the ovaries (oophorectomy) often has a beneficial effect by reducing the incidence of breast cancer, and also reducing (but not totally abolishing) the risk of developing cancer of the ovary [17].

Removal of the ovaries has a major effect on a woman's reproductive life. As most BRCA positive women who develop cancer of the ovary do so after age 35, it is probably safe to delay such surgery until the early 30s, thus allowing women a child-bearing window.

Treatment of the BRCA positive patient diagnosed with breast cancer differs from the treatment of the breast cancer patient not carrying the gene mutation. In general, modern treatment of breast cancer involves limited surgery, with, in most cases, the goal of breast conservation. In the BRCA positive patient, the risk of a second primary breast cancer involving the homolateral or contralateral breast is so high that breast conservation is less frequently recommended [18,19].

In addition to the important medical issues that a diagnosis of gene mutation raises, there are important *halakhic* issues for the observant Jewish patient. The question is raised whether mass screenings for the BRCA1 and BRCA2 genes should be encouraged. Reasons for the encouragement of mass screenings include the preventative measures that can be implemented by an individual testing positive for the gene and the potential early detection of a disease. Preventative measures include frequent mammograms, physical exams, and more invasive treatments including prophylactic hormonal treatment in the form of tamoxifen and prophylactic bilateral mastectomy. The emotional benefits of gene screening for some patients include the lessening of mental anxiety. This is obvious for the individual testing negative for the gene, but it can also be true for the patient testing positive for the gene. This can be illustrated in the lessening of emotional stress associated with the lack of knowledge of one's genetic status and the fear of being a genetic carrier. Knowledge of carrier status allows for the implementation of preventative measures and early detection of disease [20].

There are various reasons presented discouraging mass screenings for the BRCA genes in the general Jewish population and these include emotional pain, fear of stigmatization and discrimination, and the lack of definitive preventative measures and treatments. BRCA screening targets premenopausal women and the efficacy of mammography for this population is questioned due to the high density of breast tissue. Currently available preventative treatment options are not fully effective and these include surgical options, such as bilateral mastectomy for which it is impossible to fully remove all breast tissue.

Parallels can be drawn between BRCA and Tay-Sachs disease genetic testing. Tay-Sachs disease is an autosomal recessive genetic

disease manifested during infancy and found in Ashkenazi Jews. The biochemistry of Tay-Sachs was elucidated in 1969 and mass screening began in 1971. Upon initiation of genetic screening for the Tay-Sachs gene, mass screening was not supported by many rabbis and medical authorities due to the potential for stigmatization of those testing positive. In 1973, Rav Moshe Feinstein advocated for the testing of individuals of marriageable age, while he advised against the mass screening of Jewish communities due to the potential for confidentiality breaches. In the same year, the Association of Orthodox Jewish Scientists came out in support of Rav Moshe's opinion. At the time there were rabbinic authorities in support of community wide screenings for Tay-Sachs, with Rabbi J. David Bleich advocating for the screenings of individuals at a young age. The Union of Orthodox Jewish Congregations of America issued a statement in support of Rabbi Bleich's view [20].

Dor Yeshorim, a confidential testing initiative, was founded by Rabbi Joseph Eckstein during the 1980's. Dor Yeshorim does not reveal individuals' genetic status, including carriers, and has removed much of the stress and stigmatization associated with Tay-Sachs testing. Dor Yeshorim is supported by numerous rabbinic authorities including Rav Moshe Feinstein and Rabbi S.Z. Auerbach.

Important differences between BRCA and Tay-Sachs screening do exist. Testing positive as a BRCA carrier is associated with increased stress than in someone testing positive for Tay-Sachs. BRCA genes are dominant, while Tay-Sachs is associated with a recessive gene. A Tay-Sachs carrier will not develop the disease, but could produce a child with Tay-Sachs only upon mating with another Tay-Sachs carrier. With regard to an individual testing positive for the BRCA gene, the individual herself is at increased risk of developing breast cancer. Therefore, BRCA carrier status is associated with elevated stress levels than Tay-Sachs carrier status. There are other reasons for the increased level of emotional stress accompanying a BRCA carrier diagnosis. These include the fact that familial breast cancer is illustrated by incomplete penetrance and not all carriers will manifest the disease. Tay-Sachs disease exhibits complete penetrance and individuals with two Tay-Sachs genes will develop the disease. Additionally, an individual who is a BRCA carrier may never develop breast cancer or may develop it late in life, as familial breast cancer is a disease of adulthood. Tay-Sachs, however, is manifested in infancy. As indicated by the reasons mentioned, a BRCA carrier status can result in a lengthy, and at times not necessary, period of emotional stress [20].

Differences are encountered in the available prophylactic options for the BRCA gene carrier and for the Tay-Sachs gene carrier. The available preventative treatment options for an individual testing positive as a BRCA carrier are not totally successful. Surgical options, including bilateral mastectomy, are both extreme and not completely effective. Additionally, the full effects of prophylactic hormone treatment are still under review. Tay-Sachs is an incurable dis-

ease, but there are successful preventative options available including pre-marital genetic screening [20].

There are Biblical commandments informing man of the importance of providing for one's health. In Devarim 4:15 it states, "*Guard your lives diligently.*" It is a widely supported rabbinic view that a sick individual is required to consult and act in accordance with the advice of medical authorities. There is a discussion regarding whether screening for one's genetic status falls under the requirement to diligently request and follow medical advice. Rabbis, such as Rav Moshe Feinstein, raised the question that genetic screening may actually be forbidden due to the fortunetelling association. When discussing screening for Tay-Sachs, Rav Moshe quoted the *pasuk* from Devarim 18:13, "*You shall be perfect with the Lord your G-d,*" and the commentary of Rashi, "*and do not search after the future.*" Rav Moshe was of the opinion that Tay-Sachs testing cannot be equated with fortunetelling because the means of testing are simple (i.e., by a blood test). It can be concluded that while there is no Biblical requirement mandating genetic screening as a form of protecting one's health, genetic screening is allowed [20].

Emotional distress is considered in Biblical sources with regard to the revealing of a serious disease to an afflicted individual. There is a story in Kings II in which the king of Aram was sick and asked Elisha the prophet if he would live. Elisha was aware that the king would not survive but did not inform him of this but responded in the affirmative that he would live. From this case, it can be seen that at times it is better to withhold information relating to the severity of a terminally ill patient's condition, so as not to contribute to

their emotional distress. Rav Moshe Feinstein supported this view. This example is in reference to an already diseased individual, but with regard to BRCA screening, there is no current diagnosis of disease and there is no ban on revealing the genetic carrier information to a healthy individual. A positive BRCA carrier status and the stress associated with this knowledge has not shown to bring about the death of the tested individual, and therefore, these examples are not the origins for the view that does not support mass BRCA screening [20].

There are significant differences between the emotional distress suffered by an individual who is informed of an illness and that of being a BRCA positive carrier. In both cases there is profound sadness and apprehension associated with death, while for the BRCA positive individual, there is an additional worry concerning "stigmatization and discrimination – specifically from potential marriage partners." Citing this concern, Rav Moshe Tendler, is not in favor of mass screenings for the BRCA gene [20].

The BRCA gene mutations are found in 2.5% of the Ashkenazi population and there is a discussion regarding genetic screening for these genes. It can be concluded that while mass genetic screening of Jewish communities is not supported by rabbinic authorities, as the potential knowledge and preventative treatment options do not fully negate the adverse emotional distress associated with the knowledge of a carrier status. As there is no *halakhic* issue with genetic screening, BRCA screening on an individual level for those with family histories of familial breast cancer would appear to be sanctioned. ■

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WINE: AGENT OF INTOXICATION OR CHARACTER ENHANCER?

JENNIFER DELUTY

The dichotomous nature of wine throughout Biblical and Talmudic texts is quite striking. There seems to be a constant shift between the positive and the negative connotations given to the consumption of this alcoholic beverage. On the one hand, there are clear negative restrictions and explicit ramifications with regard to the consumption of wine. The extensive restrictions of a nazirite, the prohibition of entering the sanctuary intoxicated, and the general negative associations to light-headed behavior and frivolity help to comprise a general negative attitude toward alcohol consumption. Yet, Biblically, there seems to be an additional positive correlation with the consumption of wine. The foundation of Israel as a land of “grapes, figs and dates,” the various wine rituals of *Kiddush* and *Havdalah*, and the seemingly positive command to, in some way, become inebriated on Purim, allude to the definite beneficial component of this beverage. A deep analysis and observation of the chemical composition of wine and of its effects upon human physiology and activity can help to shed light on this perplexing duality. Nice!

The health and social benefits of wine consumption seemed to have been recognized and acknowledged in the early Biblical era. In King David’s analysis of the nature of man and the world in general, he explicitly states that, “Wine gladdens a man’s heart...and bread through which the heart of man is sustained” (Psalms 104). Not only does he imply that wine enables man to live in an optimistic and “gladdened” state, but also seems to equate it with bread, as a necessary and essential component of life. Rabbi David Kimchi, the famous commentator known as Radak, even goes as far as to interpret this verse as saying that wine heightens one’s intellect to the point that it prepares the mind to receive prophecy. Thus, wine can be viewed as a necessary vehicle to attaining the climax of spiritual satisfaction, the meeting with G-d himself.

The land of Israel plays a central Biblical role in the birth of the Jewish nation. It is quite significant that the land of Israel is praised as being the land of “wheat, barley, grape, fig..”(Deuteronomy 8:8). The byproducts of Israeli agriculture of wheat, wine, and fruit comprise the prestige and self-sufficient nature of the Jewish land. It is not surprising, therefore, that the four expressions of redemptions from Egypt to Israel of “I will take you out, rescue you...redeem you... Bring you (Exodus 6:6-7) are represented by four cups of wine at the Passover Seder. The nature of wine as a positive representative of the new Jewish nation and its land exalts wine for its

beneficial nature.

Many of the Talmudic writings serve to compound this notion of wine. The Talmud (Tractate Pesachim 109a) states, “Happiness is only with wine and meat.” From here, the sages derive that wine is a necessary component to fulfill the command of “Be happy in your holiday.” In general, many *halachik* authorities render it preferable to

Both the scientific and religious viewpoints emphasize a balance in the consumption of wine.

use wine for *Kiddush* and *Havdalah* if possible. Thus, wine is used to enhance many Jewish rituals. Additionally, many Cabalists have used the Talmudic (Tractate Eruvin 65a) credo of when “wine comes in, a secret is revealed” to advance the mystical nature of wine, explaining that both yayin, wine, and sod, secret, share the same Hebrew numerical value of 70. As inhibitions are lowered, depth of nature and character is revealed.

Though the Torah seems to maintain a positive light on wine consumption, other sources seem to point to a radically different approach. King Solomon, in his work of Proverbs (20:1, 23:29-30) seems to emphasize again and again the importance of distancing oneself from wine, as it can lead to frivolity and sin. Maimonides thus stated in his *halachic* work of *Mishneh Torah* (Hilchot Yom Tov 6:20) that, “when a person eats and drinks and rejoices on a festival, he should not be drawn after wine, laughter and frivolity...for drunkenness, mirth and frivolity, are not joyous but frivolity and stupidity”. Thus, to Maimonides the effects of the nature of wine are clearly negative and even detract from service of G-d and normative social behavior.

The prohibition in *Parshat Shmini* (Leviticus 10:8-9) of not entering the sanctuary in a drunken state alludes to this negative nature of wine. The *Sefer Hachinuch* gives simple logic to explain this command, writing, “It is known that it is improper to involve oneself in matters of utmost value, such as service of the temple and words

of Torah, unless one is of clear mind and gives full attention to his actions.” The Sages (Rashi to 10:10 from Tanchuma Acharei 6) even compounds this principle with Rabbi Ishmael’s interpretation that intoxication and subsequent entry into the sanctuary caused Aaron’s sons, Nadav and Avihu, to die. Not only can intoxication detract from service, but also can actually prohibit one from performing actions due to seemingly conflicting value systems.

Biblically, the vow of the nazirite (a voluntary declaration in which one decides to abstain from material possessions such as wine and hair cutting in an attempt to focus on the spiritual) can be used to convey the evils associated with wine. The Torah commands the nazirite to abstain from wine to the point that he can no longer consume, “new or aged wine, vinegar of wine, anything which grapes have been steeped, and even dried and fresh grapes”(Numbers 6:3). Exegetically, the Talmud (Tractate Sotah 2a) renders the connection between the story of the nazirite and the *sotah*. It explains that the Torah wishes to convey a moral lesson, that if one wishes to restrain from acting immorally as a *sotah*, one must stay away from grapes and wine and become a nazirite.

Scientific evidence certainly supports this dichotomous view toward wine and its effects. The beneficial effects of alcoholic beverages have been observed in the realms of the central nervous system, the immune system and other peripheral organs. Research has shown that in certain concentrations alcohol can serve to sensitize the N-methyl D-aspartate (NMDA) system of the brain, by making it more permeable to the neurotransmitter glutamate. Thus, alcohol has been proven to stimulate the cortex, hippocampus, and nucleus accumbens of the brain, enhancing one’s thinking and pleasure-seeking behaviors. Also, alcohol has been associated with high neural alpha wave conduction on an EEG, a sign of heightened body relaxation [1]. Increased animation in speech and movement is another arguably positive result of alcohol consumption. This may be a result of increased metabolism to the nigrostriatal pathway of the central nervous system, CNS, related to movement [2]. Interestingly, this research seems to explain the basis of *Chazal’s* famous statement (Eruvin 65), “wine comes in, a secret goes out.”.

Like the interactions with the CNS, there seems to be positive correlations between alcohol and the immune system. The exact link between polyphenol-rich wine and an increased immune response is not fully understood, but current research supports a positive correlation between infectious and inflammatory responses and wine consumption. There is some speculation that it may be due to the antioxidants in the pigment found in red wine, but further research is required.[1]

The abilities to inhibit platelet formation and act as antioxidant contribute to the beneficial effects on the cardiovascular system. The polyphenols in red wine (as well as in dark chocolate and black and green tea) may provide protection against oxidative stress. Nitric oxide and reactive oxygen radicals play a role in dietary polyphenol-

induced activation the transcription factor, Nrf2. This process is known to trigger antioxidant response element (ARE) driven transcription of phase II detoxifying and antioxidant defense enzymes in vascular cells [3].

Research has proven that resveratrol, a polyphenol in wine, affects major stages in cancer progression and thus played a role in reducing tumor incidence in laboratory animals cotreated with a carcinogen. Additionally, *in vitro* studies with cells in culture showed that resveratrol induced apoptosis, or programmed cell death, in cancer cells [4].

Despite the abundance of health benefits, all concentrations of alcohol may have some negative effect on the body in general. For example, at a blood alcohol level of just 0.03%, one may look flushed, have a short attention span, impaired judgment, and may experience difficulty with fine motor skills. As the alcohol level rises to about 0.09%, lethargy may ensue. Subjects become extremely tired, have difficulty remembering and understanding, have uncoordinated body motions, lose balance easily, and do not react quickly to environmental stimuli. The sensation of vertigo is connected to a loss of the vestibular system in the ear and of the functioning of the cerebellum to coordinate activity. Also, atrophy of the vermis, which is the part of the cerebellum responsible for coordinating gait, can actually cause long term damage to gait even when not inebriated. As consumption yet increases, confusion ensues. Dizziness, confusion, nausea, and aggression are often associated with this state. As the percentage of blood alcohol intensifies, the subjects may go into a coma, exhibiting a lack of responsiveness to their environment and the passage of time and of others around them. Risk of death increases due to alcohol toxins (i.e., acetaldehyde), as well as to pulmonary aspiration of vomit while unconscious and of failure of the central nervous system[6].

As a CNS depressant, alcohol consumption can have many extreme consequences ranging from blurred vision to unconsciousness and eventual death. Wine may have devastating effects on liver metabolism. Alcohol dehydrogenase and acetaldehyde dehydrogenase, two enzymes of the liver, function to degrade alcohol to acetaldehyde and thereafter to acetic acid, which is either converted to fats or broken down carbon dioxide and water. However, overworking this pathway can have distressing effects. Fatty acids continue to build and eventually block blood flow through capillaries. As liver cells die, cirrhosis, a liver disease, may ensue [5].

Alcohol is the leading known preventable cause of mental and physical birth defects in the United States. Fetal alcohol syndrome (FAS) (explain this is caused by drinking by the mother during pregnancy) includes mental, physical, and social abnormalities. Dangerously low birth weight, small head circumference, organ dysfunction, smaller eye openings, flattened cheekbones, and an indistinct philtrum (the vertical groove in the upper lip) are among the physical defects. This syndrome is also associated with developmental

delay, poor memory, and poor language comprehension, inability to understand concepts such as time and money, and poor problem-solving skills. Finally, the FAS-child is also affected socially, as correlations were noted between FAS and behavior problems, hyperactivity, inability to concentrate, and social withdrawal. Thus, alcohol intake does not just have negative benefits to the drinker but can result in lowered quality of life for the progeny [7].

Additional side effects of excessive alcohol consumption include renal dehydration and blurred vision. Alcohol inhibits osmoreceptors, which in turn send a lessened message from the hypothalamus to the pituitary gland. Lowered stimulation of the pituitary gland is detected by a low osmotic pressure, igniting a feedback signal to lower the level of ADH, leading to the excretion of large volumes of urine and eventual dehydration. The suppression of glucose transport to the occipital lobe is also thought to decrease cerebral metabolism, making the brain unable to interpret images properly [8].

Both the scientific and religious viewpoints emphasize a balance in the consumption of wine. While this substance is certainly beneficial in certain settings and volumes, excessive amounts are inappropriate and have disastrous effects. Thus in some cases, wine consumption has the ability to enhance rituals, to serve as a praise to Israel, to play a preventive role in oxidative stress, and to heighten body relaxation. Yet, when consumed in excess, wine can cause renal and liver failure, impaired judgments, and even death. As such, wine consumption at any level is inappropriate for someone who must enter into the holy sanctuary or for a nazirite.

Alcohol has a biphasic effect on the body, effecting change over time. Initially, alcohol generally produces feelings of relaxation and cheerfulness, but further consumption can lead to blurred vision and coordination problems [9].

The functional liver metabolism of alcohol dehydrogenase and acetaldehyde dehydrogenase serves to illustrate this point. The body has established a pathway in which normal consumption is broken down and dealt with in a way that allows a person to reap its benefits. Yet if this system is abused, it allows for the many destructive effects commonly associated with alcoholism. Also, the NMDA receptors, that in low concentrations, cause pleasurable stimulation can cause devastating results. They have been found, in high concentrations to become unresponsive and slow functioning. Again, the body has developed a mechanism for yielding positive results up to a certain point. Above that point, the blessing can turn into a curse!

The physiological effects of alcoholism seem to fit perfectly with a *Midrash Tanchuma* (Noach 61). In Genesis (Parshat Noach 61) it teaches that “before a person drinks wine, he is as innocent as a lamb who knows nothing and as still as a sheep before the shearers. If he drinks the right amount he becomes as strong as a lion, and declares that there is no one like him in the world. When he drinks too much, he becomes like a pig, in his own urine.” The scientific and religious messages seem to support one another. Balance is the key to maintaining a life in which one can both reap the positive benefits and prevent the negative effects of wine consumption. ■

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BUSTING THE MYTH OF JEWS WITH HORNS

ESTHER FREDERICK

Years ago, in summer camp, I had a friend named Jesse from Texas. He lived somewhere with very few Jews. Earlier in the summer he had a high school summer job as a stock boy at a grocery store, along with one other girl. Upon finding out that he was Jewish, she exclaimed in confusion: ‘But where are your horns?’ He clarified the story, explaining that she hadn’t said it with any malice. She’d simply never met a Jew before and was under the impression that we all have horns [1].”

The story demonstrates that, although rare, there remains a continuing existence of the irrational belief that Jews have horns, especially in locations without a Jewish population. Even though the belief has been mostly banished in modern civilized society, it was not always as rare of a concept as it is today. In antiquity, the conviction that Jews had horns was widespread. The idea was highly anti-Semitic and led people to believe that Jews were demons. “For example, a New South Wales description of the country people of Bomballa related that after a pregnant mother’s rebuff of a Jewish peddler selling crucifixion pictures, her child was born with fiendish eyes, horns from the cranium and claw like hands and it snapped like a dog [2].”

The ludicrous concept begs for speculation as to how this idea come about. Many postulate that a painting done by Michelangelo led to the popularity of the belief. Michelangelo’s rendition of Moshe, which shows him with cranial horns, was based on a misinterpretation of *pesukim* in *Shemos*. How did this misinterpretation occur? An analysis of the phrases in question may provide a better insight. The Torah, *Shemos* 34:29-30, states:

“וַיְהִי בְרִדַּת מֹשֶׁה מֵהָר סיני ושני לחת העדת ביד משה ברדתו מן ההר ומשה ידע כי קרן עור פניו בדברו אתו. וירא אהרן וכל בני ישראל את משה והנה קרן עור פניו לא ויראו מגשת אליו.”

“When Moses descended from Mount Sinai—with the two Tablets of Testimony in the hands of Moshe as he descended from the mountain—Moses did not know that the skin of his face had become radiant [*kahrahn*] when had He spoken to him. Aaron and all the Children of Israel saw Moses and behold! The skin of his face had become radiant [*kahrahn*] and they feared to approach him [3].”

The key word in the text is *kahrahn*. How one defines the word leads to an important conclusion. Early Greek and Latin translations wrongly associated it with the Hebrew word for horns [4]. Therefore, these translations stated and spread the belief that Moshe had horns. If the leader and role model of the Jewish people had horns, it may be somewhat rational to presume that all Jews had horns. This was

the translation Michelangelo relied on for his depiction of Moshe. However, if the Greek and Latin translations were accurate, it would be illogical for the text to state the Jewish people were fearful of approaching Moshe due to these horns, as people do not fear that which they are accustomed to.

Not surprisingly, Torah commentaries were dissatisfied with the Greek and Latin translation. Therefore, they aimed to interpret the

Torah and scientific evidence demonstrate that it is extremely rare for ANY human being to have horns.

word in a different fashion. Rashi, the renowned commentator, explains that this *kahrahn* is related to the one used to describe rays of light. It is possible that these rays projected in a fashion similar to that of animal horns. Yet, the fact remains, that these projections were rays of light and not horns with animalistic qualities. Rashbam passionately adds on to Rashi, stating that anyone who believes the word *kahrahn* is related to the word for physical horns “*ayno elah shoteh* (is non-other than an idiot!!)”

Once determined that *kahrahn* refers to rays of lights, the commentators focus on many other aspects of the glow. It is fascinating and worthwhile to spend time immersed in exploring the intricate details but for the sake of brevity this manuscript does not probe every aspect. Now that the Torah definition has been “diagnosed” as rays of light, it is time to determine their causation.

Rashi believes that the rays were spiritual light that lit Moshe’s face from the moment he received the highest level of revelation. This level of Divine revelation occurred when the Almighty *Hashem* revealed His physical back, so to speak, to Moshe. Moshe received this more intense form of revelation when he went up Mount Sinai to receive the *luchos* (tablets) for the second time.

Malbim deviates slightly from Rashi. He explains that although the radiance was indeed a manifestation of spirituality, Moshe gained this light from the first time he spoke to *Hashem*. The glow was from

the splendor of the Divine presence and an amount of it lingered to light up his face.

The Baal HaTurim upholds the opinion of the rays being a manifestation of spirituality. The Baal HaTurim, and footnote 143 in the Baal HaTurim *Chumash*, provide additional interpretations as to the actual spiritual cause of the glow. The first opinion explains that Moshe received his radiance from *Hashem's* hand, so to speak, covering his face. Moshe received the radiance while in the cleft of the rock when *Hashem* placed His hand on Moshe, after he requested from *Hashem* to see His face. Proof of this statement can be found in *Chavakuk* 3:4, which states, "A glow was like the light (of day); rays of light came from His hand...and there his hidden strength [was revealed]," [3]. The second opinion holds that Moshe's radiance came from the *luchos*. Tangentially, this opinion can help us understand how it was possible for Moshe not to know that his face was glowing. Although Moshe was aware of the spiritual light, he believed the radiance emanated solely from the *luchos*. The third explanation states that Moshe's radiance was caused by his method of writing the Torah. "When Moshe had finished writing the Torah, a bit of ink remained on the quill. He passed it over his head and that ink became rays of light [5]."

The Shem MiShmuel takes a slightly more unique approach than the aforementioned commentators. He believes the glow to be a spiritual manifestation of the great level Moshe achieved through his actions of great personal sacrifice for the Jewish nation. He proved his stance with the *Medrash Rabbah* on *Bereshiss*, chapter 11, which states that a person's face glows more on *Shabbos* than it does the rest of the week. The degree of radiance is directly related to the amount of preparation an individual put in before *Shabbos*. Similarly, Moshe's actions on behalf of the Jews added to his spiritually elevated state. This spiritual elevation physically manifested itself as rays of light.

Rav Menachem Mendel Schneerson, in *Toras Menachem*, explains that the "second tablets were a fusion of the natural and the supernatural, since they were given by G-d and yet they were made by Moshe. Therefore...Moshe...was also a fusion of the natural and the supernatural and he actually became like an angel. Moshe's face only shone with light the second time he came down from the mountain...for on this occasion his natural physical functioning had been elevated to that of an angel and consequently the light of his soul was not obstructed by his body." In other words, Moshe's glow was caused by the dual nature of the second *luchos*. The dual nature forced Moshe to become immersed in the second *luchos* and Moshe himself took on a dual nature. His natural body rose to the level of an angel, therefore, the light of his body no longer obstructed the light of his soul.

The Torah sources indicate that Moshe came down radiating spiritual light. However, in spite of the lucid and rational explanations of the Torah sources, much of the general world's population

remained unconvinced, or unaware, of the truth. Many people believed, and some still believe, that Moshe and the Jewish population had horns. Although, this belief lacks a logical scriptural basis, it is still valid to question whether the belief was fueled by scientific reality. In other words, is it biologically possible for any person, Jew or non-Jew, to have horns?

A literary search revealed relatively little scientific research and documentation available for the esoteric topic of cranial horns. The lack of documentation is in itself an indicator of the rarity of human horns. Michal *et al.* (2002), Bondeson (2001), and Tubbs *et al.* (2003) published studies regarding the characteristics, components and causation of cranial horns. Michal *et al.* found four cases, one in practice and three in past departmental files, of giant cutaneous horns in human beings. They defined cutaneous horns as lesions composed of keratin, whose height was at least half its diameter. The cases they discovered were solely found in the parietal-occipital region of elderly women. "The horns were yellow-grey and there were narrow furrows running along the length of the horns." Results of microscopic analysis revealed that the human horns were not made of the same material as animal horns. Rather, under histological study, these benign tumors seemed to be similar to tumors called proliferation tricholemmal tumors or PTTs. They concluded that the cases represented in their study were a benign and well-differentiated form of PTTs that had an unusual appearance similar to that of a gigantic horn. Surgical removal of the horns led to a 100 percent success rate, with no indications of recurrence 2-15 years after the excision [6].

Bondeson defined a cutaneous horn as, "...a protrusion of the skin consisting of cornified (keratinized) material organized in the shape of a horn." His article described several accounts of cutaneous horns verified by many eyewitnesses, including knowledgeable scientists who would not have been deceived by a hoax. Earlier societies leaned toward superstitious explanations for these horns. However, scientists, such as Thomas Bartholin, a Danish anatomist in the mid 1600's, attempted to discover a natural cause for human horns. Bartholin studied several cases of horned human beings and noted their symptoms. The symptoms, such as a reddish skin tumor which bled freely when scratched, led him to conclude that the horns were a result of epidermal lesions [7].

Bondeson demonstrated that Bartholin's conclusion agreed with current dermatological views of human horns. Modern dermatology states that human horns consist of "concentric layers of cornified epithelial cells." They are not like true animal horns as they, "lack a bony core." Additionally, they can exist on any part of the body, and are not limited to the scalp. Bondeson surmised that cranial horns result from skin tumors and, "...there are no modern counterparts to the grotesque old cases of horned human beings... [7]."

Tubbs *et al.* aimed to discover why the ancient cases were more grotesque than those recorded in modern literature. They discovered a decline of accounts over time after performing a literature search of

all available human horn documents. Their question was strengthened by their conclusion of a specimen analysis over 200 dried human horn specimens, excised from the head and face, located at the University of Alabama in Birmingham. None of the specimen analyzed were large enough to fit the qualifications necessary to be termed a horn [2].

The literary survey led to the conclusion that a large number of the historical accounts probably were inaccurate. Much of the older literature depicting cases of cutaneous horns were not realistic. In reality, there were a lesser amount of actual human horns than the literature seemed to demonstrate. Therefore, the number of human horns that existed in past times may not have been so different from modern cases.

Historical accounts were problematic for a variety of reasons. Firstly, the historical accounts were skewed by religious beliefs, which related “horns to the occult... In medieval Europe, horns were often added to depictions of everyday creatures, including humans, to indicate that the individual was demonic or otherwise linked to the devil [2].” Secondly, historical medicine lacked the current medical knowledge and terminology. It is impossible determine the components of growths referred to in historical accounts. There is no evidence to show that they were actually bony horns, rather than the cutaneous projections described by modern dermatology. Therefore, uneducated accounts of normal “...disease processes that produce entities that might be interpreted as horns by the layperson often cloud the historical records [2].”

Although Tubbs *et al.* did not deny the existence of human horns, they raised the awareness that human horns were not as prevalent as historical accounts would lead one to believe. Rather, the accounts were mostly erroneous. Additionally, Tubbs *et al.* pointed out that early surgical intervention may have accounted for lack of horns in modern medicine. In current times, a bony or cutaneous projection would be removed as it began to form. The growth would never reach the length necessary to be classified as a horn. Therefore, although modern medicine does make it possible, cutaneous horns were probably no more prevalent among humans of the past than in modern times [2].

Genetic studies demonstrate the rarity of cranial horns. “*Online Mendelian Inheritance in Man (OMIM)* is a catalog of human genes and genetic disorders, with links to literature references, sequence records, maps, and related databases [8].” The OMIM database contains a record for Occipital Horn Syndrome. This X-linked disorder is located at gene map locus Xq12-q13. According to the genetic results, human horns, which may or may not be located on the head,

sometimes appear as a clinical feature of this very rare disorder. Meaning, that even in the rare chance that this disorder occurs, it may not even produce horns. Even if horns were produced, the horns can be located anywhere on the body, making the instances of cranial horns extremely unusual. Furthermore, the disorder has no particular relevance to Jews over that of the general population. Tangentially, there is another disorder, known as Machado-Joseph Disease (MJD), which in uncommon cases produces human horns. However, they are irrelevant to our discussion as the horns produced by MJD are not the same as the cranial horns mentioned in this article [9].

Overall, there has been medical documentation of human beings with horns. However, these horns were not the same as animal horns. Rather than being a result of a bony protrusion (like most animal horns), these horns resulted from a variety of epidermal tumors. It is possible that gigantic forms of these horns did exist in antiquity but no longer do, thanks to modern science, which enables removal of these tumors before they grow to enormous lengths. However, it is more likely that the greater amount of historical cases were really invalid accounts caused by superstition and lack of medical knowledge. Genetic studies validate that human horns are indeed a nearly improbable genetic disorder.

Given the understanding that human horns did scientifically exist, it may be possible to understand the seemingly irrational belief that Jews have horns in a somewhat more forgiving light. Past societies did not have access to the genetic proof that Jews are no more likely than any other human beings to have horns. Their scientific reality showed that humans had horns. In those days, religious beliefs were the sources for their understanding. When they aimed to find an explanation for this phenomenon, their beliefs led them to associate horns with demonic powers and other superstitions. Anti-Semitic beliefs which attributed Jews with the same demonic “powers” as horned creatures, may have strengthened society’s confidence in a connection between Jews and human horns,

Conclusively, proper translation of the text in *Shemos* and current scientific evidence enable modern society to dispel this false belief. Torah and scientific evidence demonstrate that it is extremely rare for ANY human being to have horns. It is nearly impossible for both a Gentile OR a Jew to have cranial horns. In emphasis, it is as unlikely for a Jew to have horns as it is for a Gentile to have them. Next time someone who has never seen a Jew seriously believes that Jews have horns, one can hope they peruse appropriate scientific literature. Not knowing any Jews is not a valid excuse for irrational beliefs that contradict accurate science. ■

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KING ASA'S PODIATRIC CONDITION

SARAH ARIELLA HOLLANDER

Within *Tanach*, there are several examples in which podiatry and podiatric problems are mentioned. These instances include Esav clutching Yaakov's heel, Mefiboshet, the son of Shaul, being lame and King Asa suffering from a mysterious ailment in his legs. Although the Navi does not elaborate on the nature of King Asa's disease, historians and contemporary physicians have asserted that King Asa suffered from gout, a painful disease which is similar to arthritis.

Gout was clinically described only recently. It was first explained in the seventeenth century by Thomas Sydenham in his work entitled, "Tractatus de Podagra et Hydrope" [1]. Only in the second part of the nineteenth century was it discovered that crystals of monosodium urate were observed to be present during a gout attack. Finally in the 1960s were the crystals determined to be the cause of the attack [2].

Surprisingly, gout may also have existed in Biblical times. When examining the description of King Asa of Judah's ailment in his legs, the disease described bears a striking resemblance to modern day gout. King Asa (915-875 BCE) led the Jewish people for forty peaceful years. In I Kings 15:23, there is a description of the end of Asa's rulership:

"Now the rest of all the acts of Asa and all that he did and the cities which he built, are they not written in the book of chronicles of the Kings of Judah? But in the time of his old age, he was diseased in his feet."

Another source for King Asa's podiatric disease is found in 2 Chronicles 16:12:

"And in the thirty ninth year of his reign, Asa became diseased in his feet his disease was exceedingly great."

The Babylonian Talmud comments in two places about King Asa's ailment (Sanhedrin 48b and Sotah 10a). There, Rav Yehudah quoting Rav states that Asa was afflicted with podagra. Mar Zutra, the son of Rav Nachman states the condition is similar to "a needle in the raw flesh." The Gemorah asks the question of how Mar Zutra knew how the disease feels. We are given three explanations accounting for Mar Zutra's knowledge and they include either he himself suffered from it, he received a tradition from a teacher, or he knew it by Divine revelation. The phrase 'like a needle in the raw flesh' is found in other places in the Talmud (Berakhoth 18b; Shabbat 13b; 152a).

Another relevant source on gout is found in the Mishna in Shabbat 6:6, which states, "One may not go out (on the Shabbat) with a sela upon a zinit." The sela was known as a silver coin that was used as a cure for foot ailments. The Babylonian Talmud translates zinit as a corn or a bunion (Shabbat 65a) while the Jerusalem Talmud translates it as a podagra, (Shabbat 6:8:22) Rav Yehudah's translation of King Asa's illness [1].

Mar Zutra, the son of Rav Nachman, states the condition is similar to "a needle in the raw flesh."

Recently, there has been significant doubt raised as to whether King Asa's illness was in actuality gout. The historians DeVries and Weinberer state that because the evidence that the illness was really gout is tenuous, King Asa more likely suffered from peripheral obstructive vascular disease with ensuing gangrene. This disease is commonly found in elderly males with symptoms of discomfort in the legs when the individual is walking, which is generally expressed as pain and numbness or fatigue in the calves, below the obstructed arteries. These historians believe that this is more likely to be the cause of King Asa's ailment, because he became ill only at an advanced age and suffered from an ailment in his legs. However, Dr. Fred Rosner asserts that King Asa most likely did suffer from gout since clinical gout may occur at an old age and because King Asa died two years after he contracted his foot ailment, demonstrating that the disease is not life threatening [3].

Although it is impossible to ascertain whether King Asa's ailment in his legs was definitely caused by gout, the description in the Navi with the supporting evidence in the Babylonian and Jerusalem Talmuds substantiates the understanding that King Asa most likely suffered from gout. However, many scholars assert that without stronger evidence supporting the gout possibility, it is impossible to eliminate other possible diseases. ■

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THE 11TH COMMANDMENT: "DON'T BITE OFF MORE THAN YOU CAN CHEW"

DENA KAPETANSKY

“Another holiday, another meal” has become my mantra after nineteen years of being an Orthodox Jew. Growing up, not only did I have less time than the average student for physical activity due to lengthier school days in my dual program, but every week I would find myself eating a Thanksgiving-size meal for *Shabbat*. Perhaps this “commandment to eat,” coupled with the aforementioned lack of exercise, is a cause of the increasing rate of obesity in Orthodox Jewish children [2]. Even though it is a *mitzvah* to eat on *Shabbat* and special holidays, God intended for us to do it in a healthy manner. In spite of the apparent commandment to eat, Judaic thought is that our bodies are our temples, and people should take care of their health as an essential part of their lives.

The media is saturated with messages that “healthy is good” and “thin is beautiful,” and moreover that “thin is healthy.” Yet this marketing message is an interesting contrast to the highest rate of obesity in America’s history. Dr. Henry Anhalt, director of the Division of Pediatric Endocrinology and director of the Kids Weight Down Program at Maimonides Hospital in Brooklyn, estimated that “90 percent of the population will be overweight by the year 2030” [2]. Obesity is becoming an epidemic, yet “the whole thing is deeper than just finding the right diet” [1]. There are many factors contributing to obesity, and each and every aspect needs to be addressed for effective weight loss.

Staying healthy is more complicated than simply idolizing that marketing message. There are a vast array of diets and suggestions for weight loss, yet people are finding it not to be as simple as it sounds. The new Weight Watchers slogan, “stop dieting, start living,” is appropriate for the people of this generation. Many obese people have been on numerous crash diets, while the only effective way to lose the weight is to make a lifestyle change. This is accomplished by weight loss plans, such as Weight Watchers which was developed based on years of scientific research and analyses [4]. Personalized plans are created to meet an individual’s specific needs, including recommendations of healthy foods to eat, acceptable ways to eat unhealthy foods, and individualized workout regimens. Weight Watchers agrees with what the Torah advises us in keeping the body healthy.

Another aspect to weight loss is a person’s mental well-being. In his book, *Regiment of Health*, the esteemed Rabbi and physician, Maimonides, relayed the concept of “a healthy mind in a healthy body” telling us that physical well-being and mental well-being are

mutually dependent on each other [5]. Therefore, it is not enough to change eating habits and exercise habits, rather overweight people must change their mindset and self esteem for weight loss to come into full effect.

Obesity puts people at high risk for developing many health problems. The main causes, although there are contributing genetic factors, are overeating and lack of exercise. The most notorious effect of obesity is a metabolic syndrome, more commonly known as “diabetes,” a syndrome which can cause infertility, stroke, cancers, and

Another aspect to weight loss is a person’s mental well-being. In his book *Regiment of Health*, the esteemed Rabbi and physician, Maimonides, relayed the concept of “a healthy mind in a healthy body,” telling us that physical well-being and mental well-being are mutually dependent on each other.

high blood pressure [6]. The only way to treat or prevent this metabolic syndrome is a change in lifestyle habits. It is completely necessary to create a diet and exercise routine, advice everyone has heard or seen in the media, but has misinterpreted. The phrase “diet and exercise” either scares people into not committing to this lifestyle at all or promotes over-commitment. However, the Torah helps us balance and understand their meaning, as it warns us not to overeat, yet it in no way permits us to “under-eat” [6]. Similar to obesity, starving ourselves also falls under the category of not taking care of our bodies.

We see the Jewish stance on obesity throughout the *Tanach*. There are various descriptions of overweight personalities in the

Tanach and *Talmud*, such as Eglon the king of Moab, Rabbi Eleazar ben Simeon, the son of Rabbi Simeon bar Yochai, and other respected members of the Jewish nation. The Torah's view is seemingly explicit: "gluttony is dangerous—not only to the spiritual well being of a person, but to his physical health, as well" [6]. On Yom Kippur, perhaps one of the holiest days on the Jewish calendar, this issue of gluttony is brought up in our prayers, when we confess our sin of "eating for absolutely no reason at all."

Centuries before modern scientists came to the same conclusion, the Torah preached moderation and noted the problems caused by both physical and spiritual gluttony. God meant for us to "enjoy this world, not drown ourselves in pleasures" [6]. In the desert (Exodus 16:31-35), God provided the Jews with *manna* so that they could direct their efforts toward spirituality, rather than thinking about their next meal. The Jews took matters into their own hands, deciding they needed more than their allotted portion. They were punished for overindulging themselves, because they ate after already being satisfied, thus acting in a gluttonous manner.

Poorly advertised aspects of proper nutrition are adequate chewing of the food we eat and the importance of proper dental hygiene. Limiting the intake of sweets can help prevent tooth decay, or dental caries. These areas of tooth decay are caused by bacteria in the oral

cavity metabolizing sugar and generating acids, which erode the teeth [3]. If the decay goes untreated, the bacterial infection may progress to the gums (gingivitis) and thereafter to the periodontal ligament that cements the tooth into the jaw (periodontitis) [3]. Caring about dental health is included in caring about overall physical health. Eating the right foods along with brushing and flossing will result in a healthy individual on all accounts.

Maimonides wrote in his books about the effects of hygiene on physical health. When a self-indulgent Sultan complained of "constipation, dejection, bad thoughts, and indigestion," Maimonides advised him to improve his diet and hygiene. In another chapter, he described necessary changes in lifestyle to cure these symptoms. These changes related to "...bathing, sex, wine, drinking, diet, and respiratory infections" [5]. Maimonides, who lived in the 12th century, believed that diet and hygiene have major effects on physical health. This message is most relevant to the 21st century American.

Health is a multi-dimensional juggling act between healthy living, healthy food, healthy thoughts, and healthy habits. The Torah aids us in achieving this balance by providing us with specific values promoting moderation. As each person becomes more aware of what is healthy for herself, she can lock these new habits into her lifestyle in harmony with the Torah's teachings. ■

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THE BIBLICAL FOOD FOR THOUGHT

SHARON KAUFMAN

Now is the time when a plethora of Americans decide to carry out their New Year's resolutions by going on diets and attempting to become thin. Americans turn to many types of diets, most being fad diets, which are not always healthy ways of eating, but work quickly. At my Weight Watchers meeting this week, I was shocked to see how much the crowd had mushroomed since the holiday season ended. Many Americans are looking to change the way that they eat and to start eating more nutritious foods. I decided to look at the Bible to gain insights into nutrition, since the Bible teaches us a way of life. I found that the foods mentioned in the Bible represent a nutritious diet and even fulfill the United States Department of Agriculture's (USDA) food pyramid.

The USDA uses a food pyramid to elucidate nutritional guidelines for the public by advising the proper number of servings that should be eaten from each food group. Grains take up the largest segment of the pyramid with consumption anywhere from six to eleven servings daily. Fruits and vegetables take up the next largest segments of the pyramid; people should consume two to four servings of fruit and three to five servings of vegetables. Proteins and milk products should be consumed in lesser amounts, with anywhere from two to three servings in each food group. Fats, oils, and sweets should only be a small part of one's diet and should be used sparingly [1].

The Jewish people maintained a nutritious diet, with representatives from all of the food groups. Grains made up the largest part of their diet and bread is referred to as the staff of life. Beans and peas were used as a source of protein and were therefore a very important component of their diet. Fruits and vegetables were also eaten, but they played a more minor dietary role. Milk and honey of the land of Israel represented the milk products and sweet segments of the pyramid. Each food group eaten by the Jewish people will be expounded upon with Torah sources:

GRAINS

The Jewish peasants from the time of the *Tanach* depended on three staple products for their survival- grain (*dagan*), wine (*tirosh*), and oil (*yitzhar*). The importance of these three items can be seen in *Hoshea's* rebuke of his wife who said, "I will go after my lovers; they give me my bread and water, my wool and linen, my oil and my drink," to which he angrily responded, "It is I who gave her grain, the wine, and the oil" (*Hoshea* 2:7 and 10). These three staple items

contributed to a balanced diet with grain providing complex carbohydrates, wine providing sugars, vitamins, and polyphenolic antioxidants, and oil providing fats [2]. However, it is clear from many verses in the Torah that a bountiful harvest was dependent on the Jewish nation's observance of the *mitzvot*. This can be seen in the second paragraph of *kriat shema* "If you listen to My commandments...I will give rain of the land in its season...that you may gather

These three staple items contributed to a balanced diet with grain providing complex carbohydrates, wine providing sugars, vitamins, and polyphenolic antioxidants, and oil providing fats.

in your grain, your wine, and your oil." (*Devarim* 11:13-14). On the contrary, *Moshe* warns the Jewish nation that if they don't observe the *mitzvot*, "G-d will carry against you a nation from afar...It will devour the fruit of your animals and the fruit of your ground, until you are destroyed. It will not leave your grain, wine, or oil...until it causes you to perish" (*Devarim* 28:49-51).

FRUIT

Olives and grapes were the most important fruits during Biblical times because the olives were used to make oil and the grapes to make wine. Figs were a very popular fruit and were compressed into dry fig cakes, as seen in *Avigail's* present to *Dovid* of two hundred cakes of dried figs (*Shmuel* I 25:18). When *Moshe* sent twelve spies to check out the land of Israel, he asked them to bring back fruit. In accordance with his request, "They came to *Nachal Eshkol* and cut from there a branch and cluster of grapes, and two of them carried it on poles" (*Bamidbar* 13:33). The spies also brought pomegranates and figs back to the Jewish nation. The large fruit that the spies brought back sent a message to the Jewish about the land of Israel, but the commentaries differ on whether the message was meant to be positive or negative. The *Ramban* (*Devarim* 1:25) explains that

the presentation of the fruit to the Jewish people was supposed to show them that the Land of Israel is a good land that produces uniquely large fruit. However, the *Toldot Yitzchak* (*Bamidbar* 14:15) writes that the spies showed the fruit to the Jews to emphasize that since the fruit of the land is strange, so are the nations living there.

VEGETABLES

Vegetables played a minor role in the Biblical diet. Vegetables were used in salads and soups; root vegetables, such as turnips, beets, and cabbage were not eaten [2]. In the desert, the Jewish people mourned the loss of certain popular vegetables from Egypt, as they said in *Bamidbar* 11:5, “We remember the fish which we ate in Egypt at no cost, the cucumbers, and the melons and leeks, and the onions and garlic.” The *Toldot Yitzchak* explains this *pasuk*, which seems confusing, because why would the Egyptians give fish and vegetables to the Jews for free if they would not even provide straw for making bricks? He says that the Egyptians gave the Jewish people rotten fish in order to kill them, but they made it seem like a gift. He also offers another explanation which says that after the Nile rose and watered the gardens, the fish were stuck in the gardens among many vegetables. The Jewish slaves who were digging in the gardens took these trapped fish and many vegetables without paying for them.

PROTEIN

In ancient Israel, the majority of the people maintained a mainly herbivorous diet. For most members of the Jewish nation, meat was reserved for festive meals on *shabbat* and gatherings when the participants were given a piece of an animal for a sacrificial feast, such as the *korban Pesach*. However, for the families of the *cohanim*, the priests, meat was a common food item, especially the meat from the burnt offerings. The most common form of meat mentioned in the *Torah* is that from a goat or kid, as its meat was considered more valuable than that of a sheep [2]. Fattened calves were delicacies consumed by the wealthy, as seen in *Amos*’s criticism of the members of the elite, “who loll in beds inlaid with ivory and sprawl over couches feasting on lambs from the flock and fatted calves” (*Amos* 6:4). Also, *Shlomo*’s daily provisions included ten fat oxen, among many other delicacies (*Melachim* I 4:22-24).

After bread, pulse, which consisted of lentils, beans, and peas,

was the next in importance in the diet of the biblical age. It is common for one to crave a food that introduces a nutrient that is missing from the diet, which may explain the Jewish practice of eating cereals and pulse together. Cereals are low in lysine, while pulse is rich in it, so without their conscious knowledge, the Jewish people were able to obtain the eight essential amino acids used as building blocks for protein. The Jewish people used pulse as a source of protein over fish because they did not usually control the Mediterranean coast and therefore they did not have access to fish [2]. Beans and lentils were commonly cooked in pots, as seen from the pot of lentils that *Yaakov* gave to *Esav* in return for the *bechorah*, the title of the firstborn son, as it says, “*Yaakov* gave *Esav* bread and pottage of lentils” (*Bereishit* 25:34) [2].

MILK & HONEY

The population derived additional sources of fats and protein from goat milk. The *Psikta Zutrata* explains the phrase “a land flowing with milk and honey” literally. Honey flowed from the trees under which the goats would graze, out of whose udders poured milk, so that both milk and honey moistened the ground. Honey did not come from bees, but was extracted in the form of thick syrup from grapes, figs, and dates. This emphasis on honey in Israel is because it was used as a universal sweetener and therefore an important source of calories and substitute for fats [2]. In *Tehillim* 81:17, *Dovid* writes about G-d’s good treatment of the Jews: “He would feed him with the cream of the wheat and from a rock satiate you with honey.” The *Ibn Ezra* explains that when the Jews obey G-d, he provides handsomely by giving them food that is even better than cream and honey. In the desert, G-d fed the Jewish people *mann*, which was more succulent than the cream of wheat. G-d also gave the Jewish nation water from the well of *Miriam*, which was a rock that traveled with them, whose waters were sweeter than honey.

By looking at the example of our ancestors we can learn which foods are nutritious. We see the importance of eating foods from all of the major food groups and the soundness of the nutritional guidelines that we follow daily. We also learn that the productivity of the land of Israel depends on our observance of the *mitzvot*. ■

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THE MEDICAL AND ETHICAL IMPLICATIONS OF CONJOINED TWINS

CHANA KOSOFSKY

Conjoined twinning is an anomaly which may occur several days after fertilization. The first Siamese twins ever noted were Adam and Eve. Some say that Adam and Eve were initially one body and that G-d subsequently separated them through Adam's rib [1]. (Genesis Rabbah 55; Eruvin 18a). There are many medical and ethical dilemmas associated with the treatment and separation of conjoined twins. There are cases in which surgical intervention can lead to the survival of both babies. In other instances, the babies are joined at the head making separation impossible. A debate is raised when twins are joined at the heart. In this case, surgery may save the life of one twin while terminating the life of the other twin. Another concern is whether Siamese twins have the status of one person or two people. Generally, they share one body, but have two distinct heads and minds. Rabbinical authorities attempt to wrestle with problems associated with Siamese twins.

The *Bais Hillel* (Shulchan Aruch Yoreh Deah *Siman* 305) and the *Shittah Mekubetzet* (Menahot 37a) discuss the status of Siamese twins. The *Bais Hillel* states that conjoined twins are considered to be two distinct individuals. If a couple gives birth to a first born son, they are required to pay five *selaim* to a Kohen to redeem their son. However, if they have first born Siamese twin boys, they must pay ten *selaim* to redeem both of their sons.

Rabbi J. David Bleich expounds upon this idea. He quotes the *Shitta Mekubetzet*, who says that such twins are considered to be separate people regarding *halachik* issues involving inheritance and other similar concerns. Rabbi Bleich explains that neither individual is permitted to marry. Such a communion would be considered an adulterous relationship when the twins share a common set of genital organs, so any marital act would be the action of both twins. Thus, the twin who is not married to the other marriage partner would be engaging in an illicit relationship [2].

Rabbinical authorities also discuss the ethical ramifications of separation. Before discussing the ethical implications of separation, one must have a greater understanding about how and where twins can be connected. There is a debate over whether conjoined twinning is a result of fusion or fission. Most authorities say that Siamese twins are the result of an incomplete splitting of the embryonic axis, and the process of fission, or separation, was not completed. This is the most commonly accepted approach. In this case, one may argue that Siamese twins

are considered one person. They started as one embryo and remained joined together. Others say that conjoined twinning happens as a result of fusion of two initially distinct embryos. In this situation, one may argue that the twins are separate beings because they originated as two separate embryos [3].

There is a debate over whether conjoined twinning is a result of fusion or fission.

One type of connection is included within the craniopagus class. Here, parts of the neural system are shared. Babies joined at the head may have completely separated brains, or they may have brains that are moderately fused together. Theoretically, if the twins have two distinct brains, a surgeon should be able to separate them without any fatal effects. However, the vascular arrangement in the brain makes separation difficult and the results of such a complicated surgery are unpredictable [3].

Another type of fusion is included within the cephalothoracopagus class. In this case, twins are connected in the cephalic region of the head and also in the chest and upper abdominal areas. Most experts agree that surgical intervention should not even be contemplated. The majority of these twins die before or shortly after birth [3].

An ischiopagus connection occurs at the caudal region of the body. Twins are joined at the sacrum. There are intricate neuronal connections present in this area that are difficult to sever. In this case, if surgery is performed, one twin must die for the other one to survive [3].

Finally, the parapagus class of twins includes those twins where the trunks are merged together. There is a connection in the caudal region of the body and there are two distinct vertebral axes present. There may be four legs, two stomachs, and two small intestines, but there is only one large intestine. Many of these twins are stillborn or die shortly after birth. Some, however, live to maturity [3].

Extensive research has been done on Siamese twins. Researchers have attempted to produce conjoined twins in animals. One thought is that all anomalies, including conjoined twins, are a result of factors that interfere with normal development. The same teratogens (chemicals that cause birth defects) could produce different abnormalities at different stages of fetal development. There are many hypotheses which describe what may cause conjoined twins, but the true cause is unknown [3].

Jewish authorities permit the separation of twins because one twin is acting as an unintentional parasite upon the other twin. In 1977, a devout Jewish couple in Lakewood, NJ, gave birth to Siamese twins. They asked Rabbi Moshe Feinstein if the twins could be separated so that one would have a chance at life. Rabbi Feinstein stated that such twins should be separated, because one twin was an “unjust aggressor,” parasitically feeding off the other twin [4]. Some Rabbinic authorities draw a comparison to the case of a bus that is being stopped by a terrorist. If the terrorist threatens that he will bomb the bus if the people do not give up one person, then they are not allowed to give up anybody’s life. However, if the terrorist asked for one specific individual, then that individual is “designated” for death and the people should give this individual to the terrorist. In this case, the weaker twin should be considered “designated” for death. There is another

metaphor used to discuss this point as well. If one is mountain climbing and another person grabs onto his heel, the first climber for his own survival is permitted to kick the other individual down to his death. If both remain together, then potentially both may die. It is better to save one life rather than to sacrifice two lives [5].

Although this issue is a very difficult moral dilemma, even in a hypothetical sense, it is much more complex when dealing with human emotions. Parents of conjoined twins usually make their decisions in the context of intense emotional feelings, which may be understandable, but is not necessarily based on moral justifications. Parents in such a situation are extremely distraught and conflicted. Therefore, it may be difficult for them to think rationally. Doctors must see the issue from a rational perspective, but they also must be sensitive to the parent’s emotional needs. In such a complex issue, one must take into account the medical, ethical and emotional aspects associated with Siamese twins.

Doctors must be aware of the risks and benefits of this type of surgery so that they can help the parents make educated decisions. Rabbis develop the moral issues privy to this situation. While doctors and Rabbis must be involved in the decision making process, ultimately the choice of whether or not to perform surgery is in the hands of the parents. ■

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EXTRATERRESTRIAL LIFE IN OUR AGE

EMILY J. LIEBLING

“Are we alone?” This seemingly innocuous question has troubled and concerned great minds throughout history. Some dismiss the possibility of extraterrestrial life as utterly preposterous. Others spend astronomical amounts of time and resources to put the issue to rest, whether the findings prove affirmative or otherwise. Surprisingly, scientists alone do not have a monopoly on the investigation of the matter. Our sages and Rabbis have grappled with the prospect of the creation of exo-planetary inhabitants for many a century, if not millennia. Sources as early as the *Talmud* hint to the existence of extraterrestrial life and a myriad of *Gaonim*, *Rishonim* and *Acharonim* discuss its implications on Jewish philosophy and law and further debate the basic possibility of its existence.

The issue of extraterrestrial life has recently been pulled from obscurity due to encouraging discoveries on our planet Earth. Certain microorganisms have been found to thrive in extreme environments, such as temperatures as high as 80°C (176°F) and pH’s as low as 3. The presence of these extremophiles on Earth has renewed scientific hope that organisms could inhabit the severe environments of other celestial bodies [1].

To date, the bodies in our solar system that peek the most interest for their potential to support life are Mars and Titan, Saturn’s largest moon. They share the common attribute of containing the necessary precursors for life, such as water, carbon, and hydrogen. Moreover, nitrogen has been found to saturate Titan’s atmosphere. Not only do these heavenly bodies contain the precursors for life, they also possess the byproduct of earthly life: methane gas (CH₄). The intestinal bacteria of cows and other livestock contribute a vast amount (1,750 parts per billion by volume (ppb)) of methane to earth’s environment. The Institute of Physics and Interplanetary Science in Rome found, via the 2003-2004 Mars Express orbiter, that the methane concentration on Mars is a mere 0 to 35 ppb. Methane on Titan, however, is so abundant that it goes beyond the ppb measurement, and is found to occupy 5% by volume. Definite conclusions cannot yet be made as to the source of the methane on Mars and Titan, as the gas may be generated by comet strikes, volcanoes, or other geologic phenomena. The nitrogen, discovered in 1980, that engulfs Titan is a fundamental component of biological molecules, such as nucleotides and amino acids. This represents further evidence for the existence of current life or the possibility for future life to form [2]. Furthermore, the presence of water, in all its various

forms, is not unique to Mars and Titan. Gliese 581 C, a newly discovered Earth-like planet that lies outside our solar system, has been found to harbor liquid water, which raises eyebrows for the existence of life there, as well. Due to its close proximity to Earth and its habitable zone, Gliese 581 C will be the object of upcoming searches for extraterrestrial life [3].

The thought of life elsewhere in the cosmos is a humbling feeling for humanity; yet it reinforces just how loved and significant we are in the Eyes of our Creator

More important than scientific evidence, however, are Divine hints at the existence of life on worlds beyond our own. “Your kingdom is kingdom of all worlds (*olamim*) and your rule [spans] every generation” (*Tehillim* 145:13). The traditional translation of *olamim* by Radak and Ibn Ezra is “all times.” Perhaps the plural “*olamim*” also implies a multiplicity of worlds, as suggested in the interpretation by *Metzudath David*. If such is the case, the Divine kingdom may include subjects in locales beyond our Earth. Rabbi Aryeh Kaplan expounds upon this topic and delineates all arguments, citing Rabbi Chasdai Crescas, a Spanish *halachist* and Jewish philosopher, who is among the first to address the possibility of exobiological life. Rabbi Crescas writes that the Torah, both oral and written, gives no indication that life on Earth remained the extent of Creation, and that such a possibility is in no way heretical to Jewish theology. The Talmud (*Avodah Zarah* 3b) writes that *Hashem* flies over 18,000 worlds. Rabbi Crescas learns from this that inhabitants must exist because there could be no other purpose warranting *Hashem*’s guard [4].

In the *Sefer HaBrith*, Rabbi Pinchas Horowitz, similarly, maintains that extraterrestrial life, indeed, does exist; they live on planets much like our own, with the “four elements,” earth, air, fire and water.

He proves this thesis from *Shirath Devorah*, “Cursed is Meroz. Cursed are its inhabitants...” (*Shoftim* 5:23) The Talmud (*Moed Katan* 16a) derives that Meroz is the name of a star due to its juxtaposition to verse 20, “From heaven they fought. The stars from their orbits did battle with Sisera.” He maintains that though they exist, extraterrestrial beings bear no physical or spiritual resemblance to humans; they do not have free will, *bechira chofshith*, or the Torah, which are gifts given exclusively to man. The *Tikunei Zohar* states that every righteous man will be given a star with its own population over which he will rule in order to enhance his spiritual growth. The verse is cited, “Around Him are eighteen thousand” (*Yechezkel* 48:35) to prove that there will be 18,000 of these *tzaddikim*, corroborating the number of worlds mentioned above [4].

In his essay, “The Religious Implications of Extraterrestrial Life,” Rabbi Dr. Norman Lamm presents the diverging philosophies of Rambam, who purports that man is the most inferior center of a world that expands in import as well as circumference, and Rabbi Saadia Gaon who maintains man’s primacy as center of an expanding universe whose importance decreases as its circumference increases. Rabbi Dr. Lamm is not troubled by the implications of the significance of man *vis a vis* other life forms and writes “Man’s non-singularity does not imply his insignificance...Judaism, therefore, can very well accept a scientific finding that man is not the only intelligent and bio-spiritual resident in G-d’s world” [6].

For all of the above support, come dissenting opinions that oppose the idea of the existence of extraterrestrial life. One such figure is Rabbi Yosef Albo, the Spanish, fifteenth century student of Rabbi Crescas and author of *Sefer HaIkkarim*, a work on the Jewish principles of faith. He staunchly disagrees with the proposal of exobiological existence, as the purpose for the creation was for the sake of the sole possessor of free will: man. All beings without freedom of choice were placed on the world for the express objective of serving man. Ergo, any life beyond the reaches of such intent would be futile. Moreover, he states that the word *olamim*, worlds, from the aforementioned verse in *Tehillim*, refers to both the physical and metaphysical, namely, our universe as we know it and its spiritual counterpart [4].

The date on which NASA projects reveal conclusions about the existence of extraterrestrial life will, no doubt, be as extraordinary as the moment the world watched Neil Armstrong set foot on the moon. Until such time, speculation will have to suffice. The Jew’s response of, “How great are your wonders, *Hashem*; with wisdom You created them all,” is his insignia (*Tehillim* 104:24). The thought of life elsewhere in the cosmos is a humbling feeling for humanity; yet it reinforces just how loved and significant we are in the Eyes of our Creator. He gave us His *mitzvoth*, and our sages underscore that our observance of the Torah does nothing short of sustain the colossal universe in which we live (*Pirkei Avoth* 1:2). ■

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SMOKING IN HALACHA

ADINA MAIK

Today, it is well known that smoking is very unhealthy as it causes many diseases for both the smoker and the people who inhale the secondhand smoke. In addition to being a leading cause of lung cancer, smoking causes cancers of the mouth, pharynx, larynx, esophagus, and bladder, and contributes to the development of cancers of the pancreas, cervix, kidney, and stomach. Smoking is also a major cause of heart disease, aneurysms, bronchitis, emphysema, and stroke [1]. Smoking greatly reduces life expectancy. According to a study from the Centers for Disease Control and Prevention, smoking shortens male smokers' lives by 13.2 years and female smokers' lives by 14.5 years [2]. Secondhand smoke causes major damage to health including about 3,000 lung cancer deaths and about 35,000 deaths from heart disease each year in healthy non-smokers living with smokers. It can also affect non-smokers by causing asthma and other respiratory problems, eye irritation, headaches, nausea, and dizziness [1].

It is a positive Biblical commandment (*Devarim* 4:9) to guard one's life. The *Rambam*, in *Hilchos Rotzeach U'Shemiras HaNefesh* (11:5), listed many activities prohibited because they are dangerous. Based on this command to guard one's life and the medical knowledge available today about the health risks of smoking, it would seem to be *assur*, prohibited, to smoke. A *heter*, allowance, used by some Rabbis to permit smoking is based upon a verse in *Tehillim* (116:6), "*Shomer Pesayim Hashem*," meaning that God protects the foolish. There are many instances in which *Chazal* used this idea to permit an activity that involves a possible life threatening danger if society views the risk level of the activity as negligible. Rav Moshe Feinstein, in a 1963 *teshuva*, wrote that while there is a concern that one may become ill from smoking and it is appropriate to refrain from doing so, it is not *assur* because many people engage in this behavior and "*Shomer Pesayim Hashem*" applies. In a later *teshuva* in 1981, Rav Moshe Feinstein noted that one cannot smoke in a *Beis Midrash* or other public place where people might object. This is because even if it is not dangerous but just uncomfortable for the people around the smoker, it is considered *halachicly* as if the smoker has damaged the people around him and is liable for those damages [4]. Rav Moshe Shternbuch, in *Teshuvos VeHanhagos*, wrote that even if a person wants to rely on "*Shomer Pesayim Hashem*" himself, he cannot do so in a public place, such as in a *Beis Midrash*, because he cannot impose the leniency of "*Shomer Pesayim Hashem*" upon others.

While many people rely on Rav Moshe Feinstein's *teshuva* to permit smoking on the basis of "*Shomer Pesayim Hashem*," one cannot do so because many other *poskim* prohibited smoking, especially in light of the increased knowledge and awareness of the health risks involved. Later *teshuvos* by many *gedolim*, including Rav Eliezer Waldenberg, Rav Avigdor Neventzal, and Rav Shlomo Wolbe, all noted that the *heter* of "*Shomer Pesayim Hashem*" is no longer applicable because of all the new medical information on the health risks

It is a positive Biblical commandment (*Devarim* 4:9) to guard one's life.

of smoking and thus smoking is *assur* [5, 6, 7]. Rav Waldenberg noted that not only is it *assur* for a person to smoke but that others have a responsibility to stop him because he is hurting himself [5].

Many other contemporary *gedolim* have also warned about the dangers of smoking and concluded that it is *assur* nowadays. These *gedolim* include Rav Shlomo Zalman Auerbach (*Minchas Shlomo* 2:58:6), Rav Yaakov Kaminetzky (Reb Yaakov, 240), Rav Chaim Kanievski (*Sheilas Rov*, p. 92), Rav Moshe Shternbuch (*Teshuvos VeHanhagos* 3:354), and Rav Shmuel Vosner (*Shevet HaLevi* 10:295) [8]. Rav Waldenberg also brought the *Chofetz Chaim* (*Likutei Amarim* ch.13) who wrote in the early 1900s that people should not smoke because doctors had already acknowledged health risks with smoking. The *Chofetz Chaim* also presented other reasons why one should not smoke, including that it leads to *Bitul Torah*, to *Lashon Harah*, and that it is a waste of time and money [5]. The *Chazon Ish*, in his *Kovetz Igros*, wrote that smoking will cause one to forget his Torah.

While it is clear that smoking is not permissible, there seems to be some leniency for allowing someone who is already addicted to smoking to continue smoking. Rav Waldenberg said that the only *heter* for those addicted to smoking to continue is if it would cause them more short-term damage to quit than the long-term damage they would get from smoking. He noted that there is no *heter* for a non-smoker to start smoking and that a smoker not suffering severe with-

drawal symptoms, which would equal the long-term damage of smoking, also must stop smoking [5].

From a *halachic* standpoint, it is clear that today it is prohibited to smoke in public or even in private. One certainly may not start

smoking, and according to many *poskim*, one who does smoke should try to quit. The *gedolim* have made it clear that it is a danger to health and that one cannot rely on the *heter* of “*Shomer Pesayim Hashem*” to smoke. ■

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STEM CELL RESEARCH: A TORAH PERSPECTIVE

MIRIAM MERZEL

Stem cell research has been the focus of much discussion and controversy over the past decade. Scientists, ethicists, and politicians alike have opinions on whether stem cell research is appropriate and, if it is, the ways in which it should be conducted. In Judaism when there is a question about whether something is appropriate, one turns to the Torah and *halacha*. Thus stem cell research should be examined in the same manner.

Before examining what makes stem cell research such a charged issue, it is important to understand stem cell research and what it entails. Human development begins when a sperm fertilizes an egg, in essence fusing together to form one totipotent cell. A totipotent cell has the potential to develop into any type of cell. This one cell goes through several cycles of division and after about four days this mass of cells forms a blastocyst, or a layer of cells around an inner hollow with a small cluster of cells. The cells of this inner cluster are pluripotent, as they can develop into most, but not all, types of cells. For example, if inner cells were taken without the accompanying outer layer of cells and then implanted in a uterus, they could not develop into a fetus. In normal fetal development, these inner pluripotent cells continue to divide and specialize into multipotent cells, which finally differentiate into cells with specific functions.

The pluripotent stem cells are of great interest for several reasons. Studying these stem cells will lend a greater understanding to the events that occur during human development. The knowledge of what turns genes on and off in normal cells will allow for better treatment of abnormal cells. Drugs and other pharmaceutical products can be tested on stem cells as a precursor to tests done on animals and humans. There is reason to believe these cells can also be used in cell therapies to replace diseased cells, such as those in Parkinson's and Alzheimer's diseases, injuries, strokes, burns, and arthritis. Finally, because stem cells have the potential to become any type of cell, they could be directed to grow into organs for use in transplants. If the stem cells are derived from the person in need of the organ transplant, then there would be no problem of immune rejection, currently a major obstacle in organ transplants [1].

There are several sources for pluripotent cells. They can be taken from the inner mass of cells in the blastocyst; this technique destroys the embryo in the process. They can also be taken from tissues of aborted fetuses or cells from the umbilical cord. Another source is to combine any normal adult cell with an enucleated egg in the process

called somatic cell nuclear transfer. This fusion results in a cell that develops as if it was derived from the inner mass of the blastocyst, and is the basis of cloning. There are also adult stem cells, which are multipotent cells found in some types of adult tissue such as the blood and nervous system [2].

Currently the major focus is on embryonic, not adult, stem cells. Adult stem cells are more difficult to find and isolate and it is uncertain if the multipotent cells have the same ability to develop into

Judaism, in general, has no problem using embryonic stem cells even if it seems a potential life would be taken in the process. It must, however, be done according to *halacha*.

any type of cell as do pluripotent embryonic cells. It is the use of embryonic stem cells that has created much of the ethical and moral controversy because the technique involves destruction of the embryo. There is little or no controversy about stem cells from adults or from the placenta of aborted fetuses. [3] The use of stem cells from aborted fetuses is not encouraged so as not to encourage abortion for financial payment.

Judaism, in general, has no problem using embryonic stem cells even if it seems a potential life would be taken in the process. It must, however, be done according to *halacha*. The Torah specifically commands us "*verapo yerape*" (*Shemos* 21:19), to heal the sick [2]; genetic engineering for the purpose of healing is a fulfillment of this commandment [4]. Prior to entering into a scientific therapeutic technology, we must examine if it is consistent with *halacha*. The major *halachic* issues involved in using embryos as a source of stem cells are abortion and destruction of live sperm cells (*hashchasa zara*).

Abortion is a complicated issue in Jewish law as it is neither

completely banned nor allowed at whim. When the fetus places the mother's life at risk the fetus is considered a *rodef*, one who pursues another to cause harm or death, and its abortion is mandated. However, once any part of the baby emerges from the mother, both the baby and mother have equal status as potential sources of physical danger to each other, and aborting the baby is forbidden [5].

Since the source of embryonic stem cells is actually a pre-embryo, an egg fertilized outside the womb and not yet implanted, the prime question becomes whether it has the same halachic status as an embryo in terms of abortion. The *Gemara* in *Yevamos* 69b discusses the case of the daughter of a *kohen* who married a non-*kohen* and was widowed with no children shortly after marriage. Sons and unmarried daughters of *kohanim* are permitted to eat *teruma*. A childless widowed daughter of a *kohen* returns to her father's domain and is permitted to resume eating of her father's *teruma*. She is also permitted to eat *teruma* for the first forty days following her husband's death since even if she was pregnant for the first forty days of fetal life the fetus is considered *maya ba'alma*, mere water. In addition, the *Mishna* in *Niddah* 30a states that a woman who miscarries within forty days of conception does not have *tumas layda*, does not become ritually impure, as she would if she delivered a child or miscarried after forty days. The *Mishneh LiMelech* in *Hilchos Tumas Meis* 2:1 states that one who comes in contact with a fetus delivered within forty days of conception does not become *tamay meis*, ritually impure due to contact with a dead body [3, 5]. On analyzing these sources it is evident that although there are dissenting opinions within *halacha*, there is a large body of opinion that, as Rabbi Gedalya Dov Schwartz, Av Beth Din of the Beth Din of America states, "*Halacha* does not consider any embryonic development within forty days of conception as having the sacred protected status of human being. Therefore, the use of embryos for stem cell research is not considered an act of destruction of life" [4].

All major rabbinic authorities, including Rabbi Yosef Shalom Elyashiv, perhaps the preeminent Rabbinic authority in Israel today, do not consider the pre-embryo which was conceived outside of the womb and requires implantation to become a viable human being, to have the same status as a fetus conceived *in-utero*. The verse in *Bereishis* 9:6 states, "Whoever sheds the blood of man in man by man shall his blood be shed." The Rabbis teach that "man within man" refers to a fetus within its mother and that this is the verse that prohibits abortion. Since the verse specifies that the fetus must be inside the mother, the issue of abortion does not apply in a case of a pre-embryo outside of the mother. Rabbi Dr. Moshe Dovid Tendler stated that two criteria must be fulfilled for an embryo to have the status of a human being: implantation within the womb and forty days of development [6]. Prior to implantation the embryo still has the status of either a zygote or a pre-embryo and not of an abortus [7].

A final issue that must be taken into consideration is that of

hashchasas zara, the destruction of live sperm cells. The Torah forbids, *Bereishis* 38:7-10, the wasting of male seed and some authorities, including the *Chavos Yair*, view even the destruction of fertilized eggs within forty days of development, where the seed has been used, as destruction of seed [2]. According to Rabbi Yitzchok Breitowitz, the majority of *poskim* are of the opinion that if seed is taken to assist couples who cannot conceive naturally it is not considered wasted seed [8]. Many also hold that *hashchasas zara* applies only to the semen itself; once an egg is fertilized, destruction of the egg is not destruction of the male seed [9].

This discussion (that gametes taken to assist couples who cannot conceive naturally is not considered wasting of seed) leads to question that pre-embryos used for stem cells research are the result of *in vitro* fertilization. Most *halachic* authorities agree that *in vitro* fertilization is permitted, even though there will be some fertilized eggs that are not implanted within the womb and destroyed. Rabbi Tzvi Flaum, in reference to these extra, unused fertilized eggs said, "You can discard it, you can do medical research on it, you can freeze it for implantation in the future. ... At the insertion of the zygote into the uterus, issues of abortion begin." [9] Rabbi L.Y. Halperin stressed that it may be preferable to use these fertilized eggs for research than to actually destroy them. [6]

Producing embryonic stem cells specifically for research, means, by definition, creating a pre-embryo to destroy it, and is mostly an issue of *hashchasas zara*. In this situation the male gamete is not being taken to prevent infertility and to produce a child, but rather only for research. While this research may fall under the topic of *pikuach nefesh*, saving lives, it is not clear if that this is sufficient to allow seed to be taken when there is not even a possibility of a creating a child [6]. This is not significant, however, since so many pre-embryos are created in *in vitro* fertilization clinics there is no shortage of pre-embryos for research needs.

In light of recent developments in stem cell research, it seems as though this will remain a moot point. In November, 2007 articles in the scientific journals *Cell* and *Science* reported a method to make stem cells from human skin cells. Dr. Shinya Yamanaka of Kyoto University and the Gladstone Institute of Cardiovascular Disease in San Francisco and Dr. James A. Thomson of the University of Wisconsin independently inserted four genes via retroviruses into human skin cells, which transformed the differentiated cells into pluripotent stem cells. Essentially they succeeded in developing cells with the same characteristics as embryonic stem cells without the use of a human pre-embryo. This new development has opened a new door in stem cell research, although they are not yet at a point where embryonic stem cell research can be abandoned. [10] Prior to this recent development and while it is still being researched, *halacha* permits the use of embryonic stem cells derived from pre-embryos for stem cell research. ■

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THE HEART IS TIMELESS (AS ARE HEART ATTACKS)

TALIA MILLER

A heart attack, or a myocardial infarction in medical terminology, is believed by scientists to be a relatively new phenomenon. The first clinically described and documented coronary heart attack occurred in 1912. However, if one looks back in the *Tanakh*, specifically in *Neviim*, there are two recorded heart attacks. The story of Naval, who dined, partied, and stressed his body tremendously, initially suffered a mild heart attack and subsequently died from a massive heart attack (1 Samuel, chapter 25). [5] A heart attack is defined as the death of cardiac, or heart, muscles resulting from the sudden blockage of the coronary artery caused by a blood clot. The coronary arteries supply the heart muscle with oxygenated blood and their functioning are essential to the wellbeing of a human being. Without oxygen supplied to the heart muscles, death of the heart muscle soon occurs. The necessity of immediate medical care for a heart attack is needed to prevent death. In a mild heart attack, muscles, deprived of oxygen, are injured and subsequently are replaced with scar tissue, thereby placing a person in constant danger of suffering another heart attack. The pain and symptoms of a heart attack are due to injured or dead heart muscle. Chest pain and pressure then ensue, with approximately twenty to forty minutes until irreversible death of the heart muscles occur. Heart muscles continue “dying” for another six to eight hours until the heart attack is complete. To prevent irreversible scarring, meticulous medical care is necessary for someone experiencing a heart attack. [1]

A heart attack as depicted in a typical Hollywood movie occurs with the person suddenly dropping to the floor and grasping his heart. However, the more common heart attack starts slowly with chest pain, pressure, and discomfort in other areas of the upper body, including the arms, back, neck, jaw, and stomach. Shortness of breath is a recorded symptom as well and can occur without accompanying chest discomfort. In addition, some people break out in a cold sweat, becoming nauseous or lightheaded. [2]

A number of factors cause blockages in the coronary arteries. Genetics plays a strong role. There is a higher risk of heart attack in individuals who have a familial tendency towards this pathology. A hereditary problem causing elevated levels of high cholesterol can cause plaque formation in the arteries, a condition exacerbated by irresponsible eating. However, there are other contributing factors, unrelated to genetic predisposition. Cigarette smoking, nicotine

exposure, an elevated level of low density lipoprotein (LDL) cholesterol, an elevated level of adrenaline, high blood pressure, and other mechanical and biochemical forces all contribute or cause the biological processes leading to a heart attack. Rabbi Joseph, a Talmudic sage, noted that gross overeating puts a strain on the heart (*Chulin* 59a). Overeating can affect the cholesterol level and blood pressure

We have to look no further than the Torah to see the importance of blood and its proper circulation in the human body.

by causing fatty deposits to be blockages of the arteries. Once someone has suffered from a heart attack, the loss of healthy cardiac muscle is permanent, thereby making the individual more susceptible to yet another heart attack and to other medical pathologies. [1]

Without the normal pumping of blood by the heart, all other systems of the body begin to fail. It says in the *Midrash Raba* in Leviticus 4:4 that “*the heart is the decision making organ. Blood sustains life*” and delivers oxygen, nutrients and other essential substances to cells and tissues of the body. Brain damage, occurring because of lack of blood, will adversely affect all the bodily functions. Brain death or death of the heart muscles can easily cause death to the individual. If oxygen does not reach the brain via the circulatory system, death occurs within three minutes. We have to look no further than the Torah to see the importance of blood, and its proper circulation, in the human body. [3]

“*Ki HaDam Hu HaNefesh*”(Deuteronomy 12:23). The rules of the sacrifices that are to be brought to the Temple warn us not to eat the blood, as well as to dispose of it correctly. “*For the life of the flesh is in the blood*” (Leviticus 17:11), as “*blood is equated with life*” (Deuteronomy 12:23). Simply explained, without blood there is no life.

Rabbi Obadia Sforno explained that the principle of any living being is its blood. The Talmud (*Kerithut* 22a) notes *dam shehan-ishama yotzet bo* (blood in which the soul issues). When a person dies,

the nefesh, or, soul, disappears, as does the blood. In the book, *Wisdom of Ben-Sira*, the human being is described as a creature of “flesh and blood,” with blood the vehicle, or even the essence, of life. [6]

Heart attacks first appear in Samuel 1, chapter 25. Naval, a wealthy man for whom David provided protection, turned down David’s request for food for his small army. Naval said, “Who is this David...why should I take my bread and water and the meat that I have slaughtered for my shearers and give it to men coming from who knows where?” (1 Samuel 25:11). Thereafter, Naval suffered from two heart attacks upon learning that his wife had provided for David’s army. Naval became fearful of David and David’s men when he found out that his wife had given them food after he had chosen not to. Initially, Naval’s heart was healthy, without medical problems, “*v’lev Naval tov eilav*” (and the heart of Naval was good). The continuation of this sentence is what today is categorized as a heart attack “*vayamat libo bikirbo*” and “*vayigaph Hashem et Naval vayama*. Naval’s initial heart attack occurred on Rosh HaShannah and after a 10-day opportunity to repent, he then experienced a second heart attack on Yom Kippur. “*His heart died inside of him,*” and he became “*like a rock.*”

The commentators offer explanations of why Naval experienced a heart attack, thereby giving insight into the cause of a myocardial infarction. The Mitzudat David explained *vayamat libo* as Naval’s heart died from the fear of David, indicating that fear and being frightened can lead to a heart attack. The Abarbanel, as well as Rav Yishaya MiTrani, agreed that Naval’s myocardial infarction was caused by his tremendous fear of David. The Meyvi Navo concluded that “*his heart died within him*” from a lot of anguish, pain, and anger. Such nontangible, psychological effects adversely affected even someone, like Naval, who’s “heart was good.” In addition, the *pesukim* mention that Naval was a heavy consumer of alcoholic beverages, “*v’hu shikar ad miad*”. Therefore, excessive drinking, anger, anguish, fear, and pain

all contributed to Naval’s heart attack.

According to the scientific research, stress and excessive alcohol consumption contribute to heart disease. The relationship between risk of coronary heart disease and stress is well documented. People who are stressed may overeat and begin smoking or smoke more than otherwise. Excessive alcohol consumption can be detrimental as well, as it can raise blood pressure, induce heart failure, cause irregular heartbeats, and contribute to obesity. These factors correlate with the lifestyle of Naval, thus illustrating causes for the heart attacks he suffered.

In addition to the possible causes of heart attacks as noted with Naval, the incident also demonstrates that, after suffering initial heart attack, a person is prone to experience a subsequent heart attack. Certain precautions should be implemented by someone who has suffered a heart attack. Major damage can be avoided if one seeks medical help immediately. However, many are not that fortunate. After an initial heart attack, treatment is recommended to prevent a reoccurrence, which could occur with differing symptoms. From the first heart attack lifestyle changes are strongly recommended such as quitting smoking, following a healthy diet, increasing physical activity, and losing weight. Medicines are available to control blood pressure, limit discomfort, and control cholesterol levels. [4]

The history of common heart attacks most definitely dates further back than the early 1900s. The story of Naval is just one example of scientific knowledge found in Jewish history. The Biblical importance of blood and the implied suggestions as to the cause of Naval’s heart attack are consistent with modern day medical knowledge. The emphasis on the crucial importance of the blood and heart for our wellbeing, as cited in Jewish texts is remarkable. For us to ignore this information and not live our lives accordingly would be ignoring major guidelines and tools of how to live a longer, healthy life. ■

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SEX - PRESELECTION

MARINA PEKAR

As prenatal care, with its diagnostic procedures and genetic screenings, has significantly improved, the variety of reasons for utilization of these techniques has increased. Sex-preselection has been debated for quite a long time, but no clear evaluation of its ethical implications has been formulated. To come to a conclusion, one needs to analyze the science behind all available procedures and the ethical issues accompanying each procedure.

A few techniques, which differ in their efficacy, are available for sex-preselection. They are based on differentiating between sperm containing an X-chromosome and sperm containing a Y-chromosome. Since the mother always contributes an X-chromosome, it is the paternal contribution which determines the child's gender. An XX combination will produce a female, and an XY combination will produce a male.

The technique with the least efficacy, but also with the least ethical and halakhic debate surrounding it, is to manipulate the pH, i.e., the alkalinity and acidity of the female genital tract. This can be achieved by the woman maintaining a specific diet that ultimately will have an impact on the pH of the cervical and vaginal tracts. An alkaline environment, which favors Y-chromosome-bearing sperm, and thus the production of male offspring, can be achieved by a diet rich in sodium and potassium. Conversely, an acidic environment favors X-chromosome-bearing sperm and thus the creation of female offspring, and can be achieved by a diet rich in calcium and vitamin D [1]. Most modern day poskim, including Rav Shlomo Amar, Rav Meir Nissim Meuzou, Rav Avigdor Nevnval, agree that maintaining a specific diet is without question permissible [2].

Another technique that also is not very efficient in sex-preselection is the Shettles Method. This method is based on the idea that sperm bearing an X chromosome move slowly but are long-lived in the acidic female genital tract. Y-chromosome-bearing sperm, however, move quicker but die sooner in acidic surrounding. In this method, intimacy is timed according to the ovulation date. If one wishes to produce a girl, one should have intimate relations a few days before ovulation, allowing the Y-bearing sperm to die in the acidic environment of the genital tract, for a boy, however, one should have intimate relations right before ovulation, allowing the Y-bearing-sperm to fertilize the egg quicker than the competing X-bearing-sperm. In addition, if one wants to have a male child, the woman should experience an orgasm, through which secretions are produced

that favor the Y chromosome bearing sperm, thereby resulting in a male fetus. Apparently, these vaginal secretions alter the pH of the female reproductive tract, changing it from an acidic to an alkaline milieu [3]. A hint to this can be found in the Talmudic passage (*Niddah* 31a,b): "Rabbi Isaac, citing Rabbi Ammi, stated: If the woman emits her seed first, she bears a male child; if man emits his seed first, she bears a female child." Numerous other citations suggest that if a man restrains himself during intercourse, "the fruit of the womb would be his reward," implying that the wife will bear a male child [4].

Sex-preselection has been debated for quite a long time, but no clear evaluation of its ethical implications has been formulated.

The methods discussed above merely alter the probability of producing a boy or a girl. There are more efficient procedures to actually select for the desired gender. In these cases one needs to examine the reasons to select for a certain gender and examine the advantages and disadvantages of specific procedures. One of the most reliable methods to choose for a specific gender is to abort the undesired one. To know the gender of the developing fetus, the woman can undergo prenatal tests, like chorionic villus sampling or amniocentesis, which draw conclusions of the sex from a karyotype of the fetus. The *halakhic* viewpoint on this approach is absolutely negative and other issues pertaining to abortion are beyond the scope of this article [4].

One of the most reliable prenatal methods of sex selection is Microsort, where the X- chromosome-bearing sperm and the Y-chromosome-bearing sperm are separated according to the amount of DNA inside of them, using the method of flow cytometry. As the X chromosome has a bigger amount of DNA than the Y chromosome, sperm carrying an X chromosome would absorb more light than those carrying a Y chromosome. The desired sperm is then used for intrauterine insemination. The efficacy rate is 92% for girls and 81% for boys

[5]. Another similar method is the Ericsson Albumin method that yields 71% effectiveness for choosing female sex, where the separation of the sperm - the "sperm wash" - is performed according to sperm motility, with Y-chromosome-bearing sperm having a faster swim rate than X-chromosome-bearing sperm due to the difference in their respective weights [6]. The *halakhic* ramifications of intrauterine insemination are multifold, including the concern of *hashchatat zera*, spilling seed in vain, since not all sperm are used. In addition, the reason prompting sex preselection is of crucial importance. If these reasons are medical, for example, if the mother is the carrier of a dominant genetic disorder, like fragile X syndrome, then the parents would select for a girl, since the abnormal maternal X-chromosome would be balanced by the normal X-chromosome of the father. In such cases Rav Auerbach, Rav Neuwirth, Rav Yakov Ariel and Rav Meir Nissim agree that it is *halachically* permissible to undergo the sperm wash procedure [7].

Another reason to choose the child's sex would be for family balancing and *shalom bayit*. Rav Neuwirth warned against sex selection for these reasons, because in this situation one begins to play G-d. Thus, he forbade usage of the sperm wash procedure for such a purpose [7]. In opposition to his opinion, Rav Amar ruled that one could use the sperm wash procedure to fulfill the obligation of *p'ru ur'vu*, *to be fruitful and multiply which constitutes having at least one girl and one boy, and for shalom bayit*. Rav Ovadia Yosef ruled also that sex-preselection was permissible for family balancing, but under the condition of the couple already having at least six children of the same sex. Rav Mordechai Eliyahu ruled that one must have had at least five children of the same sex [8]. One may use the rationale of family balancing as a legitimate reason for sex preselection only when one wants to fulfill the commandment of *p'ru urvu*, since having children of both genders would constitute its fulfillment. Nevertheless, Rav Moshe Feinstein ruled that one needs to merely be involved in the *mitzva* of *p'ru urvu* to fulfill it, and that the *mitzva* is not result-oriented [9], which would disqualify the intent to fulfill the *mitzva* as a *halachically* acceptable reason to allow sex preselection. (my own extrapolation- common sense from following from the above)

The most reliable technique to select a child's sex is to use in vitro fertilization (IVF) coupled with preimplantation genetic diagnosis (PGD). These procedures entail the harvesting of ova from a woman by exposing her to hormonal therapy, followed by the surgical removal of oocytes. The oocytes are then fertilized outside her body, i.e., in a Petri plate, followed by the removal of a cell from the growing embryo and testing it for the occurrence of either two X chromosomes (female) or an X and a Y chromosome (male), as well as for chromosomal aberrations. After this, the desired embryos are implanted into the mother's uterus. Since implantation is a very sensitive procedure, several embryos are implanted, which may result in a multi-fetal pregnancy. This, in turn, could make fetal reduction pro-

cedure inevitable, in which the least healthy of the fetuses are removed if they constitute a danger to the mother or other developing fetuses [10]. The IVF/PGD procedure presents several *halakhic* questions. The first is whether a woman is allowed to subject herself to possible endangerment when she undergoes the medical procedures needed for ova harvesting. The procedure of ova harvesting involves different risks, such as infection, ovarian hyperstimulation syndrome, and intensive bleeding. One can argue that self-endangerment is prohibited by the Torah, but since IVF is a risk that people are usually willing to undertake, one can make an argument that it is nevertheless permitted, since "G-d watches over the simpleton" (*Tehillim* 116:6). Other questions include *hashchatat zera* and the *halakhic* permissibility of fetal reduction. Just as for the sperm wash procedure, there are different *piskei halakha* depending on the reasons for sex selection. [9]

The fetus less than 40 days old is *halachically* considered to be "*mayim be-alma*," or "a sack of water," meaning that it does not have, as yet, the legal status of being considered a person (*Yevamot* 69b). Therefore a woman who miscarries a fetus aged below 40 days, according to Shulchan Aruch (*Yoreh Deah* 194:2), is not considered as if she has given birth, does not receive the *tumat yoledet*, and the subsequent birth of a boy still requires a *pidyon ha ben*. From this we can infer that the fetus aged forty days or younger is not considered a legal person, and, apparently, this is the reason why Rav Zilberstein and other *poskim* allow one to discard unused IVF-derived pre-embryos, especially those with genetic abnormalities. Other *poskim*, like Rav Unterman, ruled that discarding unused embryos constitutes *hashchatat zera* and should not be done [8].

In order to fully discuss the question of fetal reduction, the topic of abortion should be discussed, but it is not in the scope of this article. Since it is such a *halachically* complex issue, plausible reasons are required before a couple is allowed to undergo IVF/PGD. Most *poskim* would agree that in a case of infertility or of genetic abnormality, this procedure is permitted. Nevertheless, Rav Zilberstein [7] noted, that it is absolutely absurd to produce a baby that has a doubtful status, just to get the correct sex of the baby. There is extensive debate in regards to who is the legal parent of "unnaturally conceived" babies, that is, of its status. This needs to be taken into account when examining the reasons for pre-selection.

From the debate above one can imagine the extent of the complexity of this topic. If *halakhic* advice is sought, specific questions should be asked. To summarize, it seems that most *poskim* allow the non-invasive methods of pre-selection, like dieting and timing of intercourse. In cases of preventing genetic disease most *poskim* would also agree to permit different medical procedures for sex pre-selection. In this most complex sea of medical and *halakhic* issues, perhaps the observant Jew will come to appreciate the richness of both medicine and Torah. ■

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THOUGHTS ON THE ANCESTRY OF ETHIOPIAN JEWS

TEHILLA RAVIV

Do Ethiopian Jews share a common ancestor with Ashkenazi and Sephardic Jews? Could they possibly be descendants of King Solomon? With the recent advancements in biochemical technology, many have attempted to answer these questions through genetic analysis. A great deal of research has been done in the past few years to determine the common ancestries of different populations. Jewish populations have been the focus of much of this research because Jews had limited intermarriage and conversion with other groups, greatly preserving our genetic homogeneity. Genetic analyses have mainly focused on the inheritance patterns of mitochondrial DNA and of the Y chromosome. Before one can draw any conclusions about what genetic connections exist among Ethiopian, Ashkenazi and Sephardic Jews, it is first necessary to understand the mitochondrial DNA and the Y chromosome investigative techniques and the meanings of their applications to Jewish populations.

There are two places where genetic information, coded in the form of DNA, are found in animal cells: in the nucleus as part of the chromosomes, and in the mitochondria (a cellular organelle) in the form of a DNA loop. When fertilization occurs, an egg and sperm unite and mingle equal portions of chromosomes from both the father and the mother. However, when the sperm and egg merge, only the sperm nucleus containing its chromosomes enters the egg, with none of the sperm's cytoplasm and organelles entering. The sperm, in a sense, "injects" its DNA into the egg; however, the middle piece containing the sperm's mitochondria and its flagellum remain external of the egg. Therefore, the zygote that forms receives all of its cytoplasm and cellular organelles, including the mitochondria, from the mother, and none from the father. The mitochondrial DNA is thus entirely maternal and makes a fascinating study in hereditary research.

Mitochondrial DNA can be compared between individuals or groups of individuals to determine how much genetic information they have in common. Like all DNA, mitochondrial DNA includes coding regions called genes which may occur in different forms, called alleles. Two people who are closely related will have more of the same alleles in common. Since many genes occur in many different allelic forms, there is a wide range of variation even within a population with close hereditary ties. Therefore, writes Dr. K. Bacon, "by looking at the pattern of allelic forms of many genes in different populations, one can quantify the genetic similarities between them"

and determine the degree by which they are related. One method for analyzing allelic variability employs enzymatic cleavage of DNA, resulting in DNA fragmentation. Within our DNA there are recognition sites at which specific enzymes cut the DNA into fragments. Since whether one has, or has not, a specific site for cleavage is hereditarily determined, by comparing the resultant DNA fragments one can determine the degree of similarity between two different DNA samples. That is to say, if two mitochondrial DNA samples are identical, the same fragment pattern will be attained by enzymatic cleavage.

As research techniques become more sophisticated, we can look towards a future when we can use genetic research to better understand biblical events.

In 1988, Dr. Bonne-Tamir used this technique to analyze the mitochondrial DNA from several groups, including Ashkenazi, Yemenite, and Ethiopian Jews, as well as Caucasians and several African tribes. Since mitochondrial DNA is preserved in the maternal line, one can compare different groups to determine if they have a common female ancestor. This technique can not be used to determine a paternal ancestor because mitochondrial DNA is passed down from mother to her child. Dr. Bonne-Tamir concluded that a certain pattern of DNA fragmentation, labeled the Bam Hpa/Morph3, was almost non-existent in Ashkenazi and Yemenite Jews, but was found in great amounts in Ethiopian Jews and non-Jewish Africans. Based on this and on other studies, many have concluded that it is more probable that Ethiopian Jews share a common maternal ancestor with Africans rather than with Jews [2]. This study, however, could not provide data on the Ethiopian Jews' paternal ancestor. For that one must turn to research on the Y chromosome.

Humans have 23 pairs of chromosomes that are all similar, except for the sex chromosomes which are a pair of chromosomes la-

beled X and Y. Females have two X chromosomes and males have an X and a Y chromosome. A mother passes on one of her X chromosomes to her child, and a father passes on either his X or his Y chromosome to his child. If a child receives two X's it will develop into a female, and if it receives an X and a Y it will be a boy. Since the Y chromosome is only inherited from father to son it can be studied to determine if two groups share a common paternal ancestor. A great deal of research has been done on the Y chromosome because it is unique among the chromosomes. While other chromosomal pairs commonly exchange DNA during recombination in meiosis, the Y and X chromosomes rarely exchange chromosomal segments. The Y chromosome, therefore, is mainly altered by random genetic mutations. "Mutations occur in a random fashion and can accumulate over time," which allows scientists, who can "estimate the rate of mutation," to be able to estimate "how long two groups have been separated". The longer two groups have been separated, the greater the differences will be between their DNA sequences on the Y chromosome.

In a study done on the Y chromosome in the mid 1990's, Dr. Skorecki of the Technion Medical School was able to identify certain DNA sequences called haplotypes. A haplotype is a series of designated DNA markers on a chromosome which are linked and thus are transmitted as a unit. He studied 112 different haplotypes and identified the "Cohen Modal Haplotype" (CMH) as a specific haplotype more prevalent in the Jewish subgroup of Ashkenazi and Sephardic Cohens than in Israelites and Levites. Skorecki, by further analysis, estimated that this CMH arose from a common priest ancestor shared by present day Cohens, who lived approximately 2650-3180 years ago. This time period "falls between the time of the exodus from Egypt and the destruction of the First Temple" which coincides with the time period when Aaron, the biblical father of all Cohens, lived. Since the status of Cohen is passed from father to son it makes sense that the majority of modern day Cohens share a genetic link. So too, since Levites and Israelites trace their heritage to other biblical tribes, it is understandable that they do not have a great frequency of the CMH haplotype.

While the CMH haplotype was found in a greater percentage in Cohens, Israelites and Levites were found to have a higher than normal percentage of this haplotype when compared to non-Jewish males. The frequency of finding the CMH in Cohens was 50%, in non-Cohen male Jews it was 12%, while in non-Jewish males it is

almost undetectable [3]. This has led many to conclude that the higher the frequency of the CMH in a population, the greater the probability that the population had a Jewish ancestry, since in the population there would undoubtedly have been some Cohen ancestors.

Other studies have shown that there are other haplotypes on the Y chromosome which link many male Jews. According to Dr. Hammer's study, Jewish male populations exhibit a higher frequency of the Med and YAP+2S haplotypes than other male populations. Interestingly, male Ethiopian Jews do not exhibit a high frequency of these haplotypes, and instead show a high frequency of haplotypes shared by other male non-Jewish African populations. Dr. Hammer's study therefore concluded that Ethiopian Jews do not share a common paternal ancestor with other Jews [3].

If Ethiopian Jews do not share with most Jews a maternal ancestor based on mitochondrial DNA research, and do not share a paternal ancestor based on Y chromosomal research, is there any chance they can be descendants of King Solomon? Yes, it is all a matter of how one interprets the data. In Kings I the Queen of Sheba makes a request of King Solomon, which, according to *Midrash Avoth*, was a request for him to give her a child. Their union produced a daughter, as seen in Kings 1 10:13. Many have speculated that from this child descended the Ethiopian Jews. As the child produced was a daughter, King Solomon did not pass on his Y chromosome, since a Y chromosome is only passed from father to son. Therefore, it makes sense that research done to trace lineage based on the Y chromosome would show that Ethiopian Jews do not have a Jewish ancestor, since their progenitor did not receive the "Jewish" Y chromosome. Likewise, it makes sense that research done on mitochondrial DNA would find no link between Ethiopian Jews and lay Jews, since the Queen of Sheba was not Jewish and therefore could not pass on "Jewish" mitochondrial DNA. While there is no way currently to demonstrate conclusively whether Ethiopian Jews are the descendants of King Solomon, current research can also not disprove the contrary. The only conclusion we are left with is that the Jewish ancestor of the Ethiopian Jews is unlikely to be male. While modern research could not be used to come to a definitive answer, it is not done in vain. As research techniques become more sophisticated, we can look towards a future when we can use genetic research to better understand biblical events. ■

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RELIGIOUS INFERTILITY

SHIRA ROSZLER

Many couples experience infertility. For most of them, their inability to conceive is due to physical or emotional reasons. If a couple wishes to conceive, but their religious practice makes it difficult to do so, they are experiencing what is known as religious infertility, which sometimes occurs in the Orthodox Jewish community.

Fertility is extremely important in Judaism as seen from the Biblical commandment to “be fruitful and multiply” (*Bereishit* 1:28). *Rambam*, in *Hilchot Ishut*, Chapter 15 explains that this directive is satisfied minimally by the birth of a son and a daughter [1]. Among Orthodox Jews, sexual activity is regulated by the laws of *taharat hamishpacha*, which require couples to refrain from physical contact from the onset of the female partner’s menstruation, a minimum of 5 days, until seven “clean” days after her menstrual period has ended. For most couples, the separation imposed by these laws not only enhances their attraction to one another – “absence makes the heart grow fonder,” it sets the timing of intercourse at the most fertile time, during the hours closest to ovulation. For others, however, this imposed separation may challenge the ability to conceive.

During the period of separation, a Jewish woman is considered a *niddah*, a term that indicates the need for her to be physically apart from her spouse. Jewish days begin at night, therefore, the counting of the seven *tahor* (non-menstrual) days that immediately follow the end of the menstrual flow, commences at night. Once these clean days have been counted, the woman immerses herself in the *mikveh*, a ritual bath, and then resumes sexual relations with her husband. These laws are derived from verses in the Torah in combination with rabbinically-instituted rulings. The Torah states, “When a woman has a discharge- her discharge from her flesh being blood - she shall be in her state of separation [*b'niddata*] for a seven day period and anyone who touches her shall remain contaminated until the evening” (*Vayikra* 15:19). Additionally, it states “You shall not approach a woman in her time of unclean separation, to uncover her nakedness” (*Vayikra* 18:19).

For most women who experience normal 28-day cycles, the timing of the *niddah* period leads to increased rates of fertility, because they conclude the counting of the seven clean days several days prior to the advent of ovulation. The oocyte that is released is only viable for 12-24 hours subsequent to ovulation. Therefore, intercourse closest to the time of ovulation is predicted to generate maximum fertility. Fertilization just before the conclusion of the egg or sperm’s viable

period results in an increased risk of non- viable conception [2]. With *taharat hamishpacha*, most women’s menstrual cycles cause the timing of coital activity and highest fertility to coincide.

For the minority of Orthodox Jewish women who do not experience a normal cycle, the *taharat hamishpacha* limitations may result in

Fertility is extremely important in Judaism as seen from the Biblical commandment to “be fruitful and multiply” (*Bereishit* 1:28).

decreased fertility. A short cycle and pre-ovulatory phase may cause decreased fertility [2]. Women who have a short follicular phase or short period of menstruation may also miss the fertile window of opportunity. They are not free to participate in sexual activity during their most fertile hours and thus may experience religious infertility [3].

The coital restrictions required by the guidelines of *taharat hamishpacha* that reduce the frequency of intercourse can also cause a drop in fertility in women with short cycles. Studies have found that in populations where coital activity is high, 6-12 occurrences per intermenstrual period, there is less of an effect on fertility. [2]. Restrictions on coitus activity only effect 22 percent of women who experience cycles at risk of decreased fertility [3]. If coitus is delayed until after the fifteenth day of the cycle, the percentage of women adversely affected increases to 30 - 41 percent [4]. This is due to the limitation of intercourse to the post-ovulatory phase. Orthodox Jewish women may delay resuming intercourse until after day fifteen due to their inability to immerse in the *mikveh*. This change in timing may result from a prolonged menstruation, unexpected blood spotting (which returns the woman to the status of *niddah*), or an early occurrence of the follicular phase.

For women who experience cycles lasting only 21 to 25 days, chances of increased fertility are probable through the elongation of the pre-ovulatory phase. This is achieved through administering estrogen or clomiphene citrate during the early follicular stage [4].

Clomiphene citrate and estrogen delay ovulation in women with shorter cycles and promote the release of the hormones necessary for ovulation, which is anticipated to result 5 – 10 days after the last dosage. The dosages may be ineffective if taken after the ninth day and may lead to multiple pregnancies if taken too early.

Yairi-Oron *et al.* studied the effects of estrogen therapy on patients suffering from religious infertility. Estrogen was administered to the patients on either the first or second day of the menstrual cycle and continued until bleeding ceased. Individuals treated with estrogen whose previous ovulation transpired during the seven *tahor* days before immersion and permitted intercourse, showed no significant change in the number of days of bleeding. However, these women ovulated later in the menstrual cycle and were able to immerse in the *mikveh* after a shorter period of time. The estrogen supplementation produced a proportion of pregnancy of 23 percent, consistent with percentages of the standard population [3]. This study showed that religious infertility may be remedied using estrogen therapy to postpone ovulation until a time when patients are permitted to engage in coitus activity.

Due to the aforementioned findings, *taharat hamishpacha* does not have to cause religious infertility amongst Orthodox Jewish

women. But does it have an effect on the gender of their children? Dr. S. Harlap conducted a study of women who observe the laws of *taharat hamishpacha* and examined the relationship between the genders of infants conceived on different days of the menstrual cycle. Results showed that fecundation on different days of the menstrual cycle lead to a deviation in the sex ratio [5]. The study maintained that amongst the patients observed, when intercourse was resumed two days post-ovulation, the percentage of male infants was 65.5 percent, higher than usual. However, the study was criticized for failing to take into account that many women do not ovulate on day 14, but rather at some point between day 12 and day 16. Furthermore, the study assumed that all Orthodox Jewish women engaged in coital activity immediately following the visit to the *mikveh* and that it was in that specific act that the child was conceived [6]. Later studies showed that variation of the timing of insemination was not a reliable factor affecting the sex of offspring [7].

Taharat hamishpacha raises the issue of religious fertility amongst observant Orthodox Jewish women. Fortunately, this dilemma appears to be solved with estrogen therapy. As for predicting the gender of a child conceived while these laws are observed, couples will still have to expect the unexpected. ■

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BIBLICAL IMAGES : SPEECH AND HEARING IMPEDIMENTS IN THE BIBLE

AVIVA STROH

The Torah does not hide the physical, spiritual, or character flaws of the figures that fill her pages. Throughout our Holy texts, we are informed of the “human nature” of our greatest leaders, kings, and scholars, including physical deformities and impediments.

In *Shemot* 4:10, Moshe responds to *Hashem's* command that he go before Pharaoh and demand the release of *Bnai Yisrael*. He says, “I am not a man of words... for I am heavy of mouth and heavy of tongue” [1] and he expresses a similar concern later when he says that his “uncircumcised lips” will prevent Pharaoh from listening to him, just as *Bnai Yisrael* did not heed his voice [2].

There are many opinions as to the nature of the impediment Moshe describes. The most widely known interpretations are that Moshe suffered from a form of stuttering or a lisp due to a burn incident from his childhood [3]. Rabbeinu Channanel quotes Rabbeinu Bachya and offers an alternative explanation [4]. He says that Moshe had difficulty formulating specific speech sounds, those involving the teeth and alveolar ridge. He continues by listing the specific sounds he had problems with - he says that “heavy of mouth” [1] refers to issues with ‘teeth sounds,’ specifically the “z”, “sh”, “r”, “s”, and “tz” sounds. “Heavy of tongue” [1], he says, refers to ‘tongue sounds,’ specifically the “d”, “t”, “l”, and “n” sounds.

Rabbeinu Channanel's explanation seems congruent with a diagnosis of a cleft lip and palate. Like Moshe, one who suffers from cleft lip and palate often has difficulty effectively producing ‘dental’ and ‘alveolar’ sounds as a result of unfused maxillary bones.

While other commentators such as Rashbam cite a language barrier as the cause for Moshe's concern [5], S. Levin, in his article *The Speech Defect of Moses*, uses proofs from the text to support the notion that Moshe's complaint is referring to a physical deformity [6]. Moshe uses the Hebrew word *peh*, “mouth”, in his description of his condition in *Shemot* 4:10. Levin states that in every other place in the Torah where the word *peh* is used, it is translated as a physical mouth, as opposed to language or speech. Additionally, he says that Moshe's term *aral*, uncircumcised, as used in *Shemot* 6:12, always refers to the physical nature of being uncircumcised or blocked. According to Levin, it is no coincidence that Moshe uses these words to describe his *physical* condition and Levin too believes Moshe had a physical deformity [6].

In the book of *Shoftim*, we are told of another speech impediment found in *Tanach* [7]. There, Yiftach, the leader at the time, as-

sembles men from Gilad to battle the tribe of *Efrayim* during a civil war. At a Giladite controlled checkpoint, each man that wanted to cross was asked to say the word “*Shibboleth*.” The entire tribe of *Efrayim* had a speech impediment and could not pronounce the “sh” sound and when the response was “*Sibboleth*”, it was clear the man was from *Ephrayim* and the Giladites would attack and kill him.

The Torah also informs us of figures who were deaf, most famously Chushim the son of Dan. The Torah tells us that when Yaakov

Like Moshe, one who suffers from cleft lip and palate often has difficulty effectively producing ‘dental’ and ‘alveolar’ sounds as a result of unfused maxillary bones.

died, his sons took his body to *Ma'arat Hamachpela* in Hebron to bury him with his family [8]. The Gemara tells us that Eisav came and tried to prevent the burial, citing that the plot belonged to him as the true first-born son of Yitzchak. While the brothers awaited Naftali's return from Egypt with the legal documents, Chushim, who could not understand why Yaakov's body laid in disgrace unburied, took a club and knocked off Eisav's head so they would be able to proceed with the burial and maintain honor for their deceased father and grandfather [9].

Our sages tell us that every story, word, and letter in the Torah is present to teach us something. Instead of only including sin-free and perfect characters from whom to learn, *Hashem* chose to include even those who had significant physical impairments. From here we see that the Torah speaks of real people, not mythological characters as are seen in the Epic stories from other cultures. Our heroes and role models are human, fallible, and are expected to rise above physical impediments in their service of *Hashem*. ■

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THE EIGHTH MONTH NON-VIABLE FETUS: THE ONE MONTH DIFFERENCE

DEVORAH THALER

The Talmud provides some information on the viability of fetuses born during different periods of gestation. In the time of the Talmud, childbirth was a dangerous experience, many mothers and children did not survive. There was no chance of survival for a premature infant, regardless of age or development. Until recent decades, the survival of premature newborns was rare due to the lack of modern medicine and technology; there were no antibiotics to prevent infection, no intravenous feeding tubes, or incubators. Viability is defined as the age when the fetus can survive outside of the mother's womb on its own. Changes in the age of viability have occurred over the years invariably due to the progress of medical technology. Forty years ago, the age of viability was about 30 weeks (7 months). Twenty years ago, it was about 25–26 weeks (6 months). Today, medical professionals have determined that it is possible for a 20–21 week (5 month) fetus to survive (albeit, developmental deficits may occur). Viability today has changed due to the increased medical knowledge of physicians and the improvement of life support systems.

In *Yevamos* (80a,b), the *Gemara* asks – “but can a child of the eighth month live? It was taught in a *baraisa*: a child of the eighth month is treated like a stone (which is *muktzah*) and it is forbidden to move him on *Shabbos*. However his mother may bend over him and (without touching the infant) nurse him because of the danger involved. It was taught in a *baraisa*: who is a child of the eighth month? Anyone who did not complete the months of his development in his mother's womb. Rebbi says: his identifying marks demonstrate about him whether he is nonviable.” Development of hair and nails were the criteria used to determine whether development was completed. The reason we treat a child born in the eighth month as nonviable is because his hair and nails are underdeveloped. But if the hair and nails develop fully, it was assumed to be a seven month fetus whose birth was delayed, i.e., he lingered the womb after development. Now, it has been established that fingernail and toenail growth begin at 10 weeks while the first appearance of scalp hair is at 16 weeks. Yet it is not until 38-40 weeks (9 months) that moderate to profuse silky hair is found and that nails extend beyond the fingertips. In seeming accordance with the *Gemara*, a fetus is considered full term only at 38-40 weeks when nails and hair have completely formed [1].

A baby born after the full 9 month gestation was expected to live, while a premature baby born in the 8th month of gestation

was expected to die. An 8th month old fetus was recognizable by the lack of nails and of hair. The Talmud mentions the possibility of accelerated gestation, where a fetus completed full development after 7 months of gestation. If such a fetus was born in the 8th month, because its birth was delayed since it lingered in the womb, it would have nails and hair and would be expected to live. This

The Talmud mentions the possibility of accelerated gestation, where a fetus completed full development after 7 months of gestation.

may explain the viability of the Moshe *Rabbeinu*, who was born after 7 months of gestation and lived. When the *pasuk* in Exodus 2:2 says, “She saw he was good,” it must be that “Yocheved noticed something out of the ordinary which indicated that this newborn would live. Consequently, she did everything in her power to ensure that he would survive. *Tosafos* explained that Yocheved first thought her son would die, for, as *Rashi* pointed out, he was born prematurely in the sixth month of her pregnancy. But having observed that his nails were fully formed—proof of viability—she immediately took every precaution to safeguard his future” [2].

The presumed lack of survival of an 8th month old fetus was an accepted fact in many cultures. In the ancient world of the Greeks and Romans, and amongst the Rabbis of the Talmud, there was a widespread belief that infants born in the eighth month of pregnancy were seldom or never viable, while infants born in the seventh month of pregnancy were often thought to have a better chance of surviving. Drs. Reiss and Ash described their search to find a source for this widespread belief, as they found this superstition among many obstetric patients from diverse backgrounds. The earliest source discovered was a treatise attributed to Hippocrates, which seemed to have been current in the Greek world by 5th century BCE. The doctrine was elaborated on by subsequent Greek physicians and philosophers. It appeared in the Talmud and

in medieval texts, as well as in early modern medical writings [3]. Yet we still have no reason to explain why a 7th month old would be more viable than an 8th month old fetus.

The presumed non-viability of the 8th month old fetus triggered various *halachos*, especially those regarding *Shabbos*, specifically in reference to *muktzah* and a *bris*.

However, today, an 8th month old baby born on a *Shabbos*, if deemed healthy by a physician, would have his *bris* on the subsequent *Shabbos*. We do not define the concept of “nature has changed,” here meaning that the human developmental process has changed and that an 8th month old baby of today is physically different from that born hundreds and thousands of years ago, but rather that the technology has changed (Chazon Eish and Minchat Yitzchak). Today, modern-day hospitals are equipped to successfully maintain the viability of 8th month old babies and even those with a lesser gestational period of development. Nowadays it has come to pass that a fetus of 24–25 weeks (6 months) or older has an assumed high rate of survival, while survival at 22 weeks (5 months) is possible yet rare [4]. We can see that “nature has changed” as regarding pregnancy and technological advancements. The *Gemara* in *Kesubos* 83b states, “Death is a common occurrence.” *Tosfos* explains this statement saying that many times a woman is endangered in childbirth, because in ancient times childbirth was considered a life-threatening event. However, today, one seldom hears of a woman dying during childbirth. One factor to account for the greater survival rate is probably the concept of sterilizing the operating theatre/delivery room and the various instruments. This concept is only about 150 years old and can be traced to Louis Pasteur who noted that the airborne bacteria caused decay and to Joseph Lister who made the connection to wound sepsis. Lister revolutionized operating theatre hygiene, succeeding in making sterile surgery routine by sterilizing equipment,

bandages, etc. He also suggested surgeons wear clean gloves and wash their hands before and after operations and emphasized the need for cleanliness during childbirth [5]. Secondly, most births occur in hospitals, with the necessary technology to lessen the health risks of childbirth

Even today many premature infants have trouble, because the longer the fetus stays in the womb, the more developed it becomes and the more prepared for survival. The main concern that arises in premature infants is the issue of lung maturity. Normally, in the last months of pregnancy, cells in the alveoli produce a surfactant, which keeps the surface tension inside the alveoli low so that the sacs can expand at the moment of birth, and the infant can breathe normally. The surfactant is produced starting at about 34 weeks (8 months) of pregnancy and, by the time the fetal lungs mature at 37 weeks (9 months), a normal amount is present. If an infant is born prematurely, it is possible that not enough surfactant formed in the alveoli, thereby causing the lungs to collapse and making it very difficult for the baby to get enough oxygen. Sometimes a layer of fibrous tissue, called a hyaline membrane, forms in the air sacs, making it even harder for oxygen to get through to the blood vessels. Nowadays, if there is enough time, a mother going into premature labor is given steroids to promote lung maturity in order to reduce the risk of respiratory distress syndrome (RDS) [6].

The *Gemara* discussed the nonviability of an 8th month old fetus due to the low survival rate in ancient times (related to lack of medical technology and the associated danger of childbirth). But if the fetus had hair and nails, then the *Gemara* assumed that gestation was completed, that the fetus was full term and therefore viable. Today, even 6th month fetuses are potentially viable because of the technology to help them survive and the *halachos* pertaining to 8th month fetuses in regards to *Shabbos* and *bris* are not an issue any longer. ■

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VEGETARIANISM: A GUIDE TO A PERFECT BODY, MIND, AND SOUL

RACHEL YAMNIK

The precise definition of vegetarianism is a practice of a diet that is non-animal flesh-based. When G-d created Adam and Eve, he told them, “behold I have given to you every herb yielding seed which is upon the face of all the earth, and every tree, in which is the fruit of a tree yielding seed, to you it shall be for food” (Genesis 1:29). G-d created a perfect world with the intent for humans to be vegetarians. To satisfy human desire and to prevent moral degeneracy, G-d allowed the consumption of meat many generations after the creation of the world. A vegetarian diet completely satisfies the nutritional needs for all stages of life, and large-scale studies have proven vegetarianism to increase longevity, improve health, and significantly lower the risks of cancer and other fatal diseases.

Studies published in peer-reviewed scientific journals continuously show that animal-based diets promote the development of chronic diseases and decrease longevity. In contrast, vegetarian diets reduce many of the chronic health problems brought about from eating animal-based diets. For example, Sabate found that a vegetarian-based diet reduced the incidence of diabetes and heart disease [1]. De Biase *et al.* found that those on vegetarian diets had decreased levels of triglycerides, of low density lipoproteins (LDL) and of total cholesterol than those who consumed animal-based foods [2]. Accumulation of cholesterol-containing plaques causes the hardening of the arterial walls and the narrowing of the inner channel (lumen) of arteries leading to the heart, thereby inducing heart attacks. A study completed by Barnard *et al.* determined that a low-fat vegan diet improved glycemic and lipid control in type 2 diabetic patients [3]. Other research revealed a startling relationship between diet and cancer. Animal-based diets increased cancer rates, while vegetarian-based diets lowered the risk of breast, colon-rectal, prostate, and many other kinds of cancers [4]. It is estimated that about 30-40% of cancers can be prevented with a change in dietary habits. Finally, there is a link between the development of osteoporosis and meat-based diets. High animal protein levels prevent the absorption of calcium by the body, increasing the risk of bone fractures [5]. Based on these studies a conclusion can therefore be made that animal-based diets weaken one’s health and may lead to untimely deaths.

A vegetarian diet contains all of the essential nutrients; even those nutrients that many believe are exclusively found in animal-based diets. Proteins, iron, calcium, vitamin B12, zinc, and miner-

als found in high amounts in meat-based diets are also found at elevated amounts in a vegetarian diet. For instance, wheat, rice oats, barley, nuts, and seeds, contain high levels of protein. Curry powder, cashew nuts, and cinnamon are good sources of iron. Brown rice, potato, beans, and spinach all have high levels of zinc. Vitamin B12 is found in seaweed and algae. Finally, calcium is abundant in raisins, broccoli, spinach, mango and many types of beans. This gives

Eating a vegetarian diet can arguably be linked to the fundamental value in Judaism of preserving life.

even vegans an opportunity to maintain a balanced diet since, calcium, an essential element found in high amounts in dairy products, can be derived from alternative non-dairy sources [6]. Therefore, when converting from a meat- to a vegetable-based diet, no essential nutrients need to be lost in the transition process.

Eating a vegetarian diet can arguably be linked to the fundamental value in Judaism of preserving life. In Deuteronomy 4:15, “*V'nishmartem meod l'nafshotechem,*” is explicitly commanded by G-d. According to this commandment, one must take care of her health, making sure not to be in a position that may weaken or that may be detrimental to survival. According to Rabbi Samson Raphael Hirsch, “every smallest weakening is partial murder,” and “therefore even the smallest unnecessary deprivation of strength is accountable to G-d” [7]. One cannot follow the ways of G-d and perform His commandments, if she is physically or emotionally incapacitated. One may even transgress the Sabbath, eat forbidden foods, and eat on *Yom Kippur*, the Day of Atonement, for the sake of *pikuah nefesh*, the duty to save a human life. This is plausible since the transgressing of a few of G-d’s laws to save a life, thereafter allows for the saved person to continue following in the ways of G-d [8]. Since vegetarian diets do not lack in essential vitamins and minerals, and studies indicate that meat-based diets decrease longevity, one may conclude that according to Torah values and G-d’s commandments,

a vegetarian diet should be highly considered.

Initially, G-d created a perfect world in which animals would not be consumed and for humans to be vegetarians. Historically, Adam and Eve were vegetarians. According to Rambam, G-d's original plan was for the beast to only serve and help humans and was not created to be part of the human food chain [9]. Strengthening this viewpoint is the fact that scientists generally agree that the human body is not naturally suited for consumption of animal-based products. For instance, our saliva is alkaline and contains ptyalin to digest carbohydrates; on the contrary, the saliva of carnivores is acidic. Also unlike humans, carnivorous animals have proportionally larger kidneys and livers that are needed to handle the nitrogenous wastes of a meat-based diet. Humans, lacking such enlarged organs, are thus better suited to a vegetarian diet [8]. As compared to animals, our digestive system is not well equipped to digest meat. Our small and large intestines measure four times our height. In contrast, a carnivore's digestive system is the same height as its body. It takes longer for meat to pass through the larger human digestive system, therefore allowing for the meat to decay. Vegetables pass through the intestines in much less time than do meat-containing products [10]. The physiology of the human body is better constructed for a vegetarian diet, further strengthening the idea that G-d's original plan was for humans not to consume meat.

Although G-d created a perfect world for humans, the original plan was modified due to human corruption and desires. G-d permitted the consumption of meat to Noah and his descendents only after the flood (Genesis 9:3). The consumption of meat may correlate to the resultant great reduction in human life expectancy in the generations after the great flood. For example, Adam lived for 930 years and his son Seth lived until the age of 912. Long life continued until Methuselah, who lived a generation before Noah, and died after 969 years. In comparison, Abraham, a few generations after the flood, lived only for a 175 years [8]. According to Joseph Albo, G-d only allowed humans to eat meat, because by Noah's generation, humans had fallen to such a low spiritual level that G-d finally consented to their desire to consume meat in order to prevent corruption [11]. Rav Kook further claimed that the permission to eat meat was only temporary and that the ideal state is for people, as well as for animals, to eat a diet common to herbivores. He postulated that because humans deteriorated to such a low spiritual level, G-d allowed them to eat meat to elevate their image as compared to animals and so they would focus on improving relationships between fellow humans. Based on the passage in Isaiah which states that during the Messianic period, "the wolf shall dwell with the lamb...and the lion shall eat straw like the ox" (11: 6-9), Rav Kook believed that in the time of the Messiah the world will revert back to an ideal vegetarian state [8].

G-d granted humans the right to eat meat, but placed many regulations, which if not kept, would dissolve this concession. Rav Kook

believed that the permission to eat meat was accompanied with many *shechita* regulations and that the aim of ritual slaughter is to eventually lead people away from their meat eating habits [12]. The Torah also stresses the importance of having compassion towards animals. For instance, *tsa'ar ba'alei chayim*, causing pain or suffering to animals, is prohibited (Exodus 23:5). G-d goes so far as to command us to also grant animals a day of rest on Shabbat (Exodus 20:10). According to Rashi, this meant that animals should be free to roam on the Sabbath day and graze freely (Exodus 23:12, *lema'an yanuach*). Furthermore, our sages disapproved of hunting animals for sport and noted that our behavior towards animals reveals our true character [8]. Nimrod and Esav were hunters and considered great *reshaim*. Our forefathers or righteous leaders were not hunters; most usually were shepherds or they had other non-violent occupations. Jewish law clearly protects the rights and ethical treatment of animals, and G-d views as an abomination violent treatment towards His creations.

G-d granted humans the right to consume animal-based foods, but according to the Talmud (*Pesachim* 59b) it is only morally justified to eat animals when we are involved in holy spiritual pursuits. The treatment of animals today does not reflect the high spiritual level that humans should be on and the manner in which they should behave. In reality, they are violating G-d's commandment to be compassionate towards animals. An example of a current cruel animal practice is the way in which chickens are raised for slaughter. They are put into long, windowless, crowded sheds, where they never view the outside world or breath fresh air. Over half a million male chicks are stuffed into bags daily and crushed to death, because they have no value to the egg industry. The procedures employed for veal production are also barbaric. To produce tender veal, the calf is removed from its mother after just a few days with no consideration of its need for affection and nourishment. The calf is then locked in a small dark room, where it cannot move around. To stay pale and tender, the calf is made to become anemic by providing a special high calorie, iron-free diet. Furthermore, the calf's head is tied to the stall to prevent it from drinking its own urine to satisfy its need for iron [8]. According to Rabbi David Rosen, former chief rabbi of Ireland, "the current treatment of animals in the livestock trade definitely renders the consumption of meat as *halachically* unacceptable as the product of illegitimate means" [13]. If the G-d-granted permission to consume meat is strongly linked with the commandment to treat animals with compassion, then the non-humane procedures employed for raising fowl and calves for slaughter may negate the permission to consume meat.

Although, G-d only gave us permission to consume animal-based foods to satisfy our uncontrollable desires, it is generally unhealthy to eat meat. Yet, animal sacrifice was practiced daily during the Temple period, with Jews atoning for their sins by sacrificing animal offerings to G-d. How can G-d ask for animal offerings when

He originally desired a vegetarian world? The answer is that animal sacrifice was not of Jewish origin. During the period of Moses, most people worshiped idols through offering sacrifices [8]. According to Rambam, when G-d gave the Torah to the Jewish nation, He did not command the Jews to give up all of their practices, especially those that were common for that period in history. Instead, G-d transferred this practice so that Jews would give sacrifices to G-d instead of to the idols. In that sense, all elements of idolatry were removed [14]. Rav Kook believed that in the Messianic time, animal sacrifices will not be reinstated. Rather, humans will reach such a high spiritual level that animal sacrifices will not be needed to atone for human sins. Instead, non-animal sacrifices will be given to praise G-d [15].

Based on studies published in peer-reviewed scientific journals,

a vegetarian diet, which does not lack in any essential vitamins or minerals, prevents chronic diseases and reduces the rates of various cancers. In G-d's original plan, humans were to be vegetarians. Later, however, the consumption of meat was permitted. With the consumption of meat, came many regulations and laws, mandated to maintain a sense of reverence towards the life of His creatures. Slaughter practices today do not adhere to G-d's laws. Therefore, one may possibly conclude that this permission to eat meat may have reversed. Furthermore, contradictory to G-d's original plan, animals were used as sacrifices in the Temple, to allow for an easier transition from a polytheistic to a monotheistic religion. Nevertheless, during the Messianic era the world will revert back to a vegetarian state in which only vegetarian-based sacrifices will be offered to G-d. ■

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APPROACHING THE INFINITE: AN INTERSECTION BETWEEN MATHEMATICS AND SPIRITUALITY

CHAVA ZAKHAREVICH

“Our knowledge can only be finite, while our ignorance must necessarily be infinite.”

Karl Popper, from *Conjectures and Refutations* [1]

A cursory internet search will reveal many articles on the relationship between science and Torah, a good many of them stemming from the Yeshiva University community for whom the interrelationship between these two pillars is of the utmost philosophical importance. A similar internet search replacing the word “mathematics” for “science,” however, results in a substantially lower number and variety of queries. The reason for this is that, perhaps, on a surface level, the potential for discourse may seem rather minimal, limited to the fascinating, but not existentially explosive topics of *gematriot*, the calculation of volumes, handbreadths and hairbreadths, and statistical evaluations of the “Torah Code” phenomenon. However, as with in Torah, mathematics can be examined from both a *peshat* perspective, as a tool for making empirical calculations, as well as on a deeper, *sod* level, as the more abstract and “pure” the mathematics which offers greater philosophical implications and possibilities for a more meaningful interaction with the spiritual truths of the Torah. One of the realms in which an examination between the commonalities between mathematics and spirituality is fruitful is regarding the mathematical notion of infinity as described by German mathematician Georg Cantor’s (1845–1918) set theory, and the blow to logical absolutism made by Austrian American mathematician Kurt Gödel’s (1906–1978) incompleteness theorem. To set the stage for this comparison, let us begin by examining the role of infinity in Jewish sources.

One of the most basic descriptions that the Jewish tradition uses to describe God is that He is Infinite. This description stems from the resounding words of the *Shema* in Deuteronomy 6:4 that “the Lord is One,” a statement which comes with a host of logical corollaries, meaning not only that there are no other gods beside Him, but that God, as is stated in Maimonides’ second principle of faith, is “a complete and total unity,” and thus cannot be divided into a finite number of elements [2]. Canonized further in Maimonides’ fourth principle of faith is that God is unbounded by time; He is the First source, further pointing to His being beyond the finitude of time and space. In kabalistic writings, God is referred to as *Ain Sof*, literally “without end”: without measurement, without description really [3]. [In the formulation of Maimonides, it is inaccurate to say positively

that God is infinite [4]. Rather, in concordance with Maimonidian negative theology, all we can say of God is phrased in the negative: God is not finite, and not infinite either, for those are words whose reference point is the world of things, and thus have no resemblance to the *Ain Sof*. Descriptions said of God do not penetrate to the

As with Torah, mathematics can be examined from both a *peshat* perspective, as a tool for making empirical calculations, as well as on a deeper, *sod* level, as the more abstract and “pure” the mathematics which offers greater philosophical implications and possibilities for a more meaningful interaction with the spiritual truths of the Torah.

essence of God, but rather represent our perceptions of Him as He manifests Himself through time and space, existence, and all the baggage that comes from our categorically limited vantage point.

However, if God is infinite in power and intelligence, could He not create a world which was likewise infinite? Indeed, the Talmud in *Chagiga* 13b writes that there exists an infinite amount of heavenly spheres filled with an infinite amount of spiritual beings. Similarly, there are sources which use the word ‘infinite’ to describe both the Torah and the soul [5]. However, as much as we understand the Torah to be the expressed will of God, it must be different than God Himself, and as much as the soul is considered a *chelek eloka mim’aal*, “a

part of God,” it cannot be considered infinite in the same way as the Whole [6]. Are these statements not a threat to the uniqueness of God’s status as infinite? Can there be more than one infinity? Greater infinities and lesser infinities?

On an intuitive level, this thought seems contradictory. Is not infinity all encompassing and a bit more? How can there be room for an infinite God and a creation that is equal to Him in “size”? This theological question is bothersome to other monotheistic creeds as well, belying the famous medieval speculation of how many angels can dance on a pinhead. The problem lies in that admitting an infinite quality of angels onto the headpin would involve admitting an infinitude other than God. For Medieval Scholastics such as St. Thomas Aquinas, this was considered a logical impossibility and he thus solved this paradox by saying that God could not do that which is self-contradictory, such as make the unmade, or create an entity that is as unlimited as He [1]. The argument that God does not do that which is analytically false is one that plays an important role in the rationalist Jewish tradition as well, employed by Maimonides in his Guide to the Perplexed [7].

An alternate answer, prevalent in those thinkers influenced by kabbalah and Hassidic philosophy, is that God can do that which is logically incoherent, as He is the source of rules of logic, and therefore can transcend them if He so pleases [8]. These two answers to this theological paradox mirror in some ways the development of mathematics in the early part of the Twentieth Century in the radical challenge to the supremacy of mathematical logic, mathematician Kurt Gödel’s incompleteness theorem.

To describe Gödel’s “Incompleteness Theorem” in more detail it is necessary to examine the circumstances that led to the birth of his discovery. The first cracks in the foundation of logic were paradoxes, an example of which is Russell’s “Barber’s Paradox”, which tells of a small-town barber who shaves those, and only those, who do not shave themselves [9]. This seems perfectly logical, until one asks the question “Does the barber have to shave himself?” If he shaves himself, he would defy his policy of only shaving those who don’t shave themselves, but if he doesn’t shave himself, then he has to shave himself! What looks like a silly word-game is actually an indication of a fundamental problem in formal logic. Scientists and philosophers, such as Euclid of yore and David Hilbert in modern times, wanted to repair this structural damage by attempting to reduce all scientific theories to formal systems with a finite number of axioms and rules, from which it is then possible to derive everything else [1]. This seems reasonable, and, in a sense, functions to this day. Gödel’s “Incompleteness Theorem” put an end to the expectation that the axiomatic method could be used to prove everything by showing us that in any formal theory there exists a truth that cannot be derived from a finite set of postulates, logically proving that mathematical logic is limited in its role as an arbiter of mathematical truth, and perhaps clearing philosophical space for the paradoxical, and supra-rational

[1].

The incompleteness theorem can help us respond with the Talmudic dictum of *eilu v'eilu* [10] to the seeming dichotomy between the rationalist and kabbalistic notions of God’s Omnipotence as mentioned above in the Maimonidian and Hassidic sources. The rationalist is employing the trustworthy paradigm that God as a general rule prefers creation to conform to human logic, and thus does not override His axioms, whereas the Kabbalist speaks from the vantage point of that one exceptional, unprovable axiom, that God is not limited to His general axioms of logic [11].

In addition to the incompleteness theorem, the difficulties posed by the varied forms of infinity in Jewish texts can be greater clarified by charting the development of the concept of mathematical infinity and how growth in this field has provided a new language to consider the aforementioned theological and philosophical questions.

The concept of infinity holds a pretty dogmatic place in the realm of mathematics. Anybody who has studied calculus or beyond, however, knows that it is filled with rules governing its use, limits are regularly approaching infinity, and that you had better not divide infinity by itself, lest you find yourself with an “indeterminate form” on your hands, and so on. If all of these rules were merely abstractions, than juggling with infinities would not seem so problematic, but mysteriously enough, these abstractions are successfully used to fly rockets into space and create ergonomic seat cushions. Attempts made by mathematicians such as Leopold Kronecker (1823-1891) and mathematicians of the “Constructivist school” to create a so called “real mathematics” based only on those numbers which are observable in our universe and thus excluding entities such as negative numbers, irrational numbers, and of course infinity, led to a whole host of important developments, including the theory of algorithms, which is central in computer science [1]. The majority of mathematicians, however, still rely on the prior model which allows for a more complete theoretical base for the “useful” mathematics of scientists and engineers. Applied mathematics is fine with using infinity and her other “imaginary” friends, as long as they are merely means to an end, and not a final result of a calculation [1].

Even more philosophically astounding than this “conventional” infinity are the qualities conferred upon mathematical infinity, as described by the set theory of mathematician Georg Cantor. The set theory, which has become a fundamental theory in mathematics, proved that there are different kinds of infinities, some larger than others. Cantor’s reasoning builds upon the primary mathematical notion of a set, which merely means a collection of objects considered as a whole, and the rule of “one to one correspondence” which states that for any two sets of entities which consist of the same number of elements, there can be a “one to one correspondence, a direct parallelism drawn between a member of one set and a member of the other set. Although this concept is true regarding finite sets, Cantor realized that in his comparing of two infinite sets, this correspondence

does not always hold true.

Many times, comparing infinite sets corresponds to our instinctual notion that infinity does not really come in differing shapes or sizes. A famous comparison of infinite sets, dating back to Galileo, is the comparison of the set of positive integers 1, 2, 3, ... and so on ad infinitum, to the set of squares of integers 1, 4, 9. While at first glance the latter seems smaller, as it excludes all the non-squares such as 2, 3, 5 and so forth, one can draw a one-to-one correspondence between the members of the integer set and their squares, to show that actually this seemingly smaller infinite set is the same size as the first set.

Although this paradoxical correspondence was noted by others before him, Cantor's insight was that an infinite set is not merely a potential entity, as previously thought, but an object which exists and can be treated like any other number. Interestingly, Cantor labeled this set of all positive integers (\aleph_0) (pronounced *aleph-null*) choosing the Hebrew letter as a symbol for this newer notion of infinity. Cantor famously proved however, that not all infinities are alike, and that \aleph_0 is less than the infinity of the continuum of numbers from 0 to 1, called c [11]. In addition to these, Cantor explored many more variations of mathematical infinity which are governed by a whole host of particular mathematical rules.

Many theologians were bothered by the seeming inconsistency of Cantor's work with the uniqueness of the absolute infinity of God, some even equating his theories with pantheism [12]. Does Cantor's theory bode poorly for Judaism?

Although this multiplicity, or perhaps infinitude of infinities, seems to somehow deny the uniqueness of infinitude as a Divine quality, Cantor also proved that there is an infinity which is in fact above the mathematical law which states that for every set, there is a bigger set in which it is contained. Cantor's theory is supplemented by a concept called the Totality, which includes everything that exists, and thus is not a set, free from the confines of mathematical infinity. In a similar manner, God, Who is *Ain Sof*, outside of creation entirely, is certainly greater than the Totality of everything that exists [11].

Cantor was a deeply religious man, ascribing his set theory to Divine inspiration. He was quoted as qualifying his findings with the following clarification:

The actual infinite arises in three contexts: first when it is realized in the most complete form, in a fully independent otherworldly being, in Deo, where I call it the Absolute Infinite or simply Absolute; second when it occurs in the contingent, created world; third when the mind grasps it in abstracto as a mathematical magnitude, number or

order type. [13]

Of all three of Cantor's statements, perhaps it is Cantor's third and seemingly most modest statement of infinity that is actually the most controversial from a Jewish standpoint, at least in the contention that the "mind grasps" it. Truly grasping the infinite is not only considered impossible because of the constraints of the finite human mind, but even extensive contemplation on the infinite "mind of God" is an act which is discouraged in the Jewish tradition. Rabbi Moshe Chaim Luzzato, the Ramchal (1707-1746), both a great philosopher and Kabbalist, warns against attempting to conceptualize matters of God's true essence, writing in his seminal *Da'at Tevunoth*: "It is absolutely forbidden for us to embark upon such an inquiry, our sages having stated (Chagiga 11b): 'If one reflects upon four things it is better if he had not come into the world...' and 'Do not inquire into what is removed from you'" [3]. The Talmud in Chagiga 14b cites the story of four sages, Ben Azzai, Ben Zoma, the Other, and Rabbi Akiva who entered into the "Pardes", literally, Orchard, but symbolic of some sort of realm of lofty, mystical teachings. Of the four sages, only Rabbi Akiva left unscathed, Ben Zoma died, Ben Azzai became mentally unstable, and the Other became a heretic.

Perhaps Cantor's and Gödel's discovery that there is a set but infinitely complex structure to infinity can allow the modern thinker to approach thinking about infinity in a safer, more ordered manner. However, it may be that even Cantor and Gödel, who delved into the paradoxical nature of infinities in a disciplined and non-theologically related manner, did not emerge from their intellectual journey through infinity unscathed. Cantor is thought to have suffered from what would now be characterized either as bi-polar disorder or even manic depression [1]. Gödel suffered from extreme paranoia, especially of being poisoned, requiring his wife to taste all his food before he ate. When she was hospitalized and could not taste his food, Gödel's paranoia killed him as he starved to death [1].

The Lubavitcher Rebbe wrote that one of the accompanying heralds of the messianic era will be when scientific discoveries will provide apt vessels by which to understand the hidden wisdom of the Torah [14]. At the very least, both Cantor's set theory and Gödel's incompleteness theory provide useful paradigms by which to contemplate (in a reasonable manner) the difficult and often paradoxical philosophical conceptions concerning God's nature found within the Torah. Although the author's profound lacks of knowledge in both Torah and mathematics limits the scope and depth in which the topics can be examined, it is hoped that even a conceptual introduction to the topics at hand can perhaps provide further insight into the fundamental unity of knowledge, which reflects the unity of the Creator and brings glory to His Name. ■

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BLOOD, FROGS, AND LICE

HARVEY BABICH, Ph.D.

This article analyses the initial three plagues through the eyes of various Torah commentaries and synthesizes scientific explanations within the discussions. The approach, noted by Rav E. Munk [1], is as follows: “In the miracles recorded in the Torah, the supernatural is often interwoven with the natural and the plagues may be defined as miraculously intensified forms of the diseases and other natural occurrences encountered in Egypt.” Rav E. Dessler [2] explained that there is no essential difference between the natural and the miraculous. We term an act as a miracle when HaShem causes a novel occurrence, unfamiliar to us. Everyday natural events, those governed by the so-called laws of nature, are also miracles, but their common occurrence and recognizable patterns dilute their significance.

First plague: Blood (real or look-alike)

Instructing what Moshe should inform Pharaoh, the verses read as follows: “So says HaShem, “Through this shall you know that I am HaShem; behold with the staff that is in my hand I shall strike the waters that are in the River and they shall change to blood. The fish that are in the water shall die and the River shall become foul. Egypt will grow weary of trying to drink water from the River” (Shemos 7: 17-18). The River referred to in these verses is the Nile River, the key to the economic life of Egypt, an arid country of which 95% is desert. Waters from the Nile River were diverted to streams to irrigate the soil and also to provide a source of freshwater, both for human consumption and for the livestock. The Nile River teemed with various species of fish, readily consumed by the Egyptians. Periodically, the Nile River overflowed, thereby fertilizing the surrounding soils. The retreating waters left many fish trapped within in the grasses and which were easily available for capture. This may explain (Toldos Yitzchak) B’nei Yisrael’s complaint when traveling through the desert, “We remember the fish that we ate in Egypt free of charge” (Bamidbar 11:5). Wild game, such as water buffalos, were attracted to the Nile River either were killed for food or were captured and domesticated to plough farm land. The Nile River provided a route of transportation for commerce and people. “And all the world came to Egypt” (Bereshis 41:57). Pharaoh viewed himself as master, or the god, of the Nile River, the life blood of Egypt. The Nile River was the initial target of the plagues.

As mentioned in the Haggadah, each main plague consisted of either four (Rabbi Eliezer) or five (Rabbi Akiva) subcomponents. The first plague consisted of the following events:

- a) the Nile River changed to blood or to a blood-like substance;
- b) the fish died, leaving the Egyptians without their food staple;
- c) the Nile River fouled and emitted an offensive odor;
- d) the Egyptians lacked a suitable source of drinking water;
- e) and the Egyptians wearied trying to find drinkable water either had to purchase drinkable water from B’nei Yisrael (Rashi) or had to dig for underground water (Ibn Ezra).

Apparently, the Nile River could not maintain such massive numbers of dinoflagellates; their subsequent death followed by their decomposition by aquatic bacteria would lead to the generation of malodorous air pollution.

Interestingly, in the Torah literature there appear to be two distinct interpretations of דם. The most commonly known translation of דם is that of actual human blood (e.g., Targum Onkelos; Maharal; S’forno). Rav Yaakov Culi, in his Me’am Loez, stated that the Nile River turned into blood, with the same taste, smell, and chemical and physical composition of actual blood. The Malbim noted that the Nile River water turned to blood and retained some of the characteristics of human blood, notably, the water was hot (human body temperature is 37°C) and caused the fish to die. The B’chor Shor commented that the Nile River turned to actual human blood, which coagulated (i.e., hemaagglutinated) causing the fish to die.

A lesser known interpretation of דם is that it was a blood-colored water, similar in appearance to, but not actual, blood (Targum Yerushalmi HaShalam; Targum Yonasan). Rav Bachya, as cited by Rav Z. Sorotzkin [3], suggested that water of the Nile River took on the appearance, taste, and smell of blood, but was not actual blood. A

similar explanation was presented by Rav Naftali Zvi (see Haamek Davar; Shemos 7:19) and Rav Avigdor Miller [4]. Quoting Rav Miller, “It was not blood that could be used for transfusions or for fertilizing the land, but the resemblance was close enough to sicken the spectators. A revolting miasma came up from all the streams of Egypt, and the people (who were accustomed to eating and feasting always) lost their appetite, and instead vomited again and again at the sight and odor of the revolting liquid. Normal life in Egypt came to a shocked standstill; and thirst, now the first time in their history, became the chief matter in the land. Everywhere, the infirm and aged lay dead; and the nation groaned in the depths of despair.”

Whether the water of the Nile River turned to actual blood or to a blood look-alike may impact on what caused the fish to die and why the waters were befouled. As suggested by Rav Sorotzkin [3], if the Nile River turned to actual blood, the befouling of the Nile River may be due to bacterial decomposition of the blood. Subsequently, unable to live in blood and in an aquatic ecosystem made anaerobic by excessive bacterial metabolic activities, the fish died. Bacterial decomposition of the fish added to the malodorous emissions from the Nile River.

On the phrase, “For they could not drink from the waters of the River (Shemos 7:24), Rav Munk [1] wrote that although blood is drinkable, the Egyptians could not endure seven days without drinking actual water. Do people really drink blood? Apparently, yes; the phrase “human hematophagy” describes the habit of certain societies to drink blood and to use animal blood in food items. The African Masai drink a liquid composed of a mixture of cow milk and cow blood and many communities throughout the world consume blood sausage. Ritual hematophagy, as seen in the consumption of human blood, is also known. The Scythians, a nomadic Russian people, drank the blood of the first enemy killed in battle [5].

Rav C. Rabinowitz (Daas Sofrim) suggested that the very thirsty Egyptians, in the hope that the waters only appeared red but were not actually blood, drank from the Nile River. They were incorrect and the drinking of the blood only intensified their thirst. Rav Dovid Cohen (Simchas Yavetz, Haggadah of Pesach) noted that in the Torah it specifically mentioned that the Egyptians were not able to drink from the Nile River as it was polluted with dead and decaying fish, not because it was blood. Implying, apparently, people could drink. This last point is also stated by Rav Yaakov Tzevi Mecklenburg (see Munk [6]). “In the worst emergency, the people could have drunk blood. If blood were not considered a drink by the Torah, its consumption would not have been forbidden on pain of death. This is why the Torah mentioned not only the fact that the water would turn to blood, but that the fish of the river would all die. Once the river would be full of blood plus rotting carcasses of dead fish, even the option of drinking the blood would not exist.”

If not changed to actual blood, what factors came into play to cause the waters to appear blood-like in color and in overall appear-

ance? Rav Munk [1] mentioned the possibility of aquatic vegetation causing the Nile River to turn a pale red in color. Secular scientists have offered a variety of possibilities, including the deposition of red meteorite dust from a passing comet, deposition of volcanic ash, the intrusion of red silt, and the contamination of the Nile River by red-pigmented flagellated protozoa, zooplankton, dinoflagellates, micro-fungi, and cyanobacteria [7, 8]. This last hypothesis, sudden overgrowth of an aquatic microbial species, may have the most merit. Although little publicized because of its potential negative impact on tourism, Florida often experiences red tides caused by a bloom (population explosion) of the red-colored dinoflagellate, *Karenia brevis*. This specific alga produces many neurotoxins (termed, brevetoxins), some of which become airborne and when a red tide coincides with an onshore breeze, hospitals in Florida prepare for an influx of patients. Brevetoxins constrict pulmonary (lung) bronchioles and, thus, are extremely harmful to asthmatics and others with breathing problems [9]. Other red-pigmented dinoflagellates, including species of *Gymnodinium* and *Gonyaulax*, also are involved in such blooms and also produce various neurotoxins. Such toxins are harmful to fish and other aquatic vertebrates [10]. Apparently, the Nile River could not maintain such massive numbers of dinoflagellates; their subsequent death followed by their decomposition by aquatic bacteria would lead to the generation of malodorous air pollution. As noted, each main plague had several subcomponents that added to the misery of the Egyptians; emissions of aquatic and airborne toxins generated by red-pigmented dinoflagellates would be a deleterious subcomponent of the plague, םד.

It really does not matter whether the Nile River was transformed into actual blood or into a blood look-alike. The Nile River was the pride of Egypt and was worshipped as a god. The Egyptians would prostrate themselves first thing in the morning to the Nile River, the god who provided them with a livelihood [3]. This so-called god was now transformed into a stinking cesspool! Rav Miller [4] cited the following passages from the *Admonitions of Ipuwer*, an ancient Egyptian papyrus manuscript, which apparently referred to the first plague: “The river is blood Blood is everywhere.... Men shrink from tasting That is our water.... What shall we do? Everything is in ruination...”

Second plague: Frogs

“Hashem said to Moshe, ‘Say to Aharon, stretch out your hand with your staff over the rivers, over the canals, and over the reservoirs, and raise up the frogs over the land of Egypt’”(Shemos 8:1). Apparently, only the fish, not the frogs, died when the Nile River and its tributaries were changed to blood or to a blood-like substance. Why? Fish absorb dissolved oxygen through their gills and, perhaps, their death may be related to the lack of suitable quantities of dissolved oxygen in the Nile River. Bacterial decomposition of the dead fish would have depleted the waters of their dissolved oxygen. Frogs are amphibians and are not confined to an aquatic system and, if the

surrounding vegetation remained moist, they could have survived as terrestrial denizens for the week of the plague. Or, frogs have lungs and even if they remained in the anaerobic water of the Nile River, they could come to the water surface and breathe air. In addition to pulmonary (lung) respiration, frogs have two other modes of gaseous respiration, allowing for gas exchange both in water and on land. The moist skin of frogs is supplied with capillary blood vessels, allowing for cutaneous gas exchange when in water or on land. Gas exchange also occurs across the moist surfaces of the mouth and pharynx [11]. Breathing through their lungs, most important when metabolic activity is increased, probably came into play when the frogs left the Nile River to infest Egypt. As noted, “The River shall swarm with frogs and they shall ascend and come into your palace and your bedroom and your bed and into the houses of your servants and of your people, and into your ovens and into your kneading bowls. And into you and you people and all your servants will the frogs ascend” (Shemos 7:28-29.).

When noting the dialogue Moshe should have with Pharaoh, HaShem stated, “But if you (i.e., Pharaoh) refuse to send out, behold I will strike all of your territory with frogs” (Shemos 7:27). Rav Miller [4] suggested that the phrase “all of your territory” implied that not only aquatic frogs but various species of terrestrial frogs and land toads infested Egypt. In particular, he made note of the giant toad, *Bufo marinus*, which consumes birds and small mammals and has poisonous cutaneous glands that secrete a deadly toxin when someone inadvertently stepped upon. Another usually large amphibian is the West African frog, *Conraua goliath*, more than 30 cm long from the tip of nose to anus and with a weight of 3.3 kg (or, about 7½ pounds). This giant frog devours animals, such as rats and ducks [12] and may also have been involved in the plague.

The plague of frogs commences with the following, “Aharon stretched out his hand over the waters of Egypt and the frog (צפרדע) infestation ascended and covered the land of Egypt (Shemos 8:2). In this verse the word “frog” is in the singular and Rashi cited a Midrash contending that one frog initially emerged from the Nile River. When the Egyptians struck the frog, it fragmented into many frogs. On a surface view, this appears to describe cloning, through which differentiated adult cells become embryonic or totipotent to develop into copies of the original organism. Interestingly, prior to the cloning the lamb Dolly, the initial successful cloning experiments, developed in the 1950s by Robert Briggs and Thomas King, were with frogs (*Rana pipens*) [13]. With this in mind, and probably pushing a scientific explanation to its extreme, striking the initial frog may have caused shedding of its differentiated epidermal somatic cells, which became totipotent or zygote-like cells, undergoing mitotic divisions to generate multicellular frogs.

In addition to causing physical discomfort to the Egyptians, the frogs and toads employed psychological warfare. As part of their reproduction and mating behavior, male frogs and toads croak and call

vociferously to attract females (Hickman *et al.*, 2005). The Egyptians believed that the frogs were the reincarnation of the Hebrew babies cast into in the Nile River; “Pharaoh commanded his entire people, saying, ‘Every son that will be born - into the River shall you throw him’” (Shemos 1:22). The Egyptians imagined that the frogs emerging from the Nile River, with their incessant croaking, were the reincarnated bodies of the dead babies crying out that their blood to be avenged [4].

Eventually, Pharaoh pleaded with Moshe to eliminate the plague of frogs. “HaShem carried out the word of Moshe and the frogs died - from the houses, from the courtyards, and from the fields. They piled them up into heaps and heaps and the land stank” (Shemos 8:9-10). Thus, the pollution of the atmosphere initiated through the rotting fish in the Nile River from the first plague now continued throughout the land as the frogs slowly decomposed in the hot Egyptian climate.

Although this will not be discussed, it is interesting to note that some commentaries, such as the Rav Bachya, the Ramban (*see* Munk [1]), and the S’forno (Shemos 8:3), interpreted צפרדע as the crocodile. The Haamek Davar (Shemos 7:28) suggested that צפרדע referred both to frogs and crocodiles, with frogs infesting all of Egypt and crocodiles infesting Pharaoh’s palace. For an in-depth analysis on the identity of צפרדע as the crocodile, the reader is directed to an article by Dr. S. Sperber, Department of Talmud, Bar-Ilan University [14]

Third plague: Lice infestation

HaShem said to Moshe, “say to Aharon, ‘Stretch out your staff and strike the dust of the land; it shall become lice () throughout the land of Egypt. So they did; Aharon stretched out his hand with his staff and struck the dust of the land, and the lice (כנם) infestation was upon man and beast; all the dust of the land became lice (כנם) throughout the land of Egypt (Shemos 8:12-13). Note the differential spellings of “lice” in these two sentences. The initial term, כנם, is thought to refer to the white parasitic body lice that attach to, sting, and penetrate the bodies of humans and animals (Or HaChayim). Rav Miller suggested a connection between the first and third plague. When the Nile River changed to blood or to a blood-like liquid, the Egyptians stopped from bathing and laundering their garments, thereby initiating a hygienic scenario to promote lice infestation of their scalp and body. The latter term, כנם, written in the plural, refers to at least 14 varieties (Rav M. Alshich) of species of jumping, black lice that originated from the Egyptian soil (Or HaChayim). The Ramban suggested that these were actually a new creation, “for it is not in the nature of dust to turn into lice.” Whereas the white body lice produced visible eggs (“nits”), the jumping, black species (Tosfot citing Rav Joseph of Orleans, Shabbos 12a) produced microscopic eggs [15] and thus were believed to have arisen by spontaneous generation (Rashi explaining the opinion of Beis Hillel, Shabbos 12a). Rav Miller [4] postulated that כנם included numerous parasitic species of lice,

fleas, ticks, and mites and suggested that this plague caused more than a mere excessive itching of the skin. He noted a host of pathologies, ranging from sores, rash, fever, and general debilitation to nervous complications, meningitis, and encephalitis, cardiac anomalies, and arthritic symptoms.

Ticks, mites, fleas, and lice are classified within the phylum Arthropoda, with mites and ticks in the Class Arachnida and fleas and lice in the Class Insecta. Ticks are larger than mites and carry a greater variety of infectious microbes than any other arthropods. Lice and fleas are types of wingless insects that are parasitic throughout their lifecycle (Hicksman *et al.*, 2003). There are several arthropod-borne diseases, through which a specific flea, louse, tick, or mite transfer an infectious microbe from an animal, the primary reservoir, to a human being. The following are some diseases that Rav Miller may have included under the category of **דגנ**. For example, the disease, ehrlichiosis (causative bacterial agent: *Ehrlichia chaffeensis*) is transmitted from white-tailed deer and dogs to humans by the Lone Star tick (*Amblyomma americanum*). Once inside the human body, the bacteria infect white blood cells (the monocytes) causing a non-specific febrile illness. The disease, epidemic (louse-borne) typhus, caused by the bacterium, *Rickettsia prowazekii*, is transmitted from human to human by the body louse, *Pediculus humanus corporis*. These rickettsia spread in the infected person to cause inflammation of the blood vessels, leading to abrupt headache, fever, and muscle ache. More familiar is Lyme disease, caused by the bacteria of the genus, *Borrelia*. The tick, *Ixodes scapularis*, transmits the bacteria from infected deer to humans. The initial symptoms of Lyme disease include malaise, fatigue, headache, fever, and chills, which, if untreated, progresses to neurological abnormalities, heart inflammation, and arthritis. Finally, infected persons may develop symptoms re-

sembling Alzheimer's disease and multiple sclerosis. Other arthropod-borne diseases include plague (causative bacterial agent: *Yersinia pestis*), Q fever (causative bacterial agent: *Coxiella burnetii*), and Rocky Mountain spotted fever (causative bacterial agent: *Rickettsia rickettsii*) [10].

Whereas the above-noted diseases are caused by bacteria transmitted through lice and ticks, arthropods also may transmit disease-causing protozoa and viruses from infected animals to humans. For example, the group of human diseases, termed leishmaniasis, are caused by protozoa, with their reservoirs being dogs and rodents, and transmitted through female sand flies. The viral infection, tick-borne encephalitis, is transmitted through bites from infected ticks, *Ixodes ricinus*, and is manifested as meningitis, encephalitis, and meningoencephalitis [10]. Apparently, these are the types of arthropod-borne diseases suggested by Rav Miller [4] to have occurred through the third plague.

SUMMARY

In the first three plagues HaShem initiated an attack on Egypt, using components of nature as the invading army. In addition to adversely affecting the Egyptians, physically, psychologically, and economically, HaShem attacked all components of the Egyptian biosphere: the aquatic ecosystems—the waters of the Nile River changed to blood or to a blood-like substance; the atmosphere—the air became polluted with malodors emanating from rotting fish and frogs; and the terrestrial ecosystems—the soils became infested with lice, ticks, and mites. ■

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