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A PUBLICATION OF
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STERN COLLEGE FOR WOMEN

DerechHaTeva

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DEDICATION & ACKNOWLEDGEMENTS

We dedicate this year's publication of Derech Hateva: A Journal of Torah and Science to the memory of Anne Scheiber. Though a quiet and humble woman in her lifetime, Anne Scheiber's name is well known throughout the halls of Stern College. Her donation to Yeshiva University has contributed to funding the dreams of many undergraduates who hope to help humanity through their studies in the sciences. Rabbi Dr. Norman Lamm, former president of the University, once described her impact on the Stern students, saying that though Anne Schieber died childless, she now has become "a mother to a whole community."

Throughout her life, Anne Scheiber felt discriminated against because she was both Jewish and female. After doing very well in her investments in the stock market, a place where religion and gender don't matter, she chose to bequeath her savings to institutions that would help young women realize their full potential. Aside from her gift to Yeshiva University, Anne Scheiber also donated to an Israeli educational group for young women.

Even greater than the gifts Anne Schieber left us, is the lesson she embodied. A seemingly quiet person can have a great impact on the world. As Rabbi Lamm once said, "Anne Scheiber lived to be 101 years old, but here at Yeshiva University, her vision and legacy will live forever."

SINCERELY,

THE EDITORS

Shira Apfel Esther Frederick Rebecca Katz

PASUK

אמלא אותו רוח אלקים בחכמה בתבונה ובדעת ובכל מלאכה
-שמות ל"א:ג

And I have filled him with the Spirit of God, with skill, ability and knowledge in all kinds of crafts
(Exodus 31:3)

TABLE OF CONTENTS

Infertility: A Weighty Matter	NINA J. ACKERMAN • 7
Artificial Resuscitation and Midwifery: from Torah Times to Today	DANA ADLER • 10
Brain Plasticity and Spiritual Renewal: An Exploration of Metaphor	DALIA BARENBOIM SHULMAN • 12
Exercise	KATIE BECKER • 15
Biblical Leprosy: A Confusion for Centuries	ALIZA BERK RETTER • 18
Modern Genetics in the Bible and Talmud	SARA BERMISH • 21
Onions	ROBIN BURGER • 23
Talmudic Medicine from Head to Toe	JENNIFER DELUTY • 25
He's Got Your Back	ILANA FRANKIEL • 28
Global Warming: The Hot Topic	ESTHER FREDERICK • 30
Teeth: Taking a Bite of *Tanach*, Talmud, and *Halacha*	JUDY GROSSMAN • 33
Jaundice in the Torah and the Talmud	SARAH ARIELLA HOLLANDER • 35
Oral Hygiene: In the Talmud and Today	REBECCA KATZ • 37
Allergies to Jewish Practices	SANDRA KNOLL • 40
Cosmetic Deformities in *Halachic* History	AIMEE KRAUSZ • 43
The Most Practical Hand-held Gadget: Soap and Water	JENNIFER KRAUT • 45
Tekhelet - A Chemical Conundrum	EMILY J. LIEBLING • 47
Tzafdinah: A Talmudic Scurvy?	JANNA LOGIN • 50
Skin Color Phenomena in the Torah	KATE ROSENBLATT • 53
Vaccinations: An Exploration of their History, Development and *Halachic* Ramifications	DEBRA ZHARNEST • 57
Bircas haChammah	ALYSSA SCHUCK, PH.D., DEPARTMENT OF BIOLOGY, SCW • 61
Biblical and Talmudic Microbes	HARVEY BABICH, PH.D. DEPARTMENT OF BIOLOGY, SCW • 64

INFERTILITY: A WEIGHTY MATTER

NINA J. ACKERMAN

The prevalence of infertility among couples in industrialized countries is between 10% and 20% and increasing [1]. Infertility is commonly defined as the inability of a couple to conceive after trying for one year or an inability to carry to term. Its prevalence is equal in males and females. Infertility is not a recent condition; but dates back to the times of the Bible and apparently was prevalent among women, especially in the Biblical matriarchs. The first couple experiencing infertility was Abraham and Sarah, followed by Rebecca and Isaac, and then Rachel and Jacob. A later couple, living in the time after the conquest of Israel, was Elkanah and Hannah. *Bereishis Rabbah* (45:4) explains that their infertility was "Because the Holy One, blessed be He, yearns for their prayers and supplications." The prayers of our patriarchs and matriarchs for offspring further developed their relationship with God, praying intensely that He grant them their request of progeny. However, as God works through nature, scholars try to discern physiological reasons for infertility in these Biblical women.

In the cases of Sarah and Abraham and of Rachel and Jacob, infertility was explicitly directed to the wife. In Genesis (16:2), Sarah explained to Abraham, "See, now, God has restrained me from bearing." With Rachel the verse states, "but Rachel remained barren" (Genesis, 29:31). Later, when Rachel finally conceived and bore a child, the Bible says, "And He opened her womb" (Gen. 30:23) implying that she was the cause for their infertility. With both matriarchs, the wives requested that their husbands have children for them through their maidservants. A 13th century Bible commentator and physician, Rabbi Levi ben Gershom, termed the *Ralbag*, associated these matriarchal infertilities with obesity. (Commentary on Gen. 16:1) The *Ralbag* stipulated that Sarah and Rachel were obese, which triggered an inability to conceive, possibly linked to their development of polycystic ovary syndrome, or PCOS. He supported this speculation by first stating that obesity is a known cause of infertility. He then added that both Sarah and Rachel had their maidservants replace them, to intentionally induce jealousy and depression, causing the matriarchs to lose weight and reverse their infertility[2]. They chose this means because this is the worst anguish that can be brought upon a wife in a polygamous marriage.

The disease pathology of polycystic ovary syndrome supports the *Ralbag's* stipulation. PCOS is an anovulation, or failure of the ovaries to release an oocyte, due to an excess of androgen hormone, which interferes with the ability of the ovary to release eggs during ovulation and thus leads to female infertility. As a result, fluid filled sacs and cysts appear on the ovaries. In normal ovulation, the ovarian follicles retain the egg until it matures and then releases it into the fallopian tubes. In a woman with PCOS, however, the egg matures in bunches of immature follicles that lump together, creating cysts, which prevent the release of the egg when maturation is complete. As a result, the female has menstrual irregularities, including loss of her period and irregular periods. If the egg is not released from the ovary, she may become infertile.

The *Ralbag* stipulated that Sarah and Rachel were obese, which triggered an inability to conceive, possibly linked to their development of polycystic ovary syndrome, or PCOS.

PCOS is seen frequently in obese women. Obesity, characterized by a body mass index, BMI, of 30 or above, results from the body storing more energy than it expends. A study done to test infertility in women with normal ovulation, found that severely obese women were 43% less likely to become pregnant [3]. When body mass increases, it cuts off the oxygen supply from the adipocytes, which are the cells that make up the tissue that store energy as fat. The lack of oxygen leads to the release of adipokines, cytokines released from the adipose tissue, each with respective effects on the

female reproductive system.

One type of adipikone that is released is leptin. Leptin, the body's anti-obesity hormone, inhibits feeding at the level of the hypothalamus by creating a feeling of satiation and by increasing energy expenditure. The levels of leptin are usually proportional to body fat. Regarding the female reproductive system, the level of leptin regulates menstruation. As a person achieves a certain body weight and the fat cells release more leptin, their rising levels aid in initiating puberty. Amenorrhea, or the loss of the period, is associated with decreases in body fat in individuals with eating disorders or who perform strenuous exercise, thereby secreting less leptin. Leptin also binds to receptors on ovarian follicular cells, causing an inhibitory effect on ovulation. Such binding reduces steroidogenesis, a process in which steroids, such as androgen and estrogen, are produced. In obesity, levels of leptin may be very high, leading to a major inhibition of steroidogenesis in the granulosa and theca cells, both very closely related to the reproductive system and to the developing gamete. This, in turn, can lead to poor fertility in obese women.

Adiponectin, resistin and ghrelin are three other adipose hormones that may play a role in reproduction. Ghrelin receptors and ligands were identified within the ovary, but no direct correlation to ovarian regulation has been found, as yet.

Another major side effect of obesity is its association to insulin resistance. Increased energy stores create increased levels of insulin. Such hyperinsulinemia stimulates the production of excess androgen, which may cause anovulation, similar to the pathology of PCOS. As a side note, because type 2 diabetes (insulin resistance) and PCOS have similar symptoms, they both can be treated using similar medications. In addition, sex hormone binding globulin production, SHBG, is inhibited in obese individuals, again leading to higher levels of androgen, causing anovulation.

Obesity is also linked to miscarriages. Having a BMI of over 30 can have negative effects both on the endometrium and the developing embryo. Assisted reproductive technologies are more challenging in obese women. Once pregnant, a woman's obesity can lead to many complications, including gestational diabetes, an increased risk of complicated operative delivery, birth defects, and intrauterine fetal death. Normal hormone levels and lower risk pregnancies can be achieved through weight loss. Most of the problems caused by obesity are reversible with weight loss and the accompanying reduction in BMI. The matriarchs, who may have been infertile due to PCOS, tried to motivate themselves to diet and lose weight, thereby to reverse their infertility. In both instances, this solution solved their problem [4].

With Sarah and Rachel it may seem clear that the couples' infertility was due to the wife's inability to conceive, with Rebecca and Isaac the situation it is not as clear. While scripture states that Rebecca was barren, it does not say that God closed her womb or, conversely, opened it when she became pregnant, as in the other cases. Additionally, both Isaac and Rebecca prayed for children, God preferentially positively responded only to Isaac, "God allowed Himself to be entreated by him (Isaac)" (Genesis 25:21). This response implies that, perhaps, Isaac was the cause for the couple's infertility. Another difference between Isaac and Rebecca and the others, was that while the other husbands successfully conceived with other wives, Isaac did not attempt to conceive with any other woman. Perhaps, one could assume that Isaac was sterile. The Talmud (*Yevamos* 64a) stated that Isaac was *akur,* or sterile, but later made note that both Isaac and Rebecca were sterile (*Yevamos* 64a).

In contrast to Sarah and Rachel's infertility which may have been caused by obesity, is the infertility of Hannah which may have been caused by another extreme. Hannah's story is related in the beginning of Samuel 1. She was one of Elkanah's two wives and was tormented, because of her infertility by Peninah, the other wife. According to Scripture, "Peninah had children, but Hannah had no children…for God had closed her womb" (Samuel 1 1:2-6), implying again that the infertility was due to the wife's inability to conceive. Peninah tormented Hannah leading her into a depression that caused her to stop eating, as it says, "Why do you cry and why do you not eat? Why is your heart broken?" (Samuel 1, 1:8). Drs. I. and M. Schiff [5] postulate that malnutrition was the possible cause for Hannah's infertility. Although not explaining her initial inability to conceive, Hannah's cessation of eating, which would fall under the current clinical description of anorexia, may have caused further damage and complications. This is substantiated a few verses later when Eli, the priest, said that God would grant Hannah her request for children. After hearing this, the verse says, "The woman went on her way and she ate" (Samuel 1, 1:18), and shortly thereafter she conceived, thereby linking the return to normal eating with conception.

While obesity can cause infertility, being extremely thin is not beneficial either. It is well known that anorexia and

severe malnutrition can cause cessation of the menstrual cycle. A study done tracking the menstrual cycles of athletes who were involved in strenuous exercise and activity shows many cases of amenorrhea. Intense training, 30-50 miles per week, building up over two months can lead to menstrual disturbances and abnormalities. This was mostly noted in ballet dancers and long distance runners. The study notes that menstruation may cease when there is a less than 12% body fat content [6]. Fat cells are responsible for estrogen production and without estrogen a woman cannot ovulate. A study on concentration camp inmates states similar results. According to a study done on Polish migrants, "almost all of the women in German concentration camps developed amenorrhea and following the war there was a significant reduction in their fertility" [7]. The severe weight loss in inmates, in women suffering anorexia nervosa, and in athletes causes them to lose their period, because of the inability to produce the hormones necessary to ovulate. If pregnant, there is an increased risk of miscarriage. Disturbed menstrual cycles of an anorexic woman or of a female athlete can also lead to PCOS. With a return to normal eating, however, these conditions can be reversed.

As mentioned, the prevalence of infertility is between 10-20% and is increasing. Perhaps, this is due, in part, to the increasing obesity in America today. While the matriarchs and patriarchs had to resort to various strategies to conceive, today there are more choices, such as *in vitro* fertilization and other infertility treatments. However, the best cure, when applicable, is to have a stable, healthy, and nutritious diet, coupled with an exercise regime.

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REFERENCES

[1] Stephenson, M.G. (1992). Infertility in industrialized countries: Prevalence and prevention. Soc. Prevent. Med., 37: 213-217.

[2] Levinger, U. (2008). Obesity-associated infertility- the earliest known description. Reprod. BioMed Online. 17:5-6

[3] Boyles, S. (2007), Obesity Linked to infertility in women. Retrieved January 7, 2009, from Webmd: www.webmd.com

[4] Metwally, M., Ledger, W.L., and Li, T.C. (2008). Reproductive endocrinology and clinical aspects of obesity in women. Ann. N.Y. Acad. Sci., 1127: 140-146.

[5] Schiff, I. and Schiff, M. (1998). The biblical diagnostician and the anorexic bride. Fertil. Steril., 69: 8-10.

[6] Menstrual disturbance in female athletes. (2007). Retrieved January 7, 2009, from Georgia Reproductive Specialists: www.ivf.com

[7] Lichtarowicz, A., and Lichtarowicz, E.M. (1992). History: The effect of severe social and physical stress on the menstrual history of Polish migrants. J.Obstet. Gynecol., 12: 211-213.

ARTIFICIAL RESUSCITATION AND MIDWIFERY: FROM TORAH TIMES TO TODAY

DANA ADLER

Midwifery is far from a modern practice. In fact, the earliest written source of midwifery is from the Torah. Two specific midwives, *Shifra and Puah,* are highlighted at the beginning of *Shemot*. These were the "Hebrew midwives" ordered by Pharaoh to kill all Jewish baby boys, but who instead listened to the word of G-d, as it says: "But the midwives feared G-d and they did not do what the king of Egypt decreed them, and kept the baby boys alive" (*Shemot* 1:17). For this they were rewarded. Although there may be uncertainty of their identity, our tradition holds that they were the mother and sister of *Moshe*, respectively. This raises an important question: if these two women were really *Yocheved* and *Miriam,* mother and sister of Moses, why were they referred to as "*Shifra* and *Puah*"? Commentators explain that their names were derived from specific words which indicated their specific roles as midwives: *Shifra* would beautify the newborn (in Hebrew *mishaperet*, meaning literally to "improve upon"), and *Puah* has the words "crying out" rooted in her name, because she would coo to the newborn and comfort it while crying (*Rashi*, Shemot 1:15).

The *Ba'al Haturim*, a commentary on the Torah, offers a different reason for why *Shifra* was named as such:

"שפופרת של קנה ומשימה תוך מפיו של הילד ומנפחת בו ומשיבה רוח לילד-וזהו שפרה לשון שפופרת"

"Sometimes the babies were born dead, and *Shifra* was named specifically that since her name reflects that she would take a pipe or a reed of some sort and blow into the child's mouth and resuscitate them (*Shefoferet*), and the child would live."

Nowadays we have ventilators and other major advances in neonatal and infant care. Yet early artificial respiration began with the "iron lung" invented by Dr. Egon Braun in Vienna in 1889 [1]. This involved encasing the infant within a wooden box, with the child kept in place by a plaster mold. The child's mouth was pressed against a rubber diaphragm opening to create a pressure seal. Then the operator of the iron lung would blow through the tube into the child's mouth, forcing chest compression, and the excess air would exit out of a second pipe at the bottom of the wooden box. About a hundred years prior to the iron lung, there were other methods used for inflating the lungs (artificial respiration), such as bellows. These allowed for air to be blown into the lung with one tube, and a second tube allowed for stale air to be removed. Unfortunately this was found to be an ineffective way to resuscitate, since over-inflation could cause pneumothorax (lung collapse) [2]. Therefore, the iron lung was the resuscitation method of choice. It seems that neonatal resuscitation still needed more effective devices and techniques, since face mask ventilation carried the risk of significant leakage around the face mask [3].

One need not look further than the Torah to see that efforts are taken to ensure that each and every child is brought into the world in the safest way possible.

Religious attitudes regarding artificial resuscitation and aids in general to assist the birthing mother varied greatly. In the early 19th century, the use of chloroform, an anesthetic used to ease the pains during childbirth, created outrage in the Christian church. It was seen as a blasphemous act against G-d, as Eve was cursed with painful childbirth, the punishment she and all subsequent women deserved [4]. The Jewish response was the exact opposite: Rabbi Obadiah Sforno interpreted the curse against Eve to mean that bringing up children would be more painful for mankind than for other creatures. But the prohibition of painkillers or any medications to ease the birth process would be antithetical to Jewish beliefs, as stated, "the ways of the Torah are pleasantness, and all her paths are peace" (Proverbs 3:17).

When it comes to easing the process of childbirth and caring for the needs of both mother and child, this is where midwives enter the picture. Their roles not only include comforting the mother in terms of respecting her religious beliefs and needs, but also in terms of providing medicinal

treatments to soothe the mother at the time of birth. For instance, she may lubricate the birth canal to allow for easier passage of the baby and for prevention of possible tearing of the mother and to prevent the umbilical cord from strangling the child [5]. Specifically in regard to Jewish women, since the husband is prohibited from physical contact with his wife once there is bleeding (in adherence with the laws of *niddah*, which is beyond the scope of this article); the midwife must be there for physical support while the woman is in labor. Traditionally, the midwife might have even stayed with the family to care for the mother immediately following the birth. In the early 18th century it was reported that there were special prayers composed for midwives to say for the successful delivery of the child and for the mother's safety. In terms of charging women for their services, midwives could choose whether to set wages at all, and if so, how much. However, community leaders did not want to deprive the poor of proper neonatal care, so there were times when the community would pay for midwifery service, since every new life was seen as sacred, requiring the same amount of care, financial status notwithstanding [6].

One need not look further than the Torah to see that efforts are taken to ensure that each and every child is brought into the world in the safest way possible. Use of artificial analgesics and respiration devices were encouraged in biblical times and are still encouraged within Judaism today. The story of *Shifra* and *Puah* is not the only story in *Tanakh* of artificial respiration. In Kings II, chapter 4, the prophet *Elisha* resuscitated a dead child by laying his body over the child, warming him, and blowing air into the boy's mouth. The child subsequently sneezed seven times and was revived. Ancient midwives continue to inspire midwives today, both in the Jewish world and the secular world. Midwives are trained medical professionals, and it continues to be a growing field worldwide, especially in the United States and in Israel. Many women opt for the personalized care that comes from midwives and the more traditional and "natural" methods of delivering a healthy baby.

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REFERENCES

[1] About the Exhibit Historical Collections and Services at the Claude Moore Health Sciences Library. http://historical.hsl.virginia.edu/ironlung/pg2.cfm/ (2005).

[2] Tobin, M.J. (2006). Principles and Practice of Modern Ventilation (16). McGraw-Hill Professional.

[3] O'Donnell, C.P.F., Davis, P.G., Lau, R., Dargaville, P.A., Doyle, L.W., and Morley, C.J. (2005). Neonatal resuscitation 2: an evaluation of manual ventilation devices and face masks. Arch. Dis. Child Fetal Neonatal. Ed. 90:F392-396.

[4] Wessel, H.(1988). Childbirth in the Bible. Koroth 9:270-280.

[5] *Rosh Hashanah* 2:5, *Shabbat* 18:3, B. *Shabbat* 128b.

[6] Midwifery Today-International Midwife. www.midwiferytoday.com/ (2001).

BRAIN PLASTICITY AND SPIRITUAL RENEWAL: AN EXPLORATION OF METAPHOR

DALIA BARENBOIM SHULMAN

The Mishnah in *Avot* 4:1 advises us that the wise one is "*halomed m'kol adam*," the one who learns from everybody. At a certain level, anyone and anything we encounter can be transformed into a teacher of the profoundest wisdom if only we keep our eyes and hearts open.

It is with this in mind that I am constantly thirsting to discover new metaphors in the natural world. There is nothing not made by G-d and thus unable to convey a spark of Divine wisdom.

Dr. Oliver Sacks, a British neurologist, tells what he calls the "paradoxical tale" of a colorblind painter. I read his tale with a sense of awe and fascination, grateful to derive a beautiful lesson from a medical case study. The story is told of a talented artist who was left with cerebral achromatopsia, otherwise known as color-blindness, after a car accident. He was not only blind to color, but also was unable to conjure color in his mind or dream in color. While he was initially devastated at the destruction of his colorful world, which infused his paintings with life and vitality, he eventually developed a unique and vibrant grey-scale form of art that depended on heightened texture and tonal contrast. Dr. Sacks and his colleagues aimed to explore the neurology underlying this transformation.

Translating an object in the outside world into a visual perception involves an extremely complex series of events. The optic nerves carry impulses relating to light from the eyes to the primary visual cortex of the cerebral cortex. Here, in a cell cluster known as V1, wavelength-sensitive cells use this input to extract data on basic vision, such as motion, form, and texture. This data is sent up to the secondary visual cortex, and more specifically, a cell cluster known as V4, or the "color center." Color-coding cells in this cluster correlate the input data with colors; a new level of perception is thus enabled. The data is then sent on its way to the hippocampus for memory storage, the limbic system and amygdale for association with emotion, and other parts of the cerebral cortex. The result is a perception that is an integration of form, motion, and color and is tied to memory and emotions.

Damage to the secondary visual cortex means that vision is essentially experienced as an output of the primary visual cortex. Wavelength data without integration of color has been described as unbearably ugly. This artist initially perceived objects as having "dirty" textures and harsh contrast. Writes Dr. Sacks: "For us, the output of V1 is unimaginable, because it is never experienced as such and is immediately shunted on to a higher level, where it is further processed to yield the perception of color. Thus the raw output of V1 never appears in awareness for us." In other words, we are, ironically, so "blinded" by color that we do not perceive deeper layers of tonality and texture. What is remarkable is that this painter came to embrace his new world of V1, seeing and producing paintings rich in a new depth of pattern. With the door of color closed, a "whole new world" opened to him. The cortex virtually rewired itself to create new memories and emotional associations with the new colorless world [1].

> Just as the brain learns to compensate for a loss in one area by heightened sensations in another, we can all learn that when one door closes, it is only so that another one will open.

The rewiring of the brain in response to damage in a specific area is the well-documented, albeit poorly understood, phenomenon of neuroplasticity. We've all heard that blind individuals somehow "compensate" for their lack of sight with intensified hearing and touch. After all, with the benefit of sight it is hard to imagine the fine tactile distinctions necessary to read Braille, yet the brains of blind individuals are somehow rewired to make this possible. This has been confirmed by studies indicating increased blood flow in the visual cortex of blind people

while reading Braille. To fully appreciate how phenomenal this is, it has to be understood that the visual and tactile regions of the cerebral cortex are entirely distinct. Their respective outputs are independently sent to levels higher in the cerebral cortex, where they will later merge to provide an integrated perception of the outside world. Greater blood flow to the visual cortex while feeling Braille is clear indication that new relationships were somehow forged between the visual and tactile centers [2]. Studies have also shown a similar phenomenon with the auditory center. In one study, an array of small speakers was assembled in a room. Both blind and blindfolded, sighted individuals were asked to point to the sources of various sounds. The blind individuals fared better, and it was suggested that brain plasticity accounted for reorganization of the visual cortex into a center that processes auditory messages [3].

Just as the brain learns to compensate for a loss in one area by heightened sensations in another, we can all learn that when one door closes, it is only so that another one will open. Loss of ability in one sense opens us to tap in to new potential that may have otherwise forever lain dormant.

If we think about what infuses our daily life with spirituality and a chance to connect with G-d, we probably will think of prayer. As Jews, as human beings, we melt ourselves into the prayerful experience. The synagogue is the center of the Jewish community, and we assemble regularly to pray together. There is a daily structure that we are all accustomed to and must arrange our schedules to accommodate. It is thus incredible to think that prayer did not always occupy such a central place in Jewish life; for much time it was peripheral, overshadowed by a different experience: the world of *korbanot*, sacrifices.

When *Avot* 1:2 teaches that the "world stands on three things: Torah, *avodah* –worship-, and acts of kindness," *Rashi* and *Rambam* identify *avodah* as referring to the worship of sacrifices. *Rabbeinu Yonah* writes that in our time, since the Temple was destroyed and we can no longer worship G-d through the means of sacrifices, our *avodah* is our prayer. We see how prayer replaced sacrifices from the Talmud in *Brachot* 26b, which asks: How do we know that we may pray *shacharit*, the morning prayer, until *chatzot,* midday? The Talmud answers that in the Temple, the *Beit HaMikdash,* the *shacharit* offering could be brought until *chatzot*. We may pray *minchah*, the afternoon prayer, until evening because the *minchah* offering could be brought until evening. The Talmud continues, explaining the time frame of each of our daily and festival prayers as derived from the corresponding sacrificial offerings. From here we learn the famous principal explained by *Rambam*, that the set prayers were established by the sages to correspond to the biblically ordained order of the sacrifices [4]. Our prayers are all we have left. Indeed, the Talmud in *Taanit* 2a identifies the phrase "*avodah* of the heart" in the Torah as referring to prayer. If we still had the Temple, our primary *avodah* would still be through sacrifices, and prayer, the more hidden avenue of worship, would never have been fully explored and given the full expression we experience today. It is as if we have experienced a national spiritual plasticity, a rewiring of our worshipping machinery, to uncover a bottomless wellspring of prayer.

Rabbi Abraham Isaac Hakohen Kook wrote that the destruction of the *Beit HaMikdash* changed our nation in another way. Israel of the first Temple era was a national people. As in *korbanot,* the "radiance" and communal spiritual experience of the nation shadowed the private spiritual experience. Rav Kook notices that the Bible rarely alludes to an afterlife, while the Mishnah, which was compiled post-Biblically, exhibits a virtual explosion of explicit references. (A good example is *Avot* 4:21: "This world is like a passageway to the next world.") The afterlife, being an article of our faith [5] was certainly not invented in the time of the Mishnah, rather it was given new emphasis. Rav Kook suggests that the "roots of individual religious consciousness" were born following the destruction of the Temple and its concomitant sense of national glory. The focus was shifted from national attainment to individual fulfillment, and thus the individual became concerned with his own soul's journey [6]. This internal shift is also evidenced by the transition from the Temple-era experience of prophecy to the post-Biblical situation of having Torah study dominated by Oral Law; G-d's will is no longer received externally by a prophet, but must be revealed internally through personal intellectual study of Torah. The Talmud in *Bava Batra* 12a states: *chacham adif m'navi*, the scholar is better than the prophet. Were we still in a state of prophecy, the development of the Oral Law would never have been possible [7].

I am awed by the depths of personal spirituality that our historical shifts have granted us, and how we see this lesson taught by the very cells of the human body. May G-d grant us the wisdom to uncover hidden potential in any situation that life may bring us.

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REFERENCES

[1] Sacks, O. (1995). An Anthropologist on Mars: Seven Paradoxical Tales. Vintage Books, New York.
[2] Pons, T. (1996). Novel sensations in the congenitally blind. Nature 6574:479-480.
[3] Seppa, N. (1998). Do blind people track sounds better? Science News. 154:18.
[4] Maimonides, *Mishneh Torah, Hilchot Tefillah* 1:5.
[5] Maimonides, *Mishneh Torah, Hilchot Teshuvah*.
[6] Naor, B. (2003). When G-d becomes history: historical essays of Rabbi Avraham Isaac Hakohen Kook Orot, Spring Valley, New York.
[7] Kagan, J. (1998). The Jewish Self. Feldheim, Nanuet, NY.

EXERCISE

KATIE BECKER

It's no secret that American society is turning rapidly obese. While the Bible commands (Leviticus 20:23) the Jewish nation to separate from the gentiles, Jewish society seems to be following, if not taking the lead, with respect to the overweight dilemma [1]. While today's fad diets stress the importance of nutrition, biomedical science seems to be expanding equally as much on the importance of exercise in weight management [2]. The Center for Disease Control and Prevention recommends that individuals involve themselves in moderate aerobic activity, such as brisk walking for at least 30 minutes, 5 or more days a week as well as muscle strengthening activities twice a week [3]. Yet in a study of the Jewish population in the Chicago area, where over 50% of the community's Jews had a body mass index (BMI) placing them as overweight or obese, a mere 43% of adults engaged in moderate physical exercises and an even more pitiful 22% engaged in vigorous activities, such as jogging or running [1]. The statistics were not much better among children: only half spent the recommended one hour of their day engaged in active play. Unfortunately, these statistics are not surprising to many people. Instead they serve as a source of validity for the critique that due to the immense focus on *Torah* learning among Orthodox Jews, "physical education is put on a back burner" [4], so much so that the Orthodox Jewish lifestyle is one which has negative effects on one's health. [5-6]. But is exercise really a proven aid in weight maintenance? If so, does the 'Torah lifestyle' really disagree with modern biomedical science?

In a ten-year observational study on obesity in the general population, "girls who were inactive during adolescence gained an average of 10 to 15 pounds more than active girls" [2]. Likewise, in the Chicago Jewish population over half of the population, both children and adults, were reported as overweight or obese, and less than 35% of the obese and overweight population attempted to adjust their body weight by increasing their exercise. Eva Obarzanek, a research nutritionist claimed that just 2.5 or more brisk walks per week, a modest level of activity, is enough to potentially prevent weight gain, and should be encouraged in all school and public health settings [2]. According to Obarzanek, along with countless others, with regard to weight control, exercise should be a central focus.

Surprisingly, although it appears that the Orthodox population may be disregarding Obarzanek's advice, as exercise among Orthodox Jews appears to be at a low, one would have a very hard time finding support for this sedentary lifestyle. For the most part, activity has been encouraged in both Jewish tradition and its secular counterpart. Not only were "isometric and isotonic forms of exercise commonly encountered in agricultural and military contexts in Biblical times," but according to the Talmud *Berachot,* an average man was said to be able to walk 10 *parasangs* (forty mil) in a day (*Pesach* 93b; *Yerushalmi Berachot* 1:1) [7].

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Exercise, as described by *Rambam* and secular physicians, is a rapid or powerful motion which alters respiration [7]. Exercise causes an increase in blood pressure, heart rate and cardiac output, and therefore blood flow to the heart, the muscles, and the skin increase. The body requires more energy and the body's metabolism becomes more active to supply the body with its needs [8]. Consistent exercise is important because "as the body adjusts to regular exercise, cardiac output and lung capacity increase," making the body more efficient both during exercise and at rest.

One of the most supported sources for exercise in the Torah world is the Biblical verse to "be very careful to guard your soul," (*Deuteronomy 4:15*) which the rabbis explained to mean that one must preserve his health [9]. According to *Rambam*: "maintaining a healthy body is among the ways of serving G-d, since it is impossible for one who is not healthy to understand or know anything of the Creator [10]."

This verse however can be open to many interpretations. There are many ways to guard one's health and it does not seem from a simple reading to promote exercise over pure nutritional means.

To highlight the importance of exercise as part of the commandment of guarding one's soul, the *Rambam* stresses that "as long as a person exercises and exerts himself… sickness does not befall him and his strength increases…. But one who is idle and does not exercise…even if he eats healthy foods and maintains healthy habits, all his days will be of ailment and his strength will diminish" (*Rambam, Hilchot Deot* 4:15).

The 'science world' too claims the importance of exercise with nutrition. Recent studies have shown that adding exercise to a balanced diet was found to cause physiological changes in the hormone leptin, a satiety hormone. When the physiological hunger needs are fulfilled, leptin sends a signal to the brain that food is no longer required, therefore suppressing the feeling of hunger. Leptin works on a feedback mechanism. If a person gains body weight and therefore increases body fat, this increases leptin production to cause a decrease in food consumption and an increase in fat loss. Unfortunately for those trying to loose weight, accompanied with a loss of body fat is a decrease in leptin production, causing an increase in appetite and food consumption, resulting in fat gain. This feedback mechanism causes the body to resist weight loss. Solely making adjustments to one's diet will therefore cause what most people experience as a viscous cycle of weight loss and gain. If, however, one increases physical activity, there will be "reduced plasma leptin concentrations in humans beyond the reduction expected as a result of changes in fat mass" [11], allowing the body to need less leptin, in general, and therefore making a lasting weight loss physiologically easier.

The *Rambam* seemed to be stressing the importance of exercise on a deeper level. Not only was he saying that exercise may work together with nutrition, but he claims that "nothing is to be found that can be a substitute in any way," because exercise "expels the harm done by most of the bad regimens that most men follow [7]." In accordance with the *Rambam,* scientists recently have proposed that exercise can counteract the decrease in basal metabolic rate (BMR) that some of the fad diets can cause. The BMR is the minimum calorie requirement needed to sustain an individual under resting conditions, or the minimum amount of calories the body uses at rest. Some diets can cause the body's BMR to decrease, thereby slowing down the rate at which the body burns calories. While the effects of exercise on BMR are inconclusive, there is more evidence which shows that exercising causes resting metabolic rate, which is the amount of calories one burns immediately after or hours after exercising, to increase. This serves to counteract the decrease in BMR that dieting could cause [12].

Although exercise seems vital from both a secular and Torah perspective, the question still remains as to how one may find a balance between proper exercising, while at the same time being careful not to cause *bittul Torah*. In a Talmudic passage, while giving instructions on the proper way to preserve one's health and consequently one's learning aptitude, Rabbi Yochanan said: "Spend one-third of your time in sitting, one-third in standing, and one third in walking" (*Ketubot* 111a). This passage, written over a thousand years ago, seems to perfectly summarize many scientific discoveries. The Talmud added a new dimension—not only is taking care of one's health with physical exercise not *bittul Torah*, but it is a way in which an individual can enhance his Torah learning through protecting his health [7, 13]. While many Orthodox Jews may not live an active lifestyle, overall it seems vastly inaccurate to conclude that the Torah promotes a sedentary life, as this type of behavior is one which is debased by both the Torah and science.

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REFERENCES

[1] Benjamins, M., Rhodes, D., Carp, J., and Whitman, S. (2006). A Local Community Health Survey: Findings From A Population-Based Survey Of The Largest Jewish Community In Chicago. J. Comm. Health: 31:479-495.

[2] Kimm, S., Glynn, N., Obarzanek, E., Kriska, A., Daniels, S., Barton, B., and Liu, K. (2005). Relation between the changes in physical activity and body-mass index during adolescence: a multicentre longitudinal study. Lancet: 366:301-307.

[3] Centers for Disease Control and Prevention. Physical Activity for Everyone. http://www.cdc.gov/physicalactivity/everyone/guidelines/index.html (retrieved January 18th 2009).

[4] DuBow, J. (2001). A Weighty Matter. The Jewish Week. May 18.

[5] Wael ,T., Chin, D., Silverberg, A., Lashiker, L., Khateeb, N., and Anhalt, H. (2001).Reduced Spinal Bone Mineral Density in Adolescents of an Ultra-Orthodox Jewish Community in Brooklyn. Pediatrics:107:79-89.

[6] Werner, P., Olchovsky, D. Shemi, G., and Vered, I.(2003). Osteoporosis Health-related behaviors in secular and orthodox Israeli Jewish women. Maturitas. 46: 283-294.

[7] Rosner, F., Weg I., Exercise in Judaism. Bull. NY Acad. Med.: 65:848-852.

[8] Suleman, A., Kamran, R. and Heffner, K. (2008). Exercise Physiology. EMedicine. September 10.

[9] Botwinik, J. (2008). Frum and Fit: Are We Fulfilling Our Torah Obligation to Take Care of Our Body? Jewish Action: 68: 12-18.

[10] Ullman, Y. (2003). Exercise. Ohr Somayach. http://ohr.edu/yhiy/article.php/1028 (retrieved January 2009)

[11] Reseland, J., Anderssen, S., Solvoll, K., Hjermann, I., Urdal, P., Holme, I. and Drevon, C. (2001). Effect of long-term changes in diet and exercise on plasma leptin Concentrations. Amer. J. Clin. Nutr.: 73:240-245.

[12] Mole, P. Impact of Energy Intake and Exercise on Resting Metabolic Rate. Sports-Med. 10:2:72-87.

[13] Gemara Online. *Ketubot* 111a. http://www.edaf.com (retrieved January 11th 2009).

BIBLICAL LEPROSY: A CONFUSION FOR CENTURIES

ALIZA BERK RETTER

"What has been is what will be, and what has been done is what will be done, there is nothing new under the sun" (Ecclesiastes1:9). King Solomon stated that there are no new things in this world; people only have yet to discover them. One can look to the Bible for many examples of this idea. In the Bible, the disease of *tzaraat* is discussed at length. However, for centuries historians have inaccurately defined *tzaraat*.

Tzaraat was first translated as *lepra* in the third century B.C.E. when the Hebrew Bible was translated into the Greek Septuagint. Later, the Greek text was translated to Latin, and then to English. In the process, the word *lepra* was translated to "leprosy." Lepra is the Greek generic term for skin disease and is derived from two Greek words, *lopos* (the epidermis) and *lepo* (to scale) [1,2]. However, the English definition of *lepra*, leprosy, is a specific term that describes the skin disease of leprosy, or Hansen's disease. In 1874, a Norwegian physician, G. Armauer Hansen, identified the causative agent of leprosy as the bacterium, *Mycobacterium leprae*. The disease was named Hansen's Disease in the physician's honor [3].

Although leprosy is best known for producing lesions on the skin, it can also cause lesions in the peripheral nerves, eyes, nose, mouth, and in the organs of the reticuloebdothelial system, which includes the lymph nodes, spleen, liver, and bone marrow. There are two forms of leprosy in humans, tuberculoid leprosy and lepromatous leprosy. Tuberculoid leprosy is primarily a disease of the peripheral nerves. Symptoms of this form of leprosy include enlarged peripheral nerves and anesthetic skin lesions in areas where the lesions exist. Lepromatous leprosy is a disease with symptoms including skin lesions and disfiguring nodules, nerve damage, and lesions of the mucous membranes of the nose, leading to cartilage destruction and nasal deformities. If the eyes are infected by the bacterium, blindness could develop. The bacteria destroy skin tissue, resulting in the progressive loss of toes, fingers, and facial features [4]. It is commonly understood that leprosy is transmitted by close encounters with an infected individual. Additionally, the likelihood of the disease's transmission depends on its strength [5].

However, the contemporary disease of leprosy is not *tzaraat*, or the "Biblical leprosy." Firstly, *tzaraat* was a spiritually inflicted disease, whereas modern day leprosy is caused by bacteria. The Talmud states that *tzaraat* is a divine punishment for slander. The *metzora* (the leper), was isolated and was ordered to live outside the camp. In addition, according to Rabbi Yehoshua ben Levi [6], "four are counted as dead: A poor man, a leper, a blind person, and a person who is childless." A leper is isolated and is compelled to live alone with nothing, as if dead [6, 7]. Furthermore, not everyone who displayed the symptoms of *tzaraat*, to be listed below, was diagnosed as an actual *metzora*, one who was genuinely inflicted with the disease. Additionally, one who produced simple signs of the modern day leprosy was considered a leper.

> At the time of the Bible, the *metzorah* was usually in contact with direct sunlight and this, along with *teshuvah*, repentance, would likely heal the individual.

In Biblical times, one who showed signs of *tzaraat* went to a *cohen* for an examination. "When a man shall have in the skin of his flesh a rising, called a *se`eith, sappachath* (a scab), or *bahereth* (a bright spot) on the skin of his flesh, and it forms a lesion of *tzaraat* on the skin of his flesh, he shall be brought to Aaron the *cohen*, or to one of his sons, the *cohanim*" (Leviticus 13:2). The *cohen*, an expert in skin diseases, would determine whether the lesion(s) were, in fact, *tzaraat*. The individual had to have both the morphological features of *tzaraat* and the secondary changes of *tzaraat*. If he had both of these he was declared "unclean" and sent out of the camp of Israel. Yet, if he only had features

of *tzaraat* and not the secondary characteristics, he was only temporarily isolated, and re-examined by the *cohen* once a week for a two week period. If he did not show the secondary characteristics after this two week period, he was declared clean, even though he had a lesion with the same features of *tzaraat*. However, if after this period his body displayed the secondary symptoms, he was declared to be a *metzora*, and was sent out of the camp until his lesions were healed. When the *tzaraat* disappeared, the *metzorah* underwent a purification process that included offering sacrifices and a ritual immersion.

Tzaraat is almost exclusively mentioned in Leviticus. Leviticus 13 illustrates the primary and secondary characteristics that must be present to identify *tzaraat*. *Tzaraat* that afflicts the skin appears in one of four instances: lesions on normal skin, lesions on abnormal skin, lesions in areas of disperse baldness, and localized baldness. Each manifestation of *tzaraat* is evaluated differently with its own primary and secondary characteristics.

The lesion on an individual with healthy skin, is evaluated differently from a lesion found on abnormal skin. *Tzaraat* found on healthy skin is in the form of a depigmented or hypopigmented patch. The patch is usually white which makes it easier to identify on darker skin. Also, the lesion appears depressed as compared to adjacent skin. "If the hair in the lesion has turned white and the appearance of the lesion is deeper than the skin of his flesh, it is a lesion of *tzaraat*" (Leviticus 13:3). In addition, there are three secondary characteristics. These are the presence of at least two white hairs growing in the lesion, a healthy looking spot within the lesion, and an increase in the size of the lesion since the time of the previous examination. As the Bible illustrates, "however, if the lesion spreads on the skin after it has been shown to the *cohen* for its purification, it shall be shown to the *cohen* a second time. The *cohen* shall look. And behold! The lesion has spread on the skin. The *cohen* shall pronounce him unclean. It is *tzaraat*" (Leviticus 13:7-8). At least one of these secondary characteristics must be present in order for the *cohen* to declare *tzaraat* (Leviticus 13:1-23).

Tzaraat found on abnormal skin, which is defined as skin that is burned, injured, or has severe dermatitis, usually has a ruddy white depigmented or hypopigmented patch. "If flesh has a fire burn on its skin, and on the healed area of the burn, there is a reddish white lesion, the *cohen* shall look at it. And behold! The hair has turned white in the lesion, and its appearance is deeper than the skin, it is *tzaraat* which has spread in the burn" (Leviticus 13:24-25). Additionally, in this form of *tzaraat*, there are only two possible secondary changes, white hairs and an increase in the size of the lesion.

Leprosy, unlike *tzaraat*, does not appear on the scalp. Moreover, leprosy is diagnosed by the absence or presence of anesthesia. Anesthesia is not mentioned in Leviticus. Many historians note that *tzaraat* is neither related to modern leprosy nor to the leprosy that was present in the Middle Ages [3,8].

Many physicians and researchers have come close to finding skin diseases that are similar to the descriptions of *tzaraat*. Psoriasis is one example. Leviticus 13:2 mentions a form of *tzaraat* as *sappachath*, a scab. Psoriasis is a non-contagious irritation of the skin which results in dry scaly skin. Thus the non-contagious desquamating crusted skin is common to both *tzaraat* and psoriasis. Also, psoriasis can be treated with UV sun ray exposure. At the time of the Bible, the *metzorah* was usually in contact with direct sunlight and this, along with *teshuvah*, repentance, would likely heal the individual [9,10].

The disease of vitiligo is also somewhat similar to *tzaraat*. Vitiligo is a condition in which a loss of pigmented cells results in white patches in the midst of normally pigmented skin. This is similar to a *baheret*, a white patch of skin mentioned in the Bible. However, vitiligo is smooth and lacks the secondary characteristics that are required to identify *tzaraat* [11]. In addition, it seems that the Bible describes certain white patches as "clean" and not as the infected state of an individual. As the Bible states, "and if the *tzaraat* has spread over the skin, whereby the *tzaraat* covers all the skin of the person with the lesion… then the *cohen* should look at it. And behold! The *tzaraat* has covered all his flesh, he shall pronounce the person with the lesion clean" (Leviticus 13:12-13).

Tzaraat not only infects the body but appears on the walls of the *metzora's* house as well. The Bible states, "And the Lord spoke to Moses and to Aaron saying, When you come to the land of Canaan, which I am giving you as a possession, and I place a lesion of *tzaraat* upon a house in the land of your possession" (Leviticus 14:33-34). Some incorrectly assert that *tzaraat* in this instance is mold because buildings contaminated with mold can cause a rash or skin irritation like that of *tzaraat*. For example mold infections can be responsible for "sick house syndrome". This is clearly incorrect because *tzaraat* that appears on the walls is not contagious. Additionally, this mold is classified in the genus, *Stachybotrys,* a greenish-black colored mold, whereas the *tzaraat* that forms on the wall is white [12].

Despite the persistence of equating leprosy, or Hansen's

disease, to *tzaraat*, there is little evidence to prove this [8]. *Tzaraat* is a divine infliction with no secular counterpart. It can only be diagnosed by a *cohen* and can only be healed by one's repentance and faith in G-d.

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REFERENCES

[1] Glickman, F. (1986). Commentary: Lepra, psora, psoriasis. J. Am. Acad. Dermatol. 14:863-866.
[2] Davies, M.L., Davies, T.A.L.(1989). Biblical leprosy: A comedy of errors. J. Roy. Soc. Med. 82: 622-623.
[3] Baillie, R.A., Baillie, E.E. (1982). Biblical leprosy as compared to present-day leprosy. South. Med. J. 75:855-857.
[4] Eichman, P. (1999). The history, biology and medical aspects of leprosy. Amer. Biol. Teach. 61:490-495.
[5] Wikipedia (retrieved in 2009). http://en.wikipedia.org/wiki/Leprosy
[6] Finkel, A.Y. (1995). In My Flesh I See God: A Treasury of Rabbinic Insights about the Human Anatomy. Jason Aronson Inc, Northvale, NJ.
[7] Gwilt, J.R. (1984). Biblical ills and remedies. J. Roy. Soc. Med. 79: 738-741.
[8] Beitman, G.M. (1991). Sara`at, "Leprosy" (Leviticus 13)- A review of the literature. Koroth. 9: 818-825.
[9] Goldman, L., Moraiter, R.S., Kitzmiller, K.W. (1966). White spots in Biblical times. Arch Derm. 93:744-753.
[10] Bennahum, D.A. (1985). Psoriasis, leprsoy, and the Dead Sea Valley. Koroth. 9:86-89.
[11] Verbov, J.L. (1982) Skin disease in the Old Testamnet, Practitioner. 216:229-236.
[12] Heller, R.M., Heller, T. W., Sasson, J.M. (2003). Mold- "*Tzaraat*", Leviticus and the history of confusion. Perspect. Biol. Med.. 46: 589-591.

MODERN GENETICS IN THE BIBLE AND TALMUD

SARA BERMISH

It is assumed that the principles governing the transmission of traits from one generation to the next are modern discoveries with no connection to Biblical and Talmudic times. However, upon closer examination, one realizes that this statement is a misconception. Issues of genetic diseases and laws of heredity are found throughout the Bible and Talmud. For example, the Talmud (*Chullin* 69a) recognizes that a father or mother does not transmit corresponding limbs in the child, for if so, a blind father would produce blind children [1]. Modern genetic diseases are also mentioned in the Bible including gigantism, dwarfism, and polydactyly.

One genetic disease that is much discussed throughout the Talmud is hemophilia. In *Yevamot* (64b), the Talmudic sages state that if a woman has a son and she "circumcises her first child and he dies, and a second one also dies [similarly], she must not circumcise her third child." The sages realize that hemophilia is maternally transmitted, but differ on the number of repetitive events required to establish a pattern for maternal transmission of hemophilia. Rabbi Judah believes that the third child should not be circumcised, while Rabbi Simeon believes one should wait until the fourth child [1]. The maternal aspect for transmission of hemophilia is clearly stated by *Rambam* (*Mishneh Torah, Sefer Ahavah*, 1, 18): "If a woman had her first son circumcised and he died as a result of the circumcision which, enfeebled his strength and she similarly had her second son circumcised and he died as a result of the circumcision – whether the second child was from her *first* husband or from her *second* husband – the third son may not be circumcised." Rabbi Joseph Karo (under his pen-name, *Keseph Mishneh*), comments on *Rambam's* statement, adding that, "there are families in which the blood is weak" [literally, loose]. He further states that if the sister of the woman also had a child who died after circumcision, then her subsequent children should not be circumcised [2]. These sages understand that there is a maternal genetic factor in the transmission of hemophilia.

Another genetic disease the Talmud mentions is epilepsy. Epilepsy is a genetically transmitted disease, with the defect mapped to chromosome 21. The Talmud (*Yavamot* 64a) notes, one should not take a wife from an epileptic family since this disease has a genetic factor in its transmission [3]. Dwarfism is also discussed in the Talmud. In *Bechorot* 45b, it states that a male dwarf should not marry a female dwarf, lest their offspring be a dwarf of the smallest size [1]. The sages comprehend that these diseases have a genetic component that can be passed to the next generation.

Topics of modern genetics can also be found in the Bible. In Genesis (chapter 30) Jacob utilizes the laws of heredity when dealing with the spotted and white sheep of Lavan he tends to in order to marry Rachel. Through Divine intervention, he is shown how to distinguish between homozygous spotted and heterozygous spotted sheep and therefore knows which lines to mate for the generation of white sheep. When Jacob tends Lavan's spotted sheep, he is able to apply his knowledge and promulgate the mating appropriate for producing white progeny [4].

...gigantism, a genetic disease, is found in Numbers, Deuteronomy, and Samuel I. When Moses sent spies to explore the land of Israel, they encountered giants (Numbers 13:33).

Some more common human conditions are mentioned in the Bible multiple times. For example, gigantism, a genetic disease, is found in Numbers, Deuteronomy, and Samuel I. When Moses sent spies to explore the land of Israel, they encountered giants (Numbers 13:33). In Deuteronomy, the Bible mentions giants again with Og, who was the only remaining giant after the Flood and ruled in his kingdom, Bashan (Deuteronomy 3:11); and later the Bible talks about the Philistine Goliath, who was a giant (I Samuel 17:4 [1]. Another genetic disease mentioned multiple times in the

Bible is polydactyly. Polydactyly is referred to in Samuel I repeatedly when discussing Og's three gigantic brothers. The gigantic brothers had 6 digits on each hand and on each foot (II Samuel 21:20) [5]. The issue of polydactyly was discussed further in the Talmud (*Bechorot* 45b), with Rabbi Tarfon considering this abnormality to be advantageous and Rabbi Jose considering it to be disgusting.

There is much evidence of modern genetics throughout the Bible and Talmud. The Talmudic sages of historic times comprehend the ideas of heredity and the genetic transmission of some diseases, notably hemophilia. Jacob uses the laws of heredity, specifically the monohybrid cross, to his benefit to obtain white progeny from spotted sheep. Throughout the Talmud mention is made of various genetic diseases and/or abnormalities. These connections between Torah and modern genetics enhance the links between Torah and *Mada*.

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REFERENCES

[1] Rosner, F. (2000). Encyclopedia of Medicine in the Bible and the Talmud. Jason Aronson Inc., Northvale, NJ.
[2] Rosner, F. (1969). Hemophilia in the Talmud and rabbinic writings. Ann. Intern. Med. 4:833-835.
[3] Preuss, J. (1993). Biblical and Talmudic Medicine, Rosner, F. (Ed.). Jason Aronson Inc., Northvale, NJ.
[4] Feliks, Y. (1981). Nature and Man in the Bible. Soncino Press, NY, NY.
[5] Nicolai, J.A. and Schoch, S.L., (1986). Polydactyly in the Bible. J. Hand Surg. 2:293.

ONIONS

ROBIN BURGER

While onions appear to have little or no nutritional value, both ancient Talmudic writings as well as modern scientific research prove that this vegetable has numerous physiological benefits and can be used in the treatment of various ailments.

Onions are indeed an age-old food. Images of the layered root vegetable are illustrated n ancient Egyptian drawings, and references to the onion appear in the documents of the Ur civilization. Onions have been utilized throughout history by a vast array of civilizations across the globe [1].

According to the Babylonian Talmud, onions are beneficial to the heart. The Talmud writes that one may vow that he will not eat onions "because they are injurious to the heart." Then he is told that this is not an accurate assumption, since "the wild onion is good for the heart." He is therefore "permitted to partake of wild onions, and not only of the wild onions, but of all onions." Indeed, "such a case happened before R. Meir, and he gave absolution in respect of all onions" (*Nedarim* 66a).

Thousands of years following the compilation of the Talmud, science has reached similar conclusions regarding onions. Nutritional research has recently released findings to corroborate the statements made in the Talmud. For example, onions are beneficial to the heart. Onions are also sources of dietary flavanoids which have been proven to reduce the risk of heart disease and, in addition, they decrease the risk of blood clots. Onions further reduce the risk of heart disease by increasing the HDL, high-density lipoproteins or "good" cholesterol in the bloodstream; while decreasing LDL, low-density lipoproteins or the "bad" cholesterol [2]. Furthermore, onions lower the risk of a heart attack or stroke. This has been confirmed by a recent study done in the University of Wisconsin. Based on an animal model involving eleven dogs with malfunctioning coronary arteries, medical researchers demonstrated that onions inhibited platelet aggregation, a major factor contributing to atherosclerosis (the build-up of plaque on arterial walls) which often leads to heart disease [3].

The consumption of onions is also correlated with preventing atherosclerosis by lowering blood pressure. In another experiment, rats that were fed onions, showed significantly lower blood pressure than rats not fed onions. In addition, scientists have recently discovered that onions suppress the production of angiotensin II, a chemical that constricts arteries, and increase the availability of nitrous oxide, a chemical that dilates arteries, to the heart. The combined effect of reducing platelet-derived atherosclerosis and decreasing blood pressure leads to the onion's beneficial effects on the heart [4].

The Talmud further elucidates the benefits of onions with regard to the treatment of wounds. It states: "To treat a wound, one applies *moch*, translated as cotton or lint, and sponge, as well as garlic and onion peels, which are secured with a thread" (*Tosefta Shabbat* 5:3-4). Not surprisingly, a recent clinical study suggests similar conclusions regarding the ability of a gel derived from onion extract to reduce the appearance of post-operative scars. The scars in the control group appeared to be redder, bumpier, and significantly more marked than the scars of those subjects who applied the onion extract. [5].

The Talmud further elucidates the benefits of onions with regard to the treatment of wounds.

Although the Sages of the Talmud and modern scientists enumerate the many beneficial effects of onions on the human body, there are several instances where both sources assert that onions can be harmful and should therefore be avoided under some conditions. For example, the Babylonian Talmud (*Avodah Zara* 29a) states that eating onions after bloodletting may be hazardous. Another source in *Taanit* (25a) records the story of a man who ate an onion after bloodletting and fainted.

Why should this be? According to some scientists, due to their anti-platelet effect, onions are not a wise food choice after one has lost excessive amounts of blood. Blood

loss can lead to a decrease in blood volume, which in turn may decrease blood pressure. When blood pressure drops, the body reacts by increasing platelet aggregation to prevent further blood loss. However, since onions inhibit platelet aggregation, blood does not clot, which leads to loss of blood volume, and ultimately to the decrease in blood pressure [6]. Onions, can therefore be quite unsafe for someone who has lost a significant amount of blood.

Another Talmudic source (*Nedarim* 26b, 66a) further states that that one should be careful with onions, as they can be injurious to the stomach. It is wise for one to avoid eating onions when suffering from stomach pains. This is corroborated by recent research showing that although onions do not induce acid reflux (heart burn), their ingestion does exacerbate already existing reflux symptoms. Patients suffering from acid reflux who ate onions on a regular basis suffered from more severe symptoms compared to those who did not eat onions. Once again, science agrees with what the Sages of the Talmud advised long ago: if one is experiencing stomach pains due to acid reflux it is wise to avoid onions [7].

It certainly seems as though the many benefits ascribed to onions thousands of years ago by the Sages in the Talmud have recently been rediscovered by modern science. While Science and Torah corroborate on the health gains of onions, the Talmud mentions one advantage that is not mentioned in contemporary scientific research. The Talmud states that the consumption of onions may be helpful in inducing menstruation: "The consumption of garlic or onions or the chewing of peppers can bring forth bleeding in some women" (*Niddah* 63b). Though this has yet to be proven scientifically, the Physicians Desk Reference notes that many women throughout the 20th and into the 21st centuries ate onions in order to bring about the onset of menstruation [8].

Onions play an important role in our life and are beneficial for the heart, healing of wounds, and perhaps even the induction of menstruation. More than that, current research elucidates the biological processes and chemistry behind why onions have so many health benefits. Onions are just one of many natural beneficial substances which science has come to confirm what our ancestors knew many centuries ago.

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REFERENCES

[1] Vannithone, S. (2006), The Oxford Companion to Food. Eds. T. Jaine and A. Davidson. New York: Oxford UP, Incorporated.

[2] "Health Benefits of Onions and Garlic." Disabled World - Health and Disability Community News. 20 Jan. 2009 <http://www.disabled-world.com/artman/publish/onions-garlic.shtml>.

[3] Briggs, W.H., Folts, J.D., Osman, H.E., and Goldman, I.L..(2001). Administration of raw onion inhibits platelet-mediated thrombosis in dogs. J. Nutr. 131:2619-622.

[4] Yamamoto, Y., Aoyama, S., Hamaguchi, N., and Rhi. G.-S. (2005).Antioxidative and antihypertensive effects of Welsh onion on rats fed with a high-fat high-sucrose diet. Biosci. Biotechnol. Biochem. 69: 1311-1317.

[5] Draelos, Z. D. (2008). The ability of onion extract gel to improve the cosmetic appearance of postsurgical scars. J. Cosmet. Dermatol. 7:101-104.

[6] Osmont, K.S., Arnt, C.R., and Goldman, I.L..(2003). Temporal aspects of onion-induced antiplatelet activity. Plant Foods Hum. Nutr. 58:27-40.

[7] Allen, M.L., Mellow, M.H., Robinson, M.G., and Orr, W.C. (1990).The effect of raw onions on acid reflux and reflux symptoms. Am. J. Gastroenterol. 85::377-80.

[8] Physician's Desk Reference (2004). PDR, NY, NY.

[9] Preuss, J. (1995). Biblical and Talmudic Medicine. Ed. F. Rosner, Jason Aronson, Inc., Northvale, NJ.

TALMUDIC MEDICINE FROM HEAD TO TOE

JENNIFER DELUTY

In the high-tech and fast paced 21st century, medical breakthrough and scientific development constitute an exciting, invigorating and hopeful part of daily existence. Yet, studying ancient practice and technique serve as an impetus to ask if modern man truly deserves all the credit for the latest scientific advancement. The ancient oral tradition of the Talmud serves as the most central and intricate guiding force of the *halachic* (orthodox Jewish law), social, political, and dietary realms of daily Jewish life. It therefore should not be surprising that included among the many tractates are medicinal cures, remedies and general scientific theory. The extent of knowledge and scientific investigation of the scholars is astounding. Treatments of both mouth and foot diseases as recorded in the Talmud may help to shed light on the fascinating topic of the Sages' knowledge of modern medicine.

It should be noted that among the many scientific facts recorded in the Talmud, some have been proven contrary to modern scientific thought. Although beyond the scope of this article, there are two major approaches to dealing with this issue. One camp maintains that the Talmud contains absolute scientific truth, which has been seemingly contradicted but will in the future be re-proven correct. Yet, another camp reconciles these contradictions by suggesting that some biological and sociological phenomena in prior generations now have been altered and are not reflective of current scientific reality. Thus, what was true in the *Ta'anitic* era may not necessarily be factual today.

The Talmud (*Avodah Zara* 28a) records that the Sabbath may only be violated for an "internal affliction." It then proceeds to define 'internal' as "anything from the lips inward." Rabbi Eliezer inquires regarding the exact category in which an ailment of the gums and teeth would be included. Are the gums hard and thus external or are they soft and internally located in the mouth? In an attempt to answer this question, a story is told about Rabbi Yochanon who had *tzafdina* disease, which Rashi explains as a sickness of the teeth. If necessary, he was willing to have treatment on the Sabbath, thus proving that this disease is indeed internal. Yet, in typical Talmudic fashion, this proof is thrown out when Rabbi Nachman explains that *tzafdina* is a disease in its own category because although it starts in the mouth, it "ends in the inner body," and therefore this malady cannot be used to make a general statement about teeth and gum disease. The Talmud then elucidates this pathology and notes that its symptoms include blood coming from between the teeth. The causative agents of *tzafdina* include eating cold wheat, hot barley, or fish left overnight. Interestingly, the two final cures recorded to sooth the malady are related to olives; either one must ingest a mixture with olive oil or must obtain unripe olive seeds, burn them, and place the olive ashes on one's teeth.

The symptoms, treatments and causes of both celiac disease and scurvy may underlie the Talmud's initially strange approach to the documentation of *tzafandia.*

This Talmudic passage raises may questions regarding medical treatment of *tzafdina* tooth/gum disease. It is imperative to understand scientifically the nature of the disease. Skepticism emerges with regard to its stated causes of wheat, barley and fish consumption. Also, an explanation is needed to understand this mouth ailment as affecting the inner body as well. Finally, it must be questioned whether science upholds some type of cure related to olives?

Engaging in today's modern research in mouth infection and tooth disease, celiac disease and scurvy are two major disorders which seem to explicate the Talmud's recording of cause, nature and cure of disease. Celiac (or, coeliac) disease is an autoimmune disorder of the small intestine, affecting more than 2 million people across the United States. Symptoms widely vary and include mouth sores, chronic diarrhea, fatigue and anemia in all genetically predisposed segments of the population. In general, the disorder is caused

by a reaction to gliadin, a gluten protein found in wheat and other related grains. When the body recognizes this protein, it is modified by the enzyme tissue transglutaminase, which causes a major inflammatory reaction in bowel tissue and flattens the lining of the inner intestine, a condition known as villous atrophy. This leads to further inability to absorb nutrients properly. Scurvy, a condition caused by the deficiency of ascorbic acid (vitamin C), leads to a spongy gums and bleeding from all mucous membranes as a result of the breakdown of collagen, involved in connective tissue. Symptoms include dark purple spots on skin, sunken eyes, tooth loss and bleeding gums [1].

Rabbi Nachman Bar Yitchak's statement that "*Tzafdina* is different because it starts in the mouth and ends in the intestines" is remarkably proven as recent research has found that gliadin, the part of gluten that causes the most trouble for those with celiac disease, binds to the CXCR3 receptor in the intestine. This results in the release of zonulin, a human protein that lowers the intestinal barrier to make it more permeable. While this effect is temporary in most people, the barrier stays down for long periods of time in people with celiac disease, causing disruption in the body's system [5]. This permeability of the intestines allows the antigen to easily enter and begin the harmful immune response. Dr. Jabri, a physician and researcher at the University of Chicago Pritzker School of Medicine, similarly explains the underlying immunological mechanisms of celiac disease with a theory that lymphocytes may be involved in killing enterocytes, intestinal absorptive cells. Working *ex vivo*, with cells from active celiac disease patients, the group found that interleukin-15 (IL-15) over expression helps convert antigen-specific cytotoxic T lymphocytes (CTLs) into rogue lymphokine-activated killers (LAKs) via the CTL receptor NKG2D. The LAK cells provoke a more general immune response that destroys the intestinal lining and results in poor nutrient absorption, the root cause of the disease's myriad internal complications [2].

Likewise, if the disease recorded in the Talmud is more similar to scurvy, internal consequences are huge because ascorbic acid (vitamin C) is a cofactor for the enzyme protocollagen proline hydroxylase. If ascorbic acid is not present, there is under-hydroxylation of protocollagen and defective assembly of mature collagen triple helices. The defective collagen leads to impaired synthesis of basal lamina, media, and adventitia of blood vessels, resulting in a hemorrhagic diathesis and poor wound healing. Vitamin C is also involved in the metabolism of tyrosine and the synthesis of catecholamines. In addition to its antioxidant properties, vitamin C aids iron absorption from the small intestine and is required for the disulfide bonding of hair [3]. New research even points to scurvy's vascular legion's connection to heart complication. Research at Northwestern University has confirmed cardiac enlargement, ECG changes (reversible ST-segment and T-wave changes), hemopericardium, and sudden death as prominent physical symptoms of scurvy [4].

The proposed causes of *tzafdina* by wheat and barley seem to point directly to the gluten reaction from wheat and barley. Again, the protein in gluten, which celiac immune systems recognize as foreign, causes immune responses including mouth sores. The mechanism of formation is not fully known but can be attributed to an immune response. It is also known that strains of the bacteria, *Mycobacterium tuberculosis* and *Treponema pallidum*, can cause these sores which certainly may explain the Talmud's concern about eating fish which has stayed out all night [5]. Additionally, because vitamin C deficiency is essential to a working immune system, scurvy may cause a patient to be extremely susceptible to bacterial infection. Decreased levels of immunoglobulin A (IgA), IgM, and the C3 complement, which are three key members of the immune system, have been proven to be directly linked to decreased levels of vitamin C in the blood. [6]

Finally, recent research has shown that olive oil contains cyclooxygenase (COX), a chemical found in ibuprofen which serves as an anti-inflammatory agent. Like ibuprofen, oleocanthal (a tyrosol ester organic compound extracted from olive oil) inhibits activity of COX-1 and COX-2 enzymes. Because inhibition of COX activity is the known cause of the anti-inflammatory actions of ibuprofen and other non-steroidal anti-inflammatory drugs (NSAIDs), these new findings suggest that oleocanthal is a natural anti-inflammatory agent [7]. This property makes oleocanthal of great importance to offsetting the many inflammations caused by immune reactions. Inflammations of the small intestine are the cause of villous atrophy. Sores caused by the disease are also a form of inflammation: inflammations of the mucous membrane. Thus, the symptoms, treatments and causes of both celiac disease and scurvy may underlie the Talmud's initially strange approach to the documentation of *tzafandia*.

A Mishnah in tractate *Shabbat* (6:6) discusses the medical parameters of what one is permitted to do on the Sabbath and concludes that one can "go out with a silver coin on the bottom of the foot." The Talmud (*Shabbat* 65a) explains that this refers to a wound cured with the silver coin. The first proposal that the coin functions to cure by merely applying pressure on a wound is rejected because if

that were the case, "a shard of pottery (or anything)" could have been used. The Talmud, assuming the healing quality comes from the silver itself, then inquires why it must be a coin and not simply a sheet of silver. If the embossed nature of the coin is what is beneficial, then it seems an embossed piece of wood could have also been use. The Sages therefore conclude that there is something inherent in all three parameters - the metal silver, the embossed coin, and the pressure – of the silver coin that make it effective. The Talmud's questioning may be better understood in the context of the research of silver's major antiseptic qualities. Interestingly, in today's age, as science is encountering an increase in antibiotic resistant bacteria, research points to revert back to the ancient practice of using silver to kill bacteria on open wounds.

In a recent article, Jørgensen conducted a study to investigate the effect of an ibuprofen-releasing foam (Biatain-Ibu, Coloplast A/S) combined with an ionized silver-releasing wound contact layer (Physiotulle Ag, Coloplast A/S) on painful, infected venous leg ulcers. He observed 24 patients with painful, exuding, locally infected, and stalled venous leg ulcers. The study monitored persistent pain and pain at dressing using an 11-point numerical box scale (NBS). The study produced conclusive results that persistent wound pain decreased from a mean of 6.3 +/- 2.2 to 3.0 +/- 1.7 after 12 hours and remained low thereafter. Additionally, pain at dressing change also decreased and remained low. After 31 days, the relative wound area had reduced by 42%, with an associated decrease in fibrin and an increase in granulation tissue [8]. This experiment proves that silver can help to act as a healing agent on wounds.

Although there is no way to prove the Sages knowledge of today's medical knowledge, the details, scientific investigations, and observations recorded with regard to oral and foot diseases certainly point to worldly and astute medical information. It is only through delving into the fascinating world of scientific discovery of medicinal symptoms and cures, that the brilliance and accuracy of the Talmud can be recognized and appreciated.

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REFERENCES

[1] Encyclopedia. *Scurvy* http://en.wikipedia.org/wiki/Scurvy (retrieved October 4, 2008).

[2] Meresse, B. *et al.*(2004).Coordinated induction by IL15 of a TCR- independent NKG2D signaling pathway converts CTL into lymphokine-activated killer cells in celiac disease. Immun. J. 21:357–366.

[3] Frey, J.L., and Shehan, J.M. (2008). Unknown: lower extremity papules associated with easy bruising. Dermatol. Online J. 14:19 <http://dermatology.cdlib.org/146/unknown/cutaneous/shehan2.html> (retrieved October 5, 2008).

[4] Laumann, A. (2006).*Scurvy.*http://www.emedicine.com/derm/TOPIC521.HTM (retrieved October 4).

[5] Porter, S.R. *et al.*(2005) Review article: oral ulcers and its relevance to systemic disorders. Aliment Pharmacol.Ther. J. 21: 295–306. <http://faculty.ksu.edu.sa/Asmaa%20Faden/341%20MDS/Porter%20oral%20ulcer.pdf>.

[6] Vitiman C and the immune system <profiles.nlm.nih.gov/MM/B/B/R/N/_/mmbbrn.pdf>

[7] Monell Chemical Senses Center. Olive Oil Contains Natural Anti-inflammatory Agent. Science Daily 6 September 2005. <http://www.sciencedaily.com /releases/2005/09/050906075427.htm>.(retrieved October 4 , 2008).

[8] Jørgensen, B. et al. (2008). Combined use of an ibuprofen-releasing foam dressing and silver dressing on infected leg ulcers. J. Wound Care, 5: 210-4.

HE'S GOT YOUR BACK

ILANA FRANKIEL

Chiropractic medicine has been used by healers and doctors to cure and relax the body for thousands of years. The movement of bones within the spine has been proven to promote mobility and nerve communication throughout the body. Hippocrates, an ancient Greek physician, once advised, "get knowledge of the spine, for this is the requisite for many diseases." The concept of focusing on the spine and the movement of vertebrae is actually hinted to in the Torah as a method of curing and rejuvenating the human body.

"The Lord will guide you continually, He will satisfy yourselves in dry places, He will ***yachaletz*** your bones so that you will be like a watered garden and like a source of water whose waters never fail" (Isaiah 58:11).

The word *yachaletz* comes from the root *chalatz,* a word with multiple meanings. The definitions of this verb based on the various contexts are:

1. To draw off or withdraw as in Deuteronomy 25:9, *chalatza naalo* (to take off a shoe). This is the source for the word *chaleetza*, when a childless widow is released from the obligation to marry her deceased husband's brother. This example expands the definition to be releasing something which is restricted.

2. To strengthen and equip for war, as in Numbers 31:3, *hechletzu meetchem anashim latzavah*, let men be taken from among you for an army.

These two definitions are connected in a different form of the word, *chalutz,* which is a group of people detached from the main group of the army, the vanguard or the front line. The Talmud explains the word *chalatz* as "those who are pulled off from the house to war" (*Yevamot* 102b), further combining the definitions of the term *chalatz.*

The *pasuk* in Isaiah mentioned above uses the root *chalatz* in a different form and has questionable meaning. Many commentators, including *Rashi*, believe the word here means "to strengthen." This leads the *pasuk* to mean, "in hard times, *Hashem* will strengthen our bones and rejuvenate our bodies." Another explanation follows the theme of the *pasuk* and defines the word as "to moisten," changing the definition to, "in dry places, *Hashem* will moisten our bodies." *Ibn Ezra* provides a third explanation, saying that *chalatz* means protection, so in this context *Hashem* is protecting our bones from breaking. However, none of these explanations connects the word "***yachaletz"*** to its root *chalatz* . Looking at the word in connection to releasing or strengthening for war, the word ***"yachaletz"*** means to separate the bones in order to relax and strengthen. *Hashem,* in this *pasuk,* is promising to detach and pull at the bones in order to rejuvenate and restore the body. This explanation of the mysterious wording in Isaiah, using the word "***yachaletz***," connects *Hashem's* intention to heal the human body with a chiropractic-like procedure.

> ...the mysterious wording in Isaiah, using the word *"yachaletz,"* connects *Hashem's* intention to heal the human body with a chiropractic-like procedure.

The request for healing and rejuvenation appears in Jewish prayers with this root *chalatz*. In *kedush hachodesh* there is an appeal for *"chaim shel chelutz atzemot,"* a life of relaxed and strengthened bones. Additionally in the *birchat hamazon* for *shabbos* there is a request for *"retze vehachletzenu,"* a request from *Hashem* to loosen and relax us. Both prayers ask *Hashem* to loosen our bones and restore our bodies. The root *chalatz* connects the foundation of chiropractic medicine to the powers of G-d [1].

The goal of chiropractic medicine is to locate and correct subluxations, lesions in joints that alter the joints' alignments and physiological functions. Adjustment techniques correct the alignment of the spinal vertebrae or joints, allowing proper space for the nerve flow and preventing interferences in the brain's messages to the body. Spinal manipulations

are passive, manual maneuvers which thrusts the three joint complex past its normal range of movement, increasing the joint's range of motion [2]. The joint between two lumbar vertebrae and the top and bottom facet joint of each vertebrae are actually pushed and realigned to restore the correct position. This restoration of the structure allows nerve impulses to properly reach and possibly heal the affected areas. Spinal manipulations and mobilizations can benefit patients with neck pain, back pain, and headaches [3] and help to prevent surgery. The success of spinal manipulation to relieve pain and restore functional ability is connected to an alteration in processing of somatic senses within the brain and execution of motor acts in response [4]. These connections between the brain and the spinal cord with the organs and muscles of the body ensure proper function and healing within the human body.

Hashem's complete control of our health is a clear manifestation of His presence in our lives. Isaiah's use of the word *chalatz* reflects the connection between *Hashem*, bone movement, and the restoration of the human body. We must continue to ask *Hashem* to ***yachaletz***, restore, rejuvenate and relax our bodies both spiritually and physically.

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REFERENCES

[1] Tawil, H., and Tawil, A. (2000). Was chiropractic known in Biblical times? Nahalah, Yeshiva University J. Study Bible. 2: 1-13.

[2] Winkler. K., Hegetschweiler-Goertz, C., Jackson, P.S. *et al.* (2003). Spinal manipulation policy statement. American Chiropractic Association.

[3] Hurwitz, E., Aker, P., Adams, A., Meeker, W., and Shekelle, P. (1996). Manipulation and mobilization of the cervical spine. A systematic review of the literature. Spine 21: 1746-1759.

[4] Haavik-Taylor, H. and Murphy, B. (2007). Cervical spine manipulation alters sensorimotor integration: a somatosensory evoked potential study. Clin. Neurophysiol. 118:391-402.

ESTHER FREDERICK

"לפיכך כל אחד ואחד חייב לומר, בשבילי נברא העולם..."
(מסכת סנהדרין פרק ד, משנה ה)

"Therefore everyone is obligated to say, for me the world was created..." (*Meseches Sanhedrin*, Chapter 4: *Mishnah* 5).

(ליקוטי מוהר"ן ה') "כי צריך כל אדם לומר: כל העולם לא נברא אלא בשבילי, נמצא, כשהעולם נברא בשבילי, צריך אני לראות, ולעיין בכל עת בתיקון העולם, ולמלאות חסרון העולם."

"Because every man is obligated to say the whole world was created for me, and because it was created for me, I need to constantly be looking for ways to fix the world and to fill what is lacking from the world" (*Likutei Mahran* 5).

In 2009, the world is facing an ecological crisis. The precarious state of earth's environment is now recognized as an undisputed fact. It is clear that human actions affect the climate change; what remains controversial is how soon, and to what extent, the impact of the actions will be felt. In the 1980's, theologians blamed Judeo-Christian religions for the crisis, claiming man exploits nature because the Bible allows man to exploit the earth. On the contrary, the mandates of Jewish tradition obligate man to care for and improve the world.

In the beginning of the Bible, man is commanded to "be fruitful and multiply and replenish the earth and subdue it; and rule over the fish of the sea and over the fowl of the air and over every creeping thing that creeps on the earth" (Genesis 1:28). Theologians have argued that the term "subdue" gives man the right to exploit the earth. In reality, as Philip N. Kranz so aptly states, "'Ruling' implies responsibility not domination" [1]. The command to subdue the earth obligates man to subjugate nature and "develop the world beyond the natural state he found it in" [2]. Not only is man not allowed to exploit the earth, but he is further commanded to improve upon it. Rabbi Norman Lamm points out that "subdue" cannot possibly mean exploit, or use without limits since immediately after the command to subdue, the Bible restricts man's food sources to grown foods only. Even when the restriction is lifted after the Flood, the dietary kashrut rules place restrictions on man's appetite for meat [3]. Further evidence of the nurturing and symbiotic relationship man is intended to have with the earth is presented in the following chapter of Genesis. It is written, "And the Lord God took the man [Adam] and placed him into the Garden of Eden, to work it and to protect it" (Genesis 2:15). Dr. Hershey Friedman and Dr. Yehuda Klein explain this passage to mean that "humankind has been bestowed with an obligation to settle the world and to protect it from any harm" [4].

The Jewish obligation to protect the world can be further seen in the principle of *Bal Taschit*, literally translated as "do not destroy."

Judaism has numerous rituals to remind man of his commitment to preserve the world. One such ritual is the Sabbath, a day during which "man must cease his creative interference in the natural order, "the [Jewish Law's] definition of *melakhah* or work" [3]. Part of man's moral obligation of Sabbath is an assessment of how he has utilized his creativity to add to the world in the past week [3]. The Sabbatical and Jubilee years (Leviticus 25:1-7) are an extension of the weekly Sabbath to the land. In every 7th and 50th year, it is forbidden to do any work on one's land, and the earth is given a chance to rejuvenate its natural resources. According to Friedman and Klein, "the purpose of the sabbatical year may have been to protect the land from depletion" [4].

The Jewish obligation to protect the world can be further seen in the principle of *Bal Taschit*, literally translated as "do not destroy." *Bal Taschit* is learned from the Biblical passage, "When you besiege a city a long time, to make war against it in order to capture it, you shall not destroy its trees by swinging an axe against them; for you may eat from them, and you shall not cut them down. For is the

tree of the field a man, that it should be besieged by you?" (Deuteronomy 20: 19-20). Though the prohibition specifies acts of damage during wartime, the prohibition extends to peacetime as well. The Bible mentions the prohibition in the context of a time when damage is most expected. Rabbi Lamm points out that the laws to protect nature apply only when an object has value; they are not because Jews worship nature. It is permissible to cut down fruit trees if one needs heat and has no other way of obtaining it since the trees' greatest value at that moment lies in their ability to provide heat. Using natural resources for personal benefit is permissible; the principle of *Bal Taschit* only prohibits gluttonous exploitation [3].

The laws of *Bal Taschit* are clearly extendable to caring for our ecological environment. Rabbi Eli Turkel states, "Conservation of energy is certainly included under the mitzvah of *Bal Taschit*. Therefore, every person is commanded to do whatever he can to reduce [the] waste of resources. This includes not using electricity unnecessarily, not wasting fuels of any kind, recycling materials, etc" [2]. Rabbi Turkel adds that indirect damage is not included in the prohibition. However, according to the spirit of the law, one should avoid actions that cause indirect damage as well. Therefore, using an aerosol that may indirectly affect the ozone layer should be avoided [2]. Friedman and Klein emphasize man's obligation to care for the earth with the popular Talmudic quote (Babylonian Talmud, *Bava Kama* 92b),"'Into the well from which you have drunk, do not throw any stones" [4]. As inhabitants of Earth, mankind depends on its resources and should not be treating the planet with disregard [4].

Unfortunately, man seems to be taking his responsibility casually. Global warming is indeed occurring as a direct result of humankind's actions. In 2007, the Intergovernmental Panel on Climate Change stated, "Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures…" [5]. Scientific data shows an increase in the average temperature of the world during the 20th century. The oldest data can be retrieved from natural resources such as tree rings and corals. Data dating back to the mid 1700s can be obtained from ship records, and in the mid 19th century, instruments began to be used for recording global temperatures. In the past 100 years, the world has shown a trend toward a warmer climate [6]. The freezing New York winters may make global warming seem like a myth, but in fact, the more extreme weather conditions may be a sign of global warming. Global warming is also measured by precipitation levels. As the world gets warmer, total precipitation tends to stay constant but begins to fall in more concentrated amounts, so that there are greater periods of time between precipitations, leading to floods, dry spells, and severe winters [7].

Global warming is caused by the addition of carbon dioxide and other pollutants to the atmosphere. The earth's temperature exists as a balance between the heat obtained from the sun and heat lost back into space. There are specific atmospheric gases that trap the radiation emitted from the sun. Increases in the levels of these atmospheric gases raise the temperature of the earth. The gases essential to maintaining the equilibrium of earth's temperature are known as greenhouse gases. Greenhouse gases can be found naturally like carbon dioxide, methane, and nitrous oxide, or created synthetically like sulfur hexafluoride, a chemical used in the electrical industry and CFC's, which are used as refrigerants. The industrial revolution has increased the atmospheric presence of naturally occurring gases. Factories emit carbon dioxide and other wastes, thereby increasing the levels of greenhouse gases in the atmosphere. Additionally, deforestation increases the level of atmospheric greenhouse gases. Industrially, trees are used in the manufacturing process and felled when land is cleared to create room for more factories. Trees convert carbon dioxide to oxygen during the photosynthetic cycle. Destroying trees eliminates nature's ability to maintain the balance of gases [6]. The increase in pollutant emissions and the decrease in nature's capability to balance the gases, create higher levels of greenhouse gases and a hotter Earth.

Although a sudden apocalypse due to global warming is not expected tomorrow, negative consequences are already apparent. Ecosystems are dangerously affected by small changes in temperature. As the ecosystem changes, its carrying capacity, or ability to support the resident species, is decreased. The North Atlantic ecosystems have been affected, and aquatic populations such as the Atlantic Cod, which are already diminished by exploitation, may be further reduced. If marine resources become scarce, there can be severe social and economic consequences [8]. Climate changes have been linked to the extinction of species, an increase in fire frequency and pest outbreaks, especially in boreal forests. The ice in the Arctic Ocean is disappearing, posing problems for polar bears. As global warming increases, crop yields and water resources dangerously decrease. An increase of only two degrees Celsius in the mean global temperature is dangerous, especially for developing countries [9]. These countries cannot absorb the scarcity of resources caused by higher temperatures that more advanced countries can compensate for.

The current goal in the campaign against global warming is to slow the increase of global warming and

prevent further rise of mean global temperature. There is an interest in developing cheaper ways to harness energy from natural sources such as the sun and wind. These forms of energy would reduce the need for fossil fuels, which are significant contributors of greenhouse gases. Additionally, advances in technology for the reuptake of excess carbon dioxide are being explored [10]. On an individual level, one can attempt to use less fossil fuels in his or her daily life and to recycle. By recycling paper, less trees will need to be cut down, allowing for greater uptake of carbon dioxide. Similarly, light bulbs and appliances can be replaced with energy efficient ones. Also, conserving water, which uses a lot of energy in the purification and distribution process, and insulating one's home, which lowers the amount of energy needed for heat, saves both money and the environment. Maintaining one's car, inflating one's tires, carpooling and walking can also help reach the goal of decreasing greenhouse gas emissions [11].

As Rabbi Norman Lamm aptly states, our current ecological condition serves testimony to the fact that, "man is clever enough to conquer nature - and stupid enough to wreck it, and thereby destroy himself" [3]. According to scientific data, global warming began in the 20th century and is suspected to be a byproduct of the industrial revolution. Jews are biblically mandated to care about the environment, especially in its current condition. From a scientific perspective, it is also clear that one must care about global warming. Though the world will not disintegrate tomorrow due to global warming, it can have an immediate economic impact on society by diminishing the availability of resources on the planet. Science has shown that the earth's temperature can be stabilized if we reduce our production of pollutants. With awareness of how our actions affect the environment, we can hopefully change our behavior and return Earth to being a thriving planet.

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REFERENCES

[1] Kranz, P. N. (1998). Judaism and the environment. Journal of the Medical Association of Georgia, 88, 45-47.

[2] Turkel, E. (1991). Judaism and the environment. The Journal of Halacha and Contemporary Society, 22, 44-61.

[3] Lamm, N. (1986), Ecology in Jewish law and theology., chapter VI, pp. 162-185 *In Faith and Doubt: Studies in Traditional Jewish Thought*, 2nd edition., Ktav Publishing House, Inc., NY, NY.

[4] Friedman, HH and Klein, YL (2007). Respect for God's world: The biblical and rabbinic foundations of environmentalism, Jlaw.com, http://academic.brooklyn.cuny.edu/economic/friedman/jbereadings.htm. *(Books and Publications: Other Article)*.

[5] Bernstein, L., Bosch, P., Canziani, O., Chen, Z., Christ, R., Davidson, O., et al. (2007). *Climate change 2007: Synthesis report. An Assessment of the Intergovernmental Panel on Climate Change* (No. 4) Allali, A.; Bojariu, R.; Diaz, S.; Elgizouli, I.; Griggs, D.; et al. (Eds.). http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf (retrieved February 18, 2009).

[6] Maslin, M. (2004). *Global Warming* A Very Short Introduction. Oxford University Press. NY, NY.

[7] Baldwin, P. (2009). What happened to global warming? Mother Earth News, (231), 23-23.

[8] Beaugrand, , Edwards, , Brander, , Luczak, , & Ibanez, . (2008). Causes and projections of abrupt climate-driven ecosystem shifts in the north atlantic. Ecol. Lett. 11:1157-1168.

[9] Hare, B. (2006). Relationships between increases in global mean temperature and impacts on ecosystems, food production, water and socio-economic systems. pp. 177-187, In Avoiding Dangerous Climate Change, Schellnhuber, H.J., Cramer, W., Nakicenovic, N., Wigley, T., and G. Yohe (Eds.), Cambridge University Press, NY, NY

[10] Metz, B., & van Vuuren, D. (2006). How, and at What Costs, can Low- Level Stabilization be Achieved? - An Overview, pp. 337-347, In Avoiding Dangerous Climate Change, Schellnhuber, H.J., Cramer, W., Nakicenovic, N., Wigley, T., and G. Yohe (Eds.), Cambridge University Press, NY, NY

[11] US Environmental Protection Agency. (2009). Basic Information about Climate Change. Retrieved Feb 09, 2009, http://www.epa.gov/climatechange/basicinfo.html

TEETH: TAKING A BITE OF *TANACH*, TALMUD, AND *HALACHA*

JUDY GROSSMAN

In recent years there have been many scientific breakthroughs in the field of dentistry. Braces have become a right of passage for teenagers and it is almost impossible to pick from the variety of toothpastes and mouthwashes that flood the pharmacy shelves. Although it is easy to think of dentistry and oral health as modern practices, they stem back to ancient times and are discussed throughout the *Tanach,* Talmud and *halachic* literature.

The Torah places tremendous importance on healthy and beautiful teeth. The word *shen,* tooth, appears 42 times in *Tanach*. The first time is when *Yaakov* blesses his son *Yehuda*, "…his teeth shall be whiter than milk" (*Bereishis* 49:12) [1]. Later, *Shlomo Hamelech* describes someone praising his lover by saying, "teeth like a flock of ewes from washing, bearing twins, and not one is lost" (*Shir Hashirim* 4:2). In addition, in *Mishlei* (10:26), *Shlomo Hamelech* compares a poor messenger to unhealthy practices towards teeth and says that the messenger is considered "vinegar to the teeth and smoke to the eyes" [2].

Even during the time of the Talmud the topic of false teeth was relevant [3]. In *Nedarim* (66b), it states that Rabbi Ishmael beautified the daughters of Israel by replacing their ordinary false teeth with gold ones. "And Rabbi Ishmael made a tooth in the same place as the false one to make them more beautiful." The concept of an artificial tooth is also discussed in the *Mishnah Shabbos* (6:5), when discussing whether a Jewish woman can carry a false tooth in a public domain on *Shabbos*. The concern is that the woman may take the tooth out and then transgress the prohibition of carrying. Also discussed in the Talmud is the importance of having a healthy mouth and beautiful teeth. In *Ketubot* (72b, 77a) it notes that a *kohen*, priest, can not perform holy rituals if he has bad breath, since it is considered a disability. In fact, bad breath and oral health are so important that they are considered justifiable grounds for divorce for both men and women [4].

Teeth are also important in matters of Jewish monetary laws. The Torah discusses in *Shemos* (21:24), "an eye for an eye a tooth for a tooth," when describing punishments and how they should fit the crime. This is meant to teach that one needs to pay someone whom he injures. The Torah emphasizes the eyes and teeth because both are integral parts of a person. Another place teeth are seen in monetary law is regarding a Jewish master who knocks out the tooth of his servant. Teeth are considered so valuable that the master is then required to give the servant his freedom. The law is further discussed in *Tosefta Babba Kamma* (9:27) where it states that even if the servant's tooth was already loose, yet still functional, the servant would still be granted freedom if the tooth is knocked out. In *Baba Kamma* (26b) it states that even a master who was drilling his servant's tooth and accidentally caused it to fall out, must grant the servant freedom [1]. Although the dental drill was invented by in 1790 by John Greenwood, George Washington's dentist, it was a modified version of the spinning wheel which has been used by dentists to drill teeth since the times of the Talmud [5].

The word *shen*, tooth, appears 42 times in *Tanach.*

Many modern *halachic* questions concern dentistry. The question of whether a gold cap on a tooth or a filling is considered a *chatzitza*, something which blocks the body from total immersion during a ritual bath, is discussed in modern *halachic* literature. According to Torah law, a *chatzitza* would invalidate an immersion if it is a substance that covers the majority of the body or if people generally do not want it affixed to their bodies. Although one does not need to open her mouth during a ritual bathing, there is still a prohibition against having a *chatzitza* in the mouth. The general position taken by the *poskim* is that fillings and gold caps are considered extensions of the body because they are permanent and serve the body. Therefore, they are not considered problems for *halacha* [6].

The importance of teeth and oral hygiene is seen throughout Torah and *halacha*. Although many advances have been made in modern dentistry, its roots stem back to the times of the Talmud.

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REFERENCES

[1] Nakash, A. (2003). Biblical bites. Jewish Press, May 30th , p 42.
[2] Kuster, C. and Harn, S. (1991). The mention of teeth in the Bible. Bull Hist Dent, 39:17-19.
[3] Stern, N. (1997). Esthetic and prosthetic dentistry as reflected in the Old Testament and other ancient Scriptures. J. Esth. Dent. 9:27-29.
[4] Shifman A., Orenbuch S., and Rosenberg M. (2002). Bad breathe - a major disability according to the Talmud, Isr. Med Assoc J. 4: 843-845.
[5] Stern N., and Sreter R. (1996). Prosthodontics- from craft to science. J. Hist Dent. 44:73-76.
[6] Meorot Hadaf Hayomi.(2005), Traveling with dental fillings, vol 333.

JAUNDICE IN THE TORAH AND THE TALMUD

SARAH ARIELLA HOLLANDER

In modern medicine, jaundice is defined as a symptom of a disease rather than the disease itself. The main sign of jaundice is the yellowing of the skin and the sclerae, caused by high levels of bilirubin in the blood. Bilirubin is the chemical that is produced when red blood cells are destroyed and is eventually removed from the blood's circulation by the liver. Jaundice can be caused by several conditions: from the overproduction of bilirubin which the liver can't destroy, from a defect in the function of the liver preventing it from removing bilirubin from the blood, or from a blockage of the hepatic ducts thereby decreasing the flow of bilirubin from the liver to the small intestines [1].

In Hebrew, jaundice is referred to as either the modern term *tzaheveth*, derived from the word *zahav*, gold, or the Biblical term *yerakon*, derived from the word *yarok* or green. The word *yerakon* is found six times within *Tanach*, (*Devarim* 28:22, *Melachim* I 8:37, *Yirmiyahu* 30:6, *Amos* 4:9, *Chagai* 2:17 and *Divrei Hayamim* 6:28), generally in conjunction with the word *shidaphon*. *Rashi* and several other commentators define *yerakon* as an agricultural condition in which the surface of the grain becomes pale and yellowish-green. In contrast, Rav Hirsch understands *yerakon* as referring to either jaundice or chlorosis [2].

Further information regarding *yerakon* can be found with the Mishnah and Talmud. Firstly, it is clear from *Taanis* 19a that *yerakon* refers to an emergency state spurred by an epidemic, as it is written, "the alarm is sounded and prayers are recited" when *yerakon* and *shidaphon* are found among the population. A more explicit definition of *yerakon* is provided by Rabbi Obadiah of Bertinoro who states "*Yerakon* is grain whose appearance became pale. And there are some who interpret *yerakon* to be an illness where the facial appearance of a person turns green like the grass of the field [2]."

It seems clear that the word *yerakon* is derived from the word *yarok*, green. The word *yerek* is in *Tanach* many times, all clearly referring to a green herb or grass. There are indications in the Talmud that *yarok* is yellow (*Tosfos Niddah* 19b) or light (*Tosefta Nega'im* I, 5) or dark green (Rashi in *Vayikrah*), but in general *yarok* is traditionally understood to mean green. Some interpret *yarok* to contain a bluish tinge as suggested by the description of the *soteh* that her "face turns green, whose eyes protrude and whose veins stand out" (*Mishnah Sotah* 3:4). Also, *Tosfos* in *Chullin* 47b clearly explains *yarok* as indigo or sky-blue. A final interpretation of *yarok* is the pallor caused by extreme fear as suggested by *Yirmiyahu* 30:6. This explanation is supported several places throughout the Talmud including when a person is frightened to death, his face may adopt a greenish tinge and when a man is shamed in public, his face becomes green due to the blood draining from the victim's face [2].

It seems clear that the word *yerakon* is derived from the word *yarok*, green.

The story of Rabbi Nathan and the circumcision of a child born following the death of his two older brothers who had both died due to complications of their circumcision help to understand the definition of *yarok*. When Rabbi Nathan saw the third baby had a green complexion, he suggested that the mother wait until he becomes "full blooded." Rashi explains that his green color was caused by anemia and he was weak from lack of blood production. Modern bible scholars offer different explanations for *yarok*, either the pallor caused by severe anemia or jaundice secondary to iceterus neonatorum. Furthermore, there are other instances where *yarok* can mean different shades. In *Chullin*, there is a discussion suggesting that *yarok* could be various shades of yellow or a "green resembling the leek." In addition, there is a postmenstrual flow that is called *yarok* which may or may not render a woman a *niddah*. Lastly, the milk of a kosher animal is considered white, while the milk of a non-kosher animal is said to have a greenish tinge [2].

There are several Talmudic causes for the phenomenon of jaundice. In *Shabbas* 33a, it is said that *yerakon* is a punishment for baseless hatred. It is also thought to be caused by urinary retention (*Berachos* 62b, *Tamid* 27b; *Berachos* 44b.) Dr. Rosner suggests that the disease of the gallbladder was originally caused by urinary retention and refers to the uremic coloration in a patient with advanced kidney disease [2].

There are many treatments suggested in the Talmud for jaundice. The flesh (*Yoma* 84a) or the urine (*Berachos* 7b) from a donkey should be ingested. Additionally, water of palm trees and a potion of roots (*Shabbos* 109b) are a suggestion to alleviate the condition of jaundice. Also, a potion described by Rabbi Yochanon (*Shabbos* 110a) and other remedies (*Shabbos* 110b) are suggested for jaundice in the Talmud [2].

The term *yerakon* can refer to several different conditions. The Biblical *yerakon* (other than *Yrimiyahu* 30:6) seems to be an affliction of grain. The Talmudic mention of *yerakon* refers to either jaundice or anemia. Dr. Rosner suggested that because *yerakon* was thought to be caused by baseless hatred, as hatred and anger are related to yellow bile or gall, it would make sense to conclude that the term *yerakon* is jaundice. However, the story concerning a newborn that had a greenish tinge does not provide support for either interpretation. Based on this story, Dr. Rosner finally concludes that there is no clear conclusion concerning whether the Talmudic *yerkaon* is in fact jaundice [2].

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REFERENCES

[1] Medicine Net. Online, Healthcare Media Publishing Company http://www.medicinenet.com/jaundice/article.htm. Retrieved January 15, 2008.

[2] Rosner, F. (1972). Yerakon in the Bible and Talmud: jaundice or anemia? Amer. J. Clin. Nutr. 25:626-628.

ORAL HYGIENE: IN THE TALMUD AND TODAY

REBECCA KATZ

Oral Hygiene is a major concern today – but for how long has mankind been preoccupied with oral health and disease? Even though one may assume this is a recent matter, in reality, discussions of oral medicine have existed since the time of the Talmud. What is even more interesting, some of the remedies recorded thousands of years ago have been modified and are used in a similar fashion even to this day. Today, technology has made enormous advancements and many more methods of treatment are available than there were in the days of the Talmud. Research continues to be conducted in search of additional methods of curing oral diseases.

Bad breath is not only an unpleasant condition; it is considered a serious disability in the Talmud. Judaism puts a greater focus on oral malodor as a severe problem as compared to the importance attributed to the trait by the current medical field [1]. Generally in talmudic law, a woman does not have the ability to approach her husband and request a divorce. Rather, the action generally must initiate from the man. Yet there are certain circumstances under which a woman is permitted to divorce her husband, one of these being on the grounds of the husband having bad breath (*Ketubot* 77*a*). Oral malodor may also be used as an excuse for a woman during a situation of *yibum*, the obligation of a childless widow to marry her husband's brother (Deuteronomy 25:5-10). One reason the widow may appeal for *halitza*, refusal to marry her brother-in-law, is because she can not bear the bad breath of her would-be husband (Maimonides *Hilchot Ishut* 25:13). Besides for bad breath having a part in Jewish marriages, it can also prevent *Kohanim* from performing services in the Temple. *Kohanim* with this condition were only able to continue their ritual if they treated their "disability" by putting pepper in their mouths (*Ketubot* 75a).

In the scientific world, bad breath is referred to as Halitosis. Dentists have discovered a number of causes for the condition. In most cases, bacteria that collect from food particles remaining in the mouth contribute to Halitosis. As anaerobic bacteria break down the protein of the food debris, those containing sulphur give off foul odor molecules such as methylmercaptan and hydrogen sulphide. This is another reason, other than the dental caries that may develop, of course, that it is important to brush and floss teeth daily. The food stuck between teeth and on the tongue will create a foul odor. Specific foods, such as garlic and onion, cause breath malodor, and the odor only leaves once that food has been eliminated from the body. Another source of bad breath is dry mouth, scientifically known as xerostomia, which is decreased flow of saliva. There are other medical disorders that may lead to halitosis, such as a postnasal drip or gingivitis and periodontal disease [2].

Yet there are certain circumstances under which a woman is permitted to divorce her husband, one of these being on the grounds of the husband having bad breath.

While it is accepted today that there may be many causes of bad breath, the Talmud seems to attribute oral malodor to different ones. One opinion is that eating food without salt or drinking liquids other than water lead to oral malodor (*Berachot* 40a). It's common to associate garlic and onion with bad breath, yet in the time of the Talmud, different vegetables were singled out as producing the bad smell: raw peas (*Yerushalmi Eruvin* 19a) and eating a vast amount of lentils (*Berachot* 40a) [1].

The cures for Halitosis that are mentioned in the Talmud mirror some of the methods used today to remove bad breath and maintain dental hygiene. Rabbi Yochanan, who had a medical condition called *tsafdina* (bleeding gums), was instructed by a non-Jewish woman to treat his illness and bad breath by using a mouthwash composed of

leavening water, salt and olive oil (*Yoma* 84a; *Avodah Zara* 28a). It is very possible that *tsafdina* may be gingivitis or scurvy because both cause bleeding and foul breath [1].

Coincidentally, the first two-phase mouthwash, developed in the 1980's, consisted of a mixture of salt water and olive oil, similar to the recipe discussed in the Talmud. The people at the time of the Talmud were one step ahead of modern day scientists, even though they were at technological setback. Researchers discovered that many strains of oral bacteria adhere to oil droplets. Today, mouthwashes contain low concentrations of cetylpyridinium chloride (CPC), an amphipathic cationic agent, that has been added to the formula, increasing the adhesion of bacteria to oil and acting as an antibacterial agent [3]. Mouthwash aids in the elimination of foul-smelling odor from the mouth by removing bacteria as well as food debris.

Another remedy for bad breath used thousands of years ago in the Mediterranean region was the chewing of *mastic*, a hard gum, as both a breath freshener and antibacterial agent [4]. This product comes from the resin of a Mastic tree. *Tosefta Shabbat* (8:7) suggests chewing mastic to avoid bad breath [1]. *Mastic* inspired the creation of chewing gum as we know it today. Gum began as a mouth freshener and remains as such but has expanded to have many different flavors. The Talmud suggests that rubbing cinnamon and ginger on teeth will improve bad breath (*Shabbat* 65a) [5]. Other than mint, cinnamon is one of the most common, popular flavors of chewing gum. Gum is now also viewed as being a candy as opposed to just a breath freshener, because many ingredients have been added to the classic recipe in addition to the resin of the mastic tree.

Before there were toothbrushes, a *kisem* was used to clean teeth (*Yerushalmi Demai* 8:11). This was either a toothbrush or a toothpick and it was made out of wood [5]. Today there are additional methods of keeping a clean and fresh mouth to avoid foul breath. Toothbrushes are no longer made of wood. They are far more advanced to aid in more effective brushing. Electronic toothbrushes make brushing easy, and some manual toothbrushes even contain a tongue scrubber. The Colgate 360 toothbrush was designed with a tongue cleaner that "removes odor causing bacteria from (the) tongue" [6]. Many of the toothpastes currently sold contain mouthwash in them. Through this dual action toothpaste, brushing teeth removes plaque and food debris while the mouthwash removes bacteria and freshens breath.

With the advent of modern technology, much more is known and available today in regard to oral hygiene. We are aware of far worse conditions than having bad breath; tooth decay and oral cancer have become prevalent and are much more serious. Various methods and treatments are available and being researched in order to prevent and battle these diseases.

Green tea and Black tea are two examples of products that treat or alleviate certain oral conditions. Green tea differs from Black tea in that oxidation was stopped in Green tea leaves while complete oxidation took place in Black tea leaves; yet they are both from the same plant: Camellia sinensis. They contain catechins, polyphenolic antioxidant metabolites, which have been studied for their beneficial health benefits, specifically for disease prevention. The catechins get oxidized, thereby eliminating harmful reactive oxygen species [7]. The catechins from Green tea seem to have a cytotoxic effect on oral cancer cells, killing them more than normal oral fibroblasts [8]. By this method, Green tea aids in treating oral cancer. Green tea has been shown to prevent oral cancer, tooth decay, and decrease plaque. Similarly, Black tea has shown to gradually reverse oral leukoplakia, which is precancerous oral mucosa lesions [9]. While drinking Green tea and Black tea may help prevent dental diseases even if only taken in small amounts, they are more effective when in more concentrated amounts.

Another plant that possesses anti-carcinogenic properties is Ginkgo Biloba. An extract from Ginkgo Biloba leaves, commonly referred to as EGb761, has been used as a Chinese herbal medicine for over 5000 years. EGb761 has been found to have the effect of scavenging excess free radicals produced; thereby acting as an antioxidant [10]. Experiments have been conducted showing that EGb761 is a chemopreventive agent because it induces apoptosis (programmed cell death) in cancer cells of the oral cavity. Apoptosis eliminates the abnormal cells, thereby averting carcinogenesis [11]. Apoptosis by Ginkgo Biloba is both time and dose dependent; the longer and more concentrated the sample used, the more effective EGb761 is at causing cytotoxicity in cancer cells. EGb761 contains flavonoids, a polyphenol found in specific plants, resulting in unique anti-oxidative and cytotoxic properties. Polyphenols are known to prevent carcinogenesis at certain stages, slow tumor growth, and stimulate apoptosis. Flavonoids are special in that they have shown to selectively cause apoptosis only in cancer cells, while normal cells are not affected in the same manner [12]. In this sense, flavonoids from Ginkgo Biloba are important as they may be used to treat cancer.

Interestingly, the anti-carcinogenic properties of the Green tea, Black tea and Ginkgo Biloba extract are due to their pro-oxidant, rather than to their antioxidant, properties. Apparently, these plant extracts generate hydrogen hydroxide inducing oxidative stress in the cancer cells. Cancer cells, as compared to normal, healthy cells, have a compromised defense mechanism against oxidative stress and thus are hypersensitive to these plant-derived products.

While it is interesting to learn that oral hygiene is a topic discussed in the Talmud, much advancement has been made in the field since then. The Talmud basically discusses the condition of Halitosis, lists some ways to avoid bad breath, and mentions a tool used to clean teeth. Since then, progress has been made and oral hygiene has become a much broader topic with many more tools and ways to maintain a clean and healthy mouth. Yet it can't be denied that the makeup of mouthwash used today is modeled similarly after the one described in the Talmud. Modern science has enabled further treatment discoveries for other oral diseases, many of which were not known or discussed in the Talmud. The generations before and during the time of the Talmud began to explore oral hygiene and may have led the way for oral hygiene as it is today, yet much expansion, development and evolution has occurred since then.

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REFERENCES

[1] Shifman A, Orenbuch S, Rosenberg M. (2002). Bad breath - A major disability according to the Talmud. Isr Med Assoc J. 4(10):843-5.

[2] ADA. American Dental Association. http://www.ada.org/public/topics/bad_breath.asp (retrieved October 10, 2008)

[3] Bad Breath Research. Two Phase Mouthwash. http://www.tau.ac.il/~melros/mouthwash3.html (retrieved October 12, 2008).

[4] Wrigley. The History of Chewing Gum. http://www.wrigley.com/wrigley/about/about_story_gum.asp (retrieved October 12, 2008).

[5] Rosner, F. (2000). Encyclopedia of Medicine in the Bible and the Talmud. Jason Aronson Inc. Northvale, New Jersey.

[6] Colgate. Oral Care Products. www.colgate.com/app/Colgate360/US/EN/HomePage.cvsp (retrieved October 12, 2008).

[7] Lambert, J., Seok-Joo, K., Hong, J., and Yang, S. (2007). Salivary hydrogen peroxide produced by holding or chewing green tea in the oral cavity. Free Rad. Res. 41:850-853.

[8] Weisburg J.H., Weissman D.B., Sedaghat T., and Babich, H. (2004). *In vitro* cytotoxicity of epigallocatechin gallate and tea extracts to cancerous and normal cells from the human oral cavity. Basic Clin Pharmacol Toxicol. 95:191-200.

[9] Halder, A., Raychowdhury, R., Ghosh, A., and De, M. (2005). Black tea (*Camellia sinensis*) as a chemopreventive agent in oral precancerous lesions. J. Environ. Pathol., Toxicol., Oncol. 24:141-144.

ALLERGIES TO JEWISH PRACTICES

SANDRA KNOLL

G-d tells us in Leviticus 18:5 to "observe My decrees and My laws, which man shall carry out and by which he shall live." The Torah here is setting a standard for one to live by G-d's laws, but not jeopardize one's life in trying to fulfill them. This limitation is prevalent in many contexts, one of which is where an individual suffers adverse allergic reactions that make it hard to fulfill his or her religious obligations without posing a risk to his or her health. Our sages and leaders struggle to find solutions that accommodate an individual's health needs while at the same time allow him or her to remain committed to Torah obligations and lifestyle.

An allergic reaction is an overreaction of the body's immune system. Allergies may result from inhaled materials such as pollen or dust, injected materials such as drugs or venom, ingested materials such as food or drugs, or contacted materials such as metals or plants [1]. Normally, these types of substances are harmless; however, in some people they can create a state of hypersensitivity. Hypersensitivity to dairy products can present a serious problem in those cases where Jewish law does not require the designation of "dairy". In some cases, hypersensitivity to metals can cause health side effects that result from the Jewish practices of adorning *tefillin* and head coverings.

Halacha forbids the eating of milk and meat together. The origin of this prohibition can be traced to three sources in the Torah, Exodus 23:19, Exodus 34:26, and Deuteronomy 14:21, where it is written "Don't boil a kid in its mother's milk." The *Shulchan Aruch (Yoreh Deah, Hilchot Basar Vechalav,* 77:1) explains that this statement prohibits not only cooking, but also eating and deriving benefit from, a meat and milk mixture. In addition, an individual must abstain from eating dairy foods for a certain period of time, according to one's custom, after eating meat because the meaty foods tend to leave a flavor and stick to the mouth (*Turei Zahav, Yoreh Deah, Hilchot Basar Vechalav,* 79:1). Jewish law treats the separation of meat and dairy as a very strict prohibition. Orthodox Jewish families have separate utensils and dishes for meat and dairy to avoid the possibility of contact between the two. Only *pareve* foods, foods that are neither dairy nor meat, need not be separated.

People who are allergic to milk, or have specific IgE antibodies to milk [2], need to eat meat or non-dairy foods, otherwise they will undergo severe anaphylaxis due to an IgE antibody response. This IgE antibody response is classified as a type I allergic reaction, involving mast cells, which are immune cells that release toxic agents and cytokines when an allergen binds to them. These toxic agents cause more immune cells to leave the blood and fight the allergen leading to inflammation. They also cause smooth muscle to contract leading to coughing and wheezing, and mucus to be secreted, while cytokines stimulate a further immune response [1].

There have been incidents where young children have eaten foods marked *pareve*, or non-dairy, assumed these foods were safe to eat, and then have gone into anaphylactic shock.

There have been incidents where young children have eaten foods marked *pareve,* or non-dairy [2,3], assumed these foods were safe to eat, and then have gone into anaphylactic shock. Subsequently, these foods were analyzed and shown to contain traces amounts of dairy. At first glance, one would assume that eating these foods with meat would be a violation of the *halacha*, however, this is not the case. The *Shulchan Aruch* describes a case where a small amount of meat falls into a vat of milk and *vice versa*. In such a situation, the *Shulchan Aruch* explains, one should give the food to a non-Jew to taste. If the taste remains the same despite the small amount of meat or milk, depending on the scenario, then the food retains its kosher status (*Shulchan Aruch, Yoreh Deah, Hilchot Basar Vechalav, 92:1-2*). Rav Moshe Iserlis,

in his commentary on the *Shulchan Aruch,* wrote that we do not rely on the opinion of a gentile, rather, if the meat or milk that fell in the dish is a sixtieth or less of the rest of the food's volume, then the food is kosher and if more than a sixtieth fell in, it is not kosher. Therefore, an item may still be considered *pareve* or meat even if it contains 3 to 4 parts per million of dairy particles, enough to cause a severe allergic reaction [4]. This would explain why those children underwent anaphylactic shock even though the foods they were eating were not marked as dairy.

One area where this problem is prevalent is in the packaging of food. Packing food does not constitute cooking, as there is no heat. Therefore, dairy as well as *pareve* foods can be packaged using the same packing equipment. The equipment needs only to be cleaned [5]. The problem with packing equipment is that particles from dairy products build up on the equipment and, even though the equipment is cleaned before being used for *pareve* items, the insignificant amount of dairy particles remaining on the equipment, though negligible according to *halacha*, are potentially dangerous for people allergic to dairy [5]. 0.1 to 7.5% of children are allergic to dairy [3]. Rabbinic organizations, like the Orthodox Union (OU), have addressed this issue and have started to identify products that have potential to stimulate an allergic reaction by marking them $(OU)_D$, meaning dairy, instead of the traditional $(OU)_{D.E.}$, signifying that cleansed dairy equipment was used [4].

Allergic reactions can also interfere with the commandment to adorn *tefillin,* two black leather boxes that contain parchment. The Torah commands men to, "bind them [*tefillin*] as a sign upon your arm and let them be ornaments between your eyes" (*Devarim* 6:8). As such, men wear *tefillin* on their arm and forehead during the morning prayers, except on the Sabbath and holidays. *Tefillin* contain leather straps to hold them in place on the head and on the arm. Allergic contact dermatitis, skin inflammation upon direct contact with an allergen [6], has occurred on the left arm and on the neck of men when performing the mitzvah of *tefillin*.

Contact dermatitis can result from exposure to many items, such as makeup, perfumes, fabrics, plants, antibiotics, metals, and essentially anything else skin may touch [6]. The condition can have symptoms ranging from just itching and inflammation (hotness, redness, swelling, and fluid [1]), to skin lesions that have blisters and may ooze, crust, and become scaly. It is considered a type IV allergic reaction in which symptoms do not develop until 1-3 days after initial allergenic contact, which is unlike a type I allergic reaction where a response is immediate [1]. Contact dermatitis as a result of *tefillin* is caused by potassium dichromate [7], a metal antifungal agent in which the leather straps are dipped to make them last ten years instead of eight [8]. It is not unusual to develop allergic contact dermatitis from exposure to metals and it is also more common for men to be sensitive to chromate than women.

As of 2005, only eight men are known to have developed contact dermatitis from wearing *tefillin* [7-9]. The allergy to *tefillin* is proposed to be more uncommon because of the short time period in which the *tefillin* are worn, usually less than an hour a day [9]. The amount of time is relevant because in a type IV hypersensitivity reaction a lot more allergen must be present to stimulate a response. Therefore, many chromate ions would need to penetrate into the skin and then be processed by immune cells [1]. There are three *halachic* solutions for these few men who are allergic to their *tefillin*. The first solution is to buy *tefillin* made without chromium, like vegetable tanned leather *tefillin* [7]. The second alternative is to smear oil on the inside of the leather strap. This solution, which is supported by Rav Yakov Meir Stern, is suitable as oil is not a *chazitza*, a *halachically* forbidden barrier, between the skin and *tefillin* [8]. Another option is to do as one man did, and keep putting on the *tefillin* despite the blisters and crusting [7].

A third area in which allergic reactions and *halacha* interface is regards to the custom of wearing a head covering, either a *kippa* for males or a *tichel* for married women. In *Shir Hashirim* (2:14 and 4:1), a woman's voice and hair are praised. The *gemara* thus assumes that a woman's voice and hair are provocative and must, therefore, not be heard or seen by a man who is not that woman's husband (*Brachot* 24a). As a result, Jewish tradition is that in public a married woman covers her hair.

A *kippa*, on the other hand, is the head covering adorned by Orthodox Jewish men. Men cover their heads for a different reason than women, namely to show that G-d is above them (*Kiddushin* 31a). Originally called a *sudra* in the Talmud, the *kippa* was to be worn only by those who feared G-d (*Kiddushin* 29a) and on occasions where more respect for G-d was necessary, such as at court decisions (*Shabbos* 10a), religious ceremonies (*Kiddushin* 8a), and grace after meals (*Brachot* 51a) [10]. Rav Huna the son of Rav Yehoshua, however, would not walk four *amos*, a distance of between 6 and 8 feet, without a head covering (*Shabbos* 118b). Rav Yosef Karo argued in *Beit Yosef* O.C. 8 that head coverings are mandatory for all men, all the time, while Rav Shlomo Luria and the Vilna Gaon argued that *kippot* are not always mandatory [10]. Today there are many Italian and Moroccan Jews who do not have the custom of wearing a

kippa, and Rav Moshe Feinstein allowed American Jews to take off their *kippot* for work only (*Igrot Moshe* O.C. 4:2), so as not to jeopardize their ability to earn a living [10].

Those Jews with the custom of covering their head might possibly experience an allergic reaction. Pseudo alopecia areata is the term given to Jewish religious patients who have a hair loss that is similar to those individuals with alopecia areata. Alopecia areata either is an inherited disease or is an autoimmune disease and causes round patches of hair loss [6]. Pseudo alopecia areata is different, in that the hair loss only occurs in the area where hair pins/clips that keep a *tichel* or *kippa* on the head are placed and lesions develop on the irritated skin [11]. The lesions result partially from the sharp-ended metal pin holders and partially from the type IV allergic reaction to the metal clips, just as with *tefillin*. However a *kipa* or a *tichel,* unlike *tefillin,* are worn most of the time so it is more common for people to get pseudo alopecia areata than for men who wear *tefillin* to get contact dermatitis. It is also more common for men than women to develop pseudo alopecia areata. Women have more options as to where to place a clip and they also have more hair so the clip is not always in direct contact with their skin [11].

A clinical study was performed by Yosefy *et al.* [11] on 37 Orthodox Jewish patients with pseudo alopecia areata. Patients were tested with pharmacological methods, irritants, immune inhibitors, cyclosporin A, immune enhancers, and others. These methods normally work to help regrow hair 10-30% of the time [11], however, they did not work on these religious patients. Non-pharmacological methods, such as changing the clip to a non-metal one or using a larger, less sharp, clip facilitated hair regrowth [11]. So the best solution to covering one's head despite having this kind of allergy is just to change the clip. An alternate solution is to take advantage of Rav Moshe Feinstein's leniency regarding the requirement to wear a *kippa*.

Religious Jews have always made their faith their number one priority. Sometimes, however, Judaism can create situations in which following the commandments strictly can lead to adverse health effects. As a result, the rabbis throughout history have formulated solutions that accommodate both the need to observe the religion and to preserve one's health.

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REFERENCES

[1] Parham, P. (2004). The Immune System, 2nd edition. Garland Science, Taylor & Friends Group. New York, NY.
[2] Jones, R.T., Squillace, D.L., and Yunginger, J.W. (1992). Anaphylaxis in a milk-allergic child after ingestion of milk-contaminated kosher-*pareve*-labeled "dairy-free" dessert. Ann. Allergy. 68:223-227.
[3] Gern, J.E., Yang, E, Evrard, H.M., and Sampson, H.A. (1991) Allergic reactions to milk-contaminated "nondairy" products. New Engl. J. Med.. 324:976-979.
[4] Ou Kosher. Kashrus FAQ. http://www.oukosher.org/index.php/articles/single_print/5313 (retrieved January 18, 2009).
[5] Bistricer, D. (2008) Allergens. Hamodia Magazine. p. 6-7.
[6] Medline Plus, A.D.A.M Medical Encyclopedia. http://www.nlm.nih.gov/medlineplus/encyclopedia.html (retrieved January 15, 2009).
[7] Ross, B. and Brancaccio, R.R. (1994). Allergic contact dermatitis to religious articles. Amer. J. Contact Dermat. 5:160-161.
[8] Study: some skin infections could be linked to certain chemicals in *tefillin*. (2005). Hamodia, p. 4.
[9] Gilead, L., Vardy, D.A., and Schamroth, J. (1995). *Tefillin* dermatitis (a phylacteric phenomenon). J. Amer. Acad. Dermatol..32: 812-813.
[10] Brody, S. (2009). Ask the rabbi: the way you wear your hat. Jerusalem Post http://www.jpost.com/servlet/Satellite?pagename=JPost%2FJPArticle%2FShowFull&cid=1231167313350 (retrieved January 9, 2009).
[11] Yosefy, C., Ronnen, M., and Edelstein, D. (2003). Pseudo alopecia areata caused by skull-caps with metal pin fasteners used by orthodox Jews in Israel, Israel Clin. Dev. Immunol. 10:193-195.

COSMETIC DEFORMITIES IN *HALACHIC* HISTORY

AIMEE KRAUSZ

In the last quarter of a century, there have been rapid advancements on all fronts of cosmetic surgery, making procedures more accessible and less invasive. Due to the extensive growth in this area of medicine and its increasing prevalence, Judaism has defined its stance on the permissibility of plastic surgery, in concordance with the precincts of *halacha*. Torn between the high risks involved versus the possibility of renewed self confidence, *halacha* distinguishes between cosmetic and reconstructive surgery. The former, performed merely for the enhancement of physical appearance, is generally deemed impermissible on the grounds that the pursuit of vanity fails to outweigh the harm of self inflicted danger. The latter, however, performed to correct a congenital or acquired defect, is allowed even according to the strictest opinions, especially in the cases where the deformity is likely to interfere with the patient's physical or mental well being [1].

The *Chelkat Yaakov* rules that despite the fact that cosmetic surgery may be considered elective from a medical perspective, if the patient's appearance is debilitating psychologically, the operation is considered a medical necessity [2]. This ruling assumes that *halacha* equates psychological illness with somatic illness, and applies to cases where psychological disease manifests itself in physical symptoms, thereby presenting a risk to the patient's health. This perspective is supported by *Tosafot* in *Shabbat* 50b, stating that agoraphobia, the fear of being in public places, is a psychological stress equivalent to that of physical pain. It can thus be extrapolated that since psychological pain amounts to actual pain, some forms of cosmetic surgery may be treated [3]. *Halacha* values the subjective self image of the individual and concludes that emotional well being and self image are sufficient qualifications to permit elective surgery [4].

The widespread prevalence of cosmetic procedures has contributed to modern society's fixation on body image. Yet, the centrality of beauty is not a new phenomenon and can be traced back to Biblical and Talmudic times as well. Various lotions used for woman's beautification are mentioned in Scripture, specifically in Song of Songs (3:6, 4:10) and Esther (2:12). Also, many figures in Scripture are specifically praised for their beautiful features and physique. Therefore, it is not surprising that the physical malformations common today are also referenced in the Talmud and Scripture. The historical accounts, laws and precepts contained in the Bible yield an abundance of information concerning congenital anomalies, diseases and injuries [5].

Most of the accounts refer to conditions that disqualify priests from performing ritual duties in the Temple, including head, nose, ear and mouth abnormalities.

Torn between the high risks involved versus the possibility of renewed self confidence, *halacha* distinguishes between cosmetic and reconstructive surgery.

In Leviticus (22:22), a case is discussed in which an animal born with a cleft lip is rendered invalid as an offering. Similar deformities occur in humans. An oral-facial cleft is a birth defect in which the tissues of the mouth or lip fail to form properly during fetal development, causing aesthetic and functional detractions. In the United States, clefts occur 1 in 700 -1,000 births, making it one of the most common major defects in the country, and worldwide. A cleft lip appears as a narrow opening or gap in the skin of the upper lip that extends all the way to the base of the nose. Surgery involves making an incision on each side of the cleft from the lip to the nostril and sewing the tissue together. In *Baba Kamma* 117, the Talmud discusses how Rabbi Yochanan, who was old and weak, thought that Rabbi Kahana, deformed with a cleft lip, was laughing at him.

Adolescents with cleft lip and palate are at an elevated risk for developing psychosocial problems especially those

relating to self concept, peer relationships, and appearance. Society often focuses on appearances, and this can make childhood especially hard for someone with a physical difference. This is why part of the cleft palate and lip treatment team includes psychiatric and emotional support personnel. In an effort to ameliorate this pervasive defect, Operation Smile, was founded in 1982 by Dr. William P. Magee Jr., a plastic surgeon, and his wife, Kathleen S. Magee, a nurse and clinical social worker, after a mission to the Philippines to repair children's cleft lips and palates. Operation Smile's standard International Medical Mission is comprised of a team of medical professionals from around the world who travel to partner countries to treat children during a two-week period. On a typical International Medical Mission, 300-500 children receive full medical evaluations and 100-150 children are surgically treated. Since its start, Operation Smile volunteers have operated on about 94,000 children in 25 countries.

Another common disfigurement referenced in the bible is polydactyl, which is the most frequent of the congenital hand deformities, with an incidence of 1 in every 500 live births [6]. Polydactyl is a condition in which individuals have more than the normal number of fingers or toes. It can be very conspicuous, especially when fully grown and functioning digits are supernumerary. This deformity is mentioned in early literature in Samuel II (21:20), where the text chronicles King David's encounter with a polydactyl giant. "And yet again there was a war at Gath, where there was a man of great stature, whose fingers and toes were four and twenty, six on each hand and six on each foot." Another reference to polydactyl is found in *Bechoros* (45b), where a baby *kohen* was born with six fingers on his hand. Since the extra finger looked like a normal limb, it did not render him invalid to serve in the Temple. In humans, supernumerary fingers and toes are generally removed early in life for cosmetic and/or safety reasons, for social acceptability and because clothing and utensils are designed for five-digited people.

The deformities widespread today were common over 3,000 years ago as well. Yet, due to medical advancements, these physical anomalies are easily repaired and allow individuals the opportunity to live normal, healthy lives. *Halacha*, valuing the necessity of psychological stability and healthy self image, not only permits, but encourages, the use of cosmetic surgery.

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REFERENCES

[1] Westreich, M. (1998). Orthodox Jewish law and plastic surgery. J. Amer. Soc. Plast. Surg. 102:908-913.
[2] *Chelkat Yaakov* 3:11.
[3] Geisler, D. (2004). Cosmetic surgery in *halacha*. J. Halacha Contemp. Soc. 47:29-43.
[4] Bleich, J. (1978). Survey of recent *halakhic* periodical literature. Tradition. 17:86-90.
[5] Wyzynski, D. (2001). Dysmorphology in the Bible and the Talmud. Teratology. 64:221-225.
[6] Nicolai, J.P. and Schoch, S.L. (1986). Polydactyl in the Bible. J. Hand Surg. 11: 293.

THE MOST PRACTICAL HAND-HELD GADGET: SOAP AND WATER

JENNIFER KRAUT

Last year marked the anniversary of one of the most important medical discoveries. 150 years ago, a physician in a Vienna hospital, Dr. Ignaz Semmelweis, discovered that lethal infections were spread among patients by doctors who failed to wash their hands between medical procedures [1]. With the myriad of antibacterial soaps and hand products advertised today, combined with society's obsession with cleanliness, it may be hard for us to imagine what it would be like to live in a world where a mere bacterial infection posed problems, possibly even death, for the population at large. But do not be fooled; fundamental hygiene problems still exist today.

Jews seem to defy this trend as the mandates of their religion give them reason to wash, cleanse, and purify themselves multiple times each day. Each morning a Jew washes his hands upon awakening in performance of the *negel vasser* ritual [2]. The *Mechaber* extends this ritual to when a person takes a nap in the middle of the day. After napping, one must subsequently wash one's hands and recite the requisite *bracha* [3]. Additionally, Jews ritually wash their hands while performing many other activities of daily living including, but not limited to, before and after meals, before praying, after bloodletting, after getting a haircut, after cutting nails, after a shower, and after using the bathroom [4].

The reason behind hand washing is more spiritual than physical. The *Mishna B'rurah* explains that before the *kohanim* could sit down to eat their *terumah* portion, they were required to wash their hands to remove any *tum'ah,* impurities from them. This prevented any transfer of impurities when they ate *terumah*. This idea of preventing the transfer of *tum'ah* translates into a Jewish law, still around today, for *Klal Yisrael* to wash their hands before they eat bread [5].

The requirement of hand-washing can also be derived from the statement in Leviticus 15:11, "Whomever the man with discharge (*zav*) touches without having rinsed his hands in water shall immerse his garments and immerse himself in water, and he remains contaminated until evening" [6]. A *zav* must specifically wash his *hands* because if he touches another person without having cleansed his hands, the other person will be rendered impure.

These ritual obligations have had a historical impact on the physical wellbeing of Jewish communities. In 1347, the Black Death wiped out a quarter of Europe's population. The plague originated in flea-infested rats aboard ships which arrived from the East and docked at the ports of Europe. Initially, the plague spread via bites from these fleas. The combination of overcrowding in the towns and cities, terrible sanitary conditions, and an ignorance of infectious diseases, were major factors in the ultimate toll the plague took on the continent of Europe [7]. The Jews also suffered from this unbearable plague, but their plight was significantly smaller than that of their gentile counterparts. This was primarily due to the more sanitary and hygienic tendencies of the Jews' lifestyle which were mandated by *halacha*. The plague took a less-drastic toll on the Jews due to the strict Jewish Laws that forced them to constantly wash their hands, take care of the sick, and immediately bury the dead [8].

These ritual obligations have had a historical impact on the physical wellbeing of Jewish communities.

The medical benefits of hand-washing were ultimately discovered by the medical community as well. In the 19th century, it was found that up to 25% of women died in childbirth due to childbed fever. This fever was later found to be caused by the bacterium, *Streptococcus pyogenes*. In 1843, Dr. Oliver Wendell Holmes recommended that doctors wash their hands before delivering babies because he believed that these women were catching the fever from bacteria on the hands of their doctors. A few years later, Dr. Ignaz Semmelweis saw that the mortality rate in the delivery room staffed by medical students was three times

higher than the mortality rate in the delivery room staffed by midwives. Based on this observation, he concluded that medical students must be carrying infections from procedures that they had performed earlier in the day. They were then infecting the mothers in the maternity ward. He ordered that the medical students wash their hands before coming in contact with the birthing mothers and the mortality rate in the maternity wards dropped to less than one percent [9]. Despite these astonishing results, Semmelweis' suggestion was met with much hostility from other healthcare professionals. The idea of frequently washing one's hands seemed impractical at the time. After all, there was no indoor plumbing making it difficult to get water, and to obtain water which was room temperature, it needed to be heated over a fire for a significant amount of time [9].

One would expect the hand-washing rates to be significantly higher in today's day and age when we have indoor plumbing and water can be heated up in mere moments. However, in 1992, The New England Journal of Medicine published a study that stated hand-washing rates in an intensive care unit were as low as 30% and never went above 48% [9]. Dr. Fred Rosner of the Elmhurst Hospital Center in New York explains that there are several factors which contribute to poor adherence to hand hygiene. These factors include "poor access to hand washing facilities, such as sinks, the time required to perform standard hand washing, irritant contact dermatitis associated with frequent use of soap and water, high workloads for healthcare workers, and the failure of healthcare administrators to make hygiene an institutional priority" [8]. He adds that alcohol-based hand rubs are more effective, more accessible, and save time and human resources. Therefore, these alcohol rubs should become the standard for hand hygiene in healthcare institutions [8].

Judaism has long engrained its observers with the value of hand-washing. Though the reason for hand-washing may have been purely spiritual, time periods such as the black plague have shown that there were health benefits associated with the hygiene obtained from hand-washing. Advancements in technology have made proper hygiene easily attainable and infection control by means of hand washing and other sanitary precautions has come a long way. However, the sanitary environments in hospitals that many have come to expect as the norm have yet to be perfected. As hand washing methods and antibacterial agents become more sophisticated, perhaps healthcare professionals outside the realm of Judaism will begin to standardize our age old practice of hand-washing in all of today's healthcare facilities.

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REFERENCES

[1] Water Quality and Health Council. 30 Sept. 2009 http://www.waterandhealth.org/newsletter/new/feb-1998/right.html
[2] *Mishna B'rurah. Siman 4,se'if 1.*
[3] *Mishnah B'rurah. Siman 4, se'if 15.*
[4] "Ritual Washing in Judaism." Wikipedia. 22 Sept. 2008 http://en.wikipedia.org/wiki/Ritual_washing_in_Judaism
[5] Rosner, F. (2000) Encyclopedia of Medicine in the Bible and the Talmud. Jason Aronson Inc., Northvale, NJ.
[6] *Mishna B'rurah. Siman* 158, *se'if 1.*
[7] Wein, B., (1994) Herald of Destiny, Shaar Press, Brooklyn, NY.
[8] Rosner, F. (2007) Handwashing and infection control. Mt. Sinai J. Med. 74:33-35.
[9] Case, C.L. "Handwashing." Access Excellence. 22 Sept. 2008 http://www.accessexcellence.org/AE/AEC/CC/hand_background.php

TEKHELET - A CHEMICAL CONUNDRUM

EMILY J. LIEBLING

"…And they shall place upon the *tzitzit* of the corners [of the garment] a thread of *tekhelet*" (*Bamidbar* 15:38).

"You shall make the *mishkan* of ten curtains twisted linen and *tekhelet* and *argaman* and *tola'at shani*…" (*Shemot* 26:1).

"You shall make the robe of the *ephod* entirely of *tekhelet*" (*Shemot* 28:31).

These verses represent a mere sample of the myriad references made to the pigment of *tekhelet* in the Torah. Conventionally translated as the color turquoise, *tekhelet* has become nothing short of a mystery to its seekers. The *chilazon* is the source of *tekhelet* (*Shabbat* 26a), yet the identity of its species is fraught with uncertainty. As such, the Midrash states that the *tekhelet* has been concealed and today we possess only white *tzitzit* (*Bamidbar Rabba* 17:5) [1]. Because of this anonymity, the majority of observant Jews continue the tradition of not using *tekhelet*. In relatively recent times, however, there has been a concerted effort to re-determine the nature of *tekhelet* and the process of its production.

The color of *tekhelet* has long been associated with royalty and nobility, as can be seen from the verse, "clothed in *tekhelet*, governors and rulers…" (*Yechezke*l 23:6). The vestments of the *Kohein Gadol* were sewn of *tekhelet*-dyed wool and the palace of King *Achashverosh* was adorned with the piercing blue, as well (*Esther* 1:6). The *Gemara*, in *Menachot* 44a specifies that "the *chilazon* emerges from the water once every seventy years and with its blood *tekhelet* is dyed; therefore, *tekhelet* is expensive." *Rashi* comments that the rarity with which the *chilazon* appears on land is the reason for its astronomic cost. This could provide an understanding as to why the color was found mainly in the company of the wealthy. In fact, it was precisely the harvesting of the *chilazon* that gave the tribe of *Zevulun* its great wealth. When Moshe blessed *Bnei Yisrael* before his death, he declared to *Zevulun*, "…for by the riches of the sea they will be nourished and by the treasures concealed in the sand" (*Devarim* 33:19). The Talmud, in *Megilla* 6a, discloses that the "treasures" refer to "white glass" and the blood of the *chilazon*.

Recent chemical evidence has led scientists to believe that the *chilazon* is, indeed, the *Murex trunculus* snail, which was used by the Phoenicians to dye their garments.

In various and disparate locations, the *Gemara* gives several criteria by which the *chilazon* is identified. Why, then, is this creature unbeknownst to us today? The answer lies in the fact that our tradition gives specific criteria for the *chilazon*, but several species would have to be combined to meet those criteria. Some of the physical characteristics include:

- Its appearance on land once every 70 years (*Menachot* 44a).
- Its anatomy is like that of a fish (*Menachot* 44a).
- It is captured with nets that are lowered into the water (*Shabbat* 74b).
- Its capture on *Shabbat* is prohibited by *tzad* (*Shabbat* 75a).
- The method of dye extraction from the *chilazon* is described as "*potzea*", the cracking of a hard surface (and not *korea*, which would imply the ripping of flesh) (*Shabbat* 75a).

Descriptions of the *tekhelet* itself are given, as well:

- Its blood is collected in a separate sack, and does not diminish the life of the *chilazon* upon extraction (*Tosfot*, *Ketuvot* 5b).

- The dye is of better quality when extracted from a live *chilazon* (*Shabbat* 75a).
- The color of *tekhelet* from the *chilazon* is identical to that of *kala ilan* (indigo) (*Bava Metziah* 61b).
- *Tekhelet* is permanent and does not fade with time nor wash out of the dyed wool (*Menachot* 43b).

Even though so many details are known about the *chilazon* and the *tekhelet*, the question still remains as to why the manufacture and wearing of *tekhelet* ever fell out of practice? There has been much speculation about the disappearance of *tekhelet*. No doubt ever existed in our tradition as to the identity of the *chilazon* or the process of *tekhelet* production. The falling from practice of dying with *tekhelet* was not a result of suddenly forgetting how to accomplish the task. It was due, rather, to the political decrees of Rome, as well as the enormity of its cost. During the supremacy of the Roman Empire, emperors, among them Valentinian, Theodosius, and Arcadius, proclaimed an official prohibition against the public production of *tekhelet*. They restricted the wearing of this royal color only to certain nobility, threatening capital punishment to those who disobeyed. Thus, the great danger associated with the use of *tekhelet* caused it to become lost as the generations passed. Additionally, the production of *tekhelet* was very expensive, even for the nobility who were permitted to use it. To appreciate the expense that *tekhelet* represented, in 301 BCE, one pound of *tekhelet*-dyed wool cost 50,000 *dinarii*, a salary of almost three years for a baker [2].

Throughout the ages, several proposals have been made as to the *chilazon's* identity. Although modern day evidence is not supportive, *Rambam*, *Rashi*, and *Tosfot* agree that the *chilazon* is a fish. This creature satisfies the first three criteria, but how, then, can its dye be removed by *potzea*, which would imply that the *chilazon* has a hard shell to be cracked or smashed? *Rashi* resolves the issue and proposes that in this context, *potzea* means "squeezing out" the blood, or dye, from the *chilazon*. Some maintain that because *tekhelet* is used in the construction of the *mishkan*, it must be derived from a kosher source. Others disagree and counter that the dye is used to color materials which necessarily adhere to *kashrut* laws; the dye, in and of itself, is not considered to be substantive and may, therefore, come from non-kosher animals [3].

A resurrection of the search for *tekhelet* came with the advent of a renewed Messianic enthusiasm of the nineteenth century. Religious leaders wrote and preached about the imminent redemption to the eager masses. Amid the excitement, were discussions regarding the rebuilding of the Temple and the recreation of the priestly garb. A standstill was then reached; how could the holy vestments be made without *tekhelet*? Rabbi Gershon Henoch Leiner, the Radziner Rebbe, assumed the responsibility of finding the lost ingredient and the animal from which it comes. He traveled to an aquarium in Naples to investigate a suggestion that the *chilazon* was the squid, *Sepia officinalis*, or as more commonly known, the cuttlefish. He consulted with the chemists of his town and found that its black ink secretions could be turned to blue. The Talmudic descriptions of the anatomy of the *chilazon* and its blue dye now paralleled his discovery. In three treatises, *Sefunei Temunai Chol*, *Petil Tekhelet*, and *Ein HaTekhelet*, R' Leiner identified the *chilazon* as the cuttlefish.

In 1913, as part of his doctoral dissertation on *tekhelet*, Rabbi Isaac Herzog, Chief Rabbi of Dublin and subsequently Chief Rabbi of Israel, contacted eminent chemists and dye experts in Germany for an analysis of the *tekhelet* of the Radziner Rebbe. The shocking results showed that the deep blue was, in fact, an inorganic dye known as ferric ferrocyanide, $Fe_7(CN)_{18}$, or Prussian blue. Upon request for the methods of *tekhelet* production used by the Radziner Chasidim, Rabbi Herzog noted that the ink was heated to very high temperatures and iron filings were then added to the hot liquid. Through this procedure, organic molecules in the ink decomposed. The carbon and nitrogen atoms recombined with the iron, producing the deep blue pigment. Thus, the Radziner's *tekhelet* was not from the squid, but from an inorganic substance that could be produced from a generic chemical reaction. It represented the recombination of the atomic components of any number of molecules. Rabbi Herzog decided that the Radziner Rebbe's formula could not be true *tekhelet*, as the Talmud goes to great lengths to specify the requirement of a specific biological species. He proffered, instead, that the *chilazon* could be the *Janthina* snail [4].

In the mid-1800's, archaeologists unearthed several "factories" where dye was produced. Near these structures were large piles of snail shells, among them, the *Murex trunculus* [2]. Recent chemical evidence has led scientists to believe that the *chilazon* is, indeed, the *Murex trunculus* snail, which was used by the Phoenicians to dye their garments. The dye of the *Murex trunculus* undergoes a series of transformations, from colorless to yellow to green to blue, and finally, to purple [5]. Because *tekhelet* should be purely indigo, the presence of purple is very enigmatic. In the 1980's, Otto Elsner of the Shenkar College of Fibers investigated the ancient technique of exposing the dye to the sun. He and Ehud Spanier of Haifa University

researched this method even further and found that when the *M. trunculus* dye is in a chemically reduced state and subsequently exposed to any form of ultraviolet light, the purple hue completely disappears. Thus, the dye naturally reduces upon exposure to sunlight, which would explain the method of old [4].

The biochemistry of the *in vivo* dye production was later explained. The precursors of the dye are in the snail's hypobrachial gland as a clear, colorless liquid. Upon the liquid's exposure to air and sunlight, an enzyme known as purpurase converts it into the dye. The reaction produces a mixture of the blue indigo and the purple dibromoindigo. The sunlight causes the carbon-bromine bonds to break and the molecule is transformed into indigo, or *tekhelet*. Because of the rapid denaturation of purpurase, the gland must be squeezed immediately from the living mollusk, which is a criterion consistent with the *Gemara's* description that the animal remain viable after the extraction of the dye [4]. Rabbi Dr. Moshe D. Tendler, *Shlita*, writes that though no single individual can testify that he has received a tradition as to the identity of the *chilazon* and *tekhelet*, the knowledge that has surfaced from research and investigation is almost incontrovertible. Thus, "…the matter is equivalent to the testimony of two witnesses, whose word is sufficient to establish a matter" [2].

The complexity of the modern reestablishment of *tekhelet* is truly fascinating. It reflects the beautifully unwavering devotion of the Jew to *HaShem* and His commandments. The tireless efforts of those determined to find the *chilazon* and study the manufacture of its dye have hopefully contributed to the nearing of our final redemption. May we merit once again to see the *tekhelet*-colored constituents of the third and final Temple speedily in our days.

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REFERENCES

[1] Feliks, J. (2007) *Tekhelet*. Encyclopaedia Judaica, 2nd Ed. Berenbaum, M. and Skolnik, F. (Eds.). Macmillan Reference USA, Detroit, MI. pp.586-587.

[2] Kollel Iyun Hadaf of Har Nof. Thoughts on the Daily Daf. http://www.dafyomi.co.il/ (retrieved January 12, 2009).

[3] Tendler, M.D. (1996). Identifying *Tekhelet*: Masoret and Yedi'ah. *Tekhelet*: The Renaissance of a Mitzvah. Cohen, A. (Ed.). The Michael Scharf Publication Trust of Yeshiva University Press, New York, NY. pp. 39-50.

[4] Sterman, B. (1996). The Science of *Tekhelet*. *Tekhelet*: The Renaissance of a Mitzvah. Cohen, Rabbi A. (Ed.). The Michael Scharf Publication Trust of Yeshiva University Press, New York, NY. pp. 63-78.

[5] *Tekhelet* Questions. *Ptil Tekhelet* The Association for the Promotion and Distribution of *Tekhelet*. http://tekhelet.com (retrieved January 21, 2009).

TZAFDINAH: A TALMUDIC SCURVY?

JANNA LOGIN

As early as the Talmudic era, the great Rabbis in Jerusalem and Babylonia dealt with the complexities of the vitamin C deficiency, more commonly known as scurvy. As centuries passed, physicians continued to grapple with deadly effects of the disease until its source was discovered by James Lind, the Scottish physician, in 1747 [1].

In an attempt to discover the source of the disease, Dr. Lind performed an experiment on twelve patients, each of whom had scurvy. He provided each patient with different acidic supplements, such as lemons, garlic or vinegar. The garlic had no effect, those treated with vinegar recovered much slower, and the patients provided with the citrus fruits were cured quickly and efficiently [1].

After Dr. Lind's findings, it became common practice for sailors to travel with crates of lemons, limes and kale to prevent the widespread malady throughout their long voyage. As a result, thousands of lives were saved. Captain James Cook is most noted for never losing a passenger to scurvy due to the meticulous precautions he took before embarking on each voyage. Before each departure, he loaded crates of lemon juice onto the ship, eventually causing the nickname "limeys" to become the prevalent term used for describing sailors.

However, well before sailors were afflicted, the Rabbis looked to find cures for the devastating illness, caused by a deficiency in vitamin C (ascorbic acid), existent amongst their villages. In the Babylonian Talmud, a disease known as *tzafdinah* is characterized through bleeding gums as its primary symptom. *Rashi* notes that *tzafdinah* is a life threatening disease originating in the mouth and ending in the intestines, and in essence it is "a sickness of the teeth and gums" [2]. Rabbi Judah, a sage familiar with the first hand effects of scurvy suffered seven years from its brutal effects. In this instance, however, the Talmud uses the word *tzipparana*, indicating a variation of scurvy [3].

In Yoma (84a), *tzafdinah* is discussed in reference to Rabbi Yochanan's suffering. The *Talmud Yerushalmi* (Shabbat, 14:14,30) delineates the story in which Rabbi Yochanan met with a Roman matron to receive a remedy for his discomfort caused by scurvy. She prepared a special remedy that consisted of "the water of leaven, olive oil, and salt," according to Rabbi Acha, and "geese fat smeared with a goose feather" according to Rav Ashi. Abaye mentions that he tried all these suggestions, but remained uncured until an Arab passerby suggested "tak[ing] the stones" of unripe olives, burning them in a fire and placing them along the gum line. The *Gemara* attributes the disease to the ingestion of "hot wheat foods and remnants of fish hash and flour [2]." Dr. Fred Rosner references a cure for *tzafdinah* noted in Berachot 40a by Rabbi Yochanan who taught: "he who becomes accustomed to eating mustard every thirty days keeps illnesses out of his houses (abdomen)" in regard to scurvy [*Shabbat* 65a] [3].

The Talmud *Yerushalmi* (Shabbat, 14:14,30) delineates the story in which Rabbi Yochanan met with a Roman matron to receive a remedy for his discomfort caused by scurvy.

Since *tzafdinah* can be fatal, the Torah takes measures to protect its believers. In the *Mishna Yoma* (8: 6) the laws of the Sabbath are taken into account when dealing with a life-threatening illness. In this passage, Rabbi Matthia ben Cheresh teaches that if one has a pain in his throat, he may medicate himself on the Sabbath. Maimonides interprets this to mean that the disease in question pertains to rotting gums and if left untreated, the palate will rot as well. Thus, one may use medication for *tzafdinah* on the Sabbath since it is an issue of life and death [2].

Although scurvy and its deadly effects are no longer a mystery of the past, the disease is still quite prevalent in the lives of "the urban poor, the elderly, and chronic alcoholics" [4]. Those with cancer and chronic renal failure are

especially subject to the disease [4], and smokers increase their needed daily intake of vitamin C from 30% to 50% [5]. "Pregnancy, breast-feeding, and surgery" additionally increase the level of vitamin C necessary for everyday functions. Furthermore, scurvy may occur in those who exclusively consume particular foods such as "dried meat, tea, toast, and canned vegetables" [5].

Scurvy adversely affects "blood vessels, eyes, gums, kidneys, muscles [and] teeth" [1]. In its early stages, after several months of dietary inadequacy, the vitamin deficiency can be manifest as bleeding around the gums and under the skin [5]. The gums become swollen and inflamed and appear spongy [6]. Further vitamin C deficiency may result in "irritability, depression, weight loss, fatigue" [5]. A patient may also encounter "malaise and weakness" [4].

It is uncommon for infants to develop scurvy, as breast milk and infant formulas contain sufficient levels of vitamin C [5]. However, if infants do in fact contract the disease, severe complications ensue and include "fever, diarrhea, loss of weight, and vomiting" [6].

In general, progression of the disease leads to the fragility of small blood vessels in the skin and other tissues potentially leading to bruising and breakage of these areas [6]. Cases that detail a severe inadequacy of the vitamin can result in a depressed blood volume as a result of intestinal hemorrhages [6]. Advanced stages of scurvy can lead a person to become edentulous while kidney and intestinal malfunction can be fatal [1]. Anemia may occur and wounds will heal slower. Late manifestations of vitamin C deficiency are most commonly noted by "edema, oliguria, neuropathy, intracerebral hemorrhage, and death" [4]. However, patients without teeth do not have their gums affected and those with good dental hygiene may not encounter gum lesions [7]. Scurvy can be diagnosed through ascertaining a decreased plasma vitamin C level, generally below 0.1 mg/dL [4].

Vitamin C is necessary for the body to function as it "is essential for the formation of bone and connective tissue [which binds other tissues and organs together]" [5]. Additionally, it acts as an aid in absorbing iron into the body as well as healing burns and wounds. Because vitamin C is an antioxidant, it enables the body to protect itself from free radicals which are "reactive by-products of normal cell activity" [5]. Furthermore, vitamin C is crucial in producing the hormone necessary to regulate metabolism speed [1] and is integral for proper collagen synthesis, which leads to effective "dentine formation" to prevent the loss of teeth [8].

Twenty-first century recommendations for the protection against scurvy require the daily intake of 10 mg of vitamin C [7]. Diagnosed patients should increase their daily intake from 100 to 200 mg and 500 mg in severe cases. Upon intensive treatment, symptoms should disappear within two to three days and bone disorders are expected to heal in up to three weeks [9]. Suggested sources of vitamin C include broccoli, Brussels sprouts and green peppers. One should take note that vegetables do not retain their vitamin C content when cooked [6] and subsequently canned vegetables lose large portions of their healthful content [5].

Current suggestions indicate that mustard may be used as a possible cure for Scurvy, in sync with a fourth century remedy prescribed by Rabbi Yochanan [3]. Thanks to the brilliant minds of the Talmudic sages, experienced sailors, and early physicians, scurvy's life threatening effects remains a nightmare of the past. Today, it is rare to develop scurvy except in impoverished communities due to malnutrition. Fortunately, we now know that vitamin C, available in simple citrus fruits, is the answer to this age-old public health dilemma.

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REFERENCES

[1] Chang, A. L. S., Katz, L.M., Hawley, H. B., Piotrowski, N. A.(2008). Medical Guide Volume IV. Irons-George, T., Dawson, D. P., Garey, D, Beres, C. B., Buchea, J. I. (Eds.). Salem Press Inc, Pasadena, CA.

[2] Rosner, F.(1972). Scurvy in the Talmud. NYS J. Med. 72:2818-2819.

[3] Preuss, J. (1993). Biblical and Talmudic Medicine. Rosner, F. (Ed.) Jason Aronson Inc., Northvale, NJ.

[4] Tierney. L., Jr., McPhee, S. J., Papadakis, M. A. (2008). Current Medical Diagnosis and Treatment, 47th Edition. Tierney. L., Jr. (Ed.). McGraw-Hill, New York, NY.

[5] The Merck Manual, (2003) 2nd Edition. Beers, M. H., Porter, R., Fletcher, A.I., Jones, T. V., Berkwits, M., Kaplan, J. L. (Eds.). Merck & Co., Westpoint, PA.

[6] Clark, R. L., Cumley, R. W. (1973). The Book of Health. Clark, R. L., Cumley, R. W. (Eds.)Van Nostrand Reinhold, New York, NY.

[7] Shils, M. E., Young, V. R., (1988). Modern Nutrition in Health and Disease, 6th Edition. Lea & Febiger, Philadelphia, PA.

[8] Rajakuma, K. EMedicine. Web Med. http://emedicine.medscape.com/article/985573-overview. (Retrieved January 10, 2009).

[9] Professional Guide to Diseases, (2005). 8th Edition. Etkin, S., Lenker, D. P., Mills, E. J. (Eds.). Lippincott Williams & Wilkins, Amber, PA.

SKIN COLOR PHENOMENA IN THE TORAH

KATE ROSENBLATT

Skin color is one of the most distinguishable features of human appearance. It is a polygenic trait, controlled by 3 or 4 genes. Each gene by itself makes only a small contribution to the phenotype; the overall appearance is a reflection of the sum total of the effects of each individual gene [1].

Breishit (9:18) gives some interesting insight into the genetics of skin color: "The three sons of Noach who emerged from the *tevya* were Shem, Chom, and Yefet, and the descendants of these spread over the whole Earth." As such, the people who survived the *mabul* were inevitably going to be the ancestors of all subsequent human populations. According to a *medrash* in *Breishit Rabbah* (34:7), Chom and his wife were olive-skinned and are thought to be the progenitors of the dark-skinned races. But how does this explain the existence of extremely dark skin [1]?

Suppose a gene pair for skin color contains a dominant allele *P* that codes for a certain amount of pigmentation and a recessive allele *p* coding for no pigmentation. In a case in which skin color is determined by 3 pairs of polygenes, a person with the genotype *P1p*1*P*2*P*2*P*3*P*3 will be darker than someone with the genotype *P*1*p*1*P*2*p*2*P*3*p*3. During the process of gametogenesis, these polygenes are randomly allocated to the gametes, or sex cells. Two trihybrids with the genotype *P*1*p*1*P*2*p*2*P*3*p*3 could hypothetically have offspring ranging from opposite ends of the skin-color spectrum. That is, from albino (*p*1*p*1*p*2*p*2*p*3*p*3) to extremely dark or black skin (*P*1*P*1*P*2*P*2*P*3*P*3). Thus, if Chom and his wife were trihybrids, each having a skin color genotype of *P*1*p*1*P*2*p*2*P*3*p*3, there is a 1/256 chance that they could have produced offspring with extremely dark skin [1].

A story that dates back only to 2006 illustrates this phenomenon. In this case, a mixed-race (olive-skinned) couple produced a set of twins with very different skin color genes. One twin was black with dark hair and dark eyes, while the other twin was white with blonde hair and blue eyes. As mentioned above, in the process of gametogenesis in the parents, a random mixture of genes are distributed to each sex cell. Gametes from a mixed-race person will in most cases have a combination of both black and white genes. These gametes will fuse to form a zygote, with a phenotype of a mixed race. Rarely will the egg or sperm have all the genes for one skin color, but it could still happen. If both egg and sperm contained all "white" genes, then the baby will be "white" and if the egg and sperm contain all "black" genes, then the baby will be "black." This rarity is exactly what happened in the case of this mixed race couple who produced twins with phenotypes at opposite ends of the skin-color spectrum [2].

> According to Rabbi Yehoshua ben Korchah, the significance of Queen Esther's second name, Hadassah, was evident in the greenish yellow tinge of her skin, like that of a myrtle.

Getting back to Chom and his wife, the story about the twins supports the likelihood that Chom and his wife were the progenitors of the black race. At the same time, it also points to the possibility of Chom and his wife having been able to produce offspring with an albino skin as well [1].

Words in Torah also give insight into various diseases that are characterized by unusual discoloration of the skin. One of these infirmities is neonatal jaundice, whose most visible symptom is the yellowing of the skin [3]. Jaundice is the most commonly discussed liver disease in the Talmud. Some medical information on the condition is provided by an anecdote in the Talmud, which demonstrates its practical application in the customary *brit milah* [4]. But before the *halachic* applications of the condition are delved into, it is necessary to offer a brief description of the disease.

Jaundice is caused by too much bile pigment in blood. In neonates, hemolytic or pathological jaundice is characterized by an increased production of bile pigment as a result of red blood cell damage. This type of jaundice may be caused by

antibodies produced by an incompatible blood transfusion. In infants, this may be caused by fetomaternal blood group incompatibility [3]. The antibodies produced by the mother to fight the mismatch will treat her fetus as an intruder, causing the red blood cells in the fetus to agglutinate [5]. Bilirubin is the yellow breakdown product of normal heme catabolism and is excreted in the urine. Relatively high levels of bilirubin, however, may be indicative of such hemolytic disease and is a symptom of pathological jaundice [6]. Physiological jaundice on the other hand, sometimes also found in neonates, is typified by hyperbilirubinemia, a temporary defect in the synthesis of the enzyme that breaks down bile to an excretable form [3].

Modern medicine notes that technically an infant diagnosed with neonatal hyperbilirubinemia is no more at risk to undergo *brit milah* than is an infant without the condition. If medical opinion was the only standard for determining whether or not *brit milah* is to be performed, the ritual would not be delayed for an infant with physiological jaundice [7]. However, a passage in the Talmud (*Shabbat* 134a) may indicate otherwise:

"Abaye also said: Mother told me…If he [infant] is *yarok*, so that he is deficient in blood, we must wait until he is full-blooded and then circumcise him." Furthermore, R' Natan was presented with a case of a woman whose first two sons had died from bleeding after circumcision. She brought her third son before R' Natan, who relayed that "seeing that he was *yarok*, I examined him and saw no covenant blood in him. I said to her, wait until he is full-blooded; she waited and then circumcised him and he lived. They called him Nathan the Babylonian after my name."

There is some controversy as to exactly what color *yarok* or *yerakon* refers to and whether or not the term used in the case of R' Natan Habavlee actually referred to neonatal jaundice. However, the Talmud generally uses the words *yarok* and *yerakon* to describe jaundice, characterized by a yellow discoloration of the skin [4].

During the time of the Talmud, there was no clinical test for these diseases [7]. An authority would notice an infant's yellow complexion and conclude that the infant may be at risk for some disease. This concern alone justified the postponement of the *brit milah* until the symptoms disappeared. However, with today's diagnostic testing, it has been determined that an infant with physiological jaundice is at no greater risk to undergo *brit milah* than a normal, healthy baby. Do the statements of Abaye's mother bear the same weight as *halacha*? It seems that her recommendation suggested no basis in *halachic* tradition. In fact, *Rashi* commented that the advice of Abaye's mother was based on her experience as a nurse, indicating the medical opinion of the time [7].

On the other hand, the advice of Abaye's mother prompted a ruling by the *Rambam* (*Hilchot Milah* 1:17) and the *Shulchan Aruch, Yoreh De'ah* (263:1). As such, many rabbinical authorities forbid circumcision of a jaundiced infant despite modern medicine's view that physiological jaundice is not a threat to the infant; "one cannot accept medical advice that contradicts the words of *Chazal* [7]."

Further analysis of the passage may make one wonder if the Talmud even intended to postpone *brit milah* in all cases of *yarok*. In fact, *Rambam*, *Hilchot Milah* (1:17) actually ruled that an infant who is "*yarok be-yoter*" or overly-*yarok* may not be circumcised. By implication, an infant with a tint of *yarok*, may be circumcised. The *Avnei Nezer*, *Choshen Mishpat* (no. 125) cited *Rambam*'s verdict as justification for giving final authority to the physician in evaluating the overall condition of the jaundiced infant [7].

The *tinok hayarok* mentioned in the Talmud may have been referring to *tinok hayarok be-yoter* as more than 60% of all babies born display symptoms of jaundice. It would be irrational to consider that historically 60% of all circumcisions were delayed. Otherwise, a more extensive discussion on the topic would be evident in previous sources. By implication, the standard of *yarok* is likely to be *yarok be-yoter* [7].

Further discussion on the *tinok hayarok* is far beyond that which has been discussed. In the final analysis, a Rav is always to be consulted in the case of a *tinok hayarok* and a doctor should make the diagnosis with the *mohel*'s approval. In cases of physiological jaundice, decisions regarding whether or not to postpone the *brit milah* are rendered on a case-by-case basis. A diagnosis of physiological jaundice is generally based on eliminating the possibility of hemolytic disease and evaluating the overall health of the baby and level of bilirubin. In cases of pathological jaundice the *brit milah* is always postponed until symptoms have disappeared [7].

Thus far, skin color phenomena implied by or openly discussed in Torah have been gleaned from the *Chumash* and *Talmud*. Another such incidence of skin color is evident in the *Megillah* as well. Traditionally, Judaism believes that a person's name bears some symbolic meaning. According to Rabbi Yehoshua ben Korchah, the significance of Queen Esther's second name, Hadassah, was evident in the greenish yellow tinge of her skin, like that of a myrtle. Queen Esther is thought to have had an interesting medical condition called chlorosis, also known as "green-sickness". This condition manifested in young women plagued by iron deficiency anemia and is accompanied by a greenish complexion [8].

As far as what recorded history can impart, physicians have attempted to describe the features of chlorosis since the 17th century, but the actual nature of the disease remained a mystery for a long time. However, in 1895, it was proposed that chlorosis was caused by a nutritional iron deficiency. This seems to be the generally accepted medical opinion today. Cases of chlorosis have increasingly been recorded towards the end of the 19th century, but after World War I the incidence of the disease declined. By the 1930s, cases of human chlorosis were no longer being reported [9].

Some of the earliest references to chlorosis in the medical literature discuss the habit of avoiding meat as being a contributing factor to the disease [10]. It is interesting to note that according to a *midrash*, Queen Esther avoided meat in the palace of Achashverosh so as not to transgress the Jewish dietary laws [11]. By doing so, she denied herself an excellent source of iron [12]. Perhaps there is a relationshsip between these facts about the nutritional value of meat, Queen Esther's meatless diet in the king's palace, and her "diagnosis" of green-sickness.

Queen Esther's greenish complexion may have been caused by a reduced hemoglobin percentage, a symptom of chlorosis [13]. Hemoglobin is the iron-containing protein that transports oxygen in red blood cells [14]. Reduced hemoglobin may point to a decrease in the amount of normal blood circulating at the surface of the body [13]. This may explain the greenish yellow pallor of Queen Esther, which apparently did not detract from her beauty.

From the genetics of skin color, to the *tinok hayarok*, to Queen Esther's green complexion, the *Torah* provides some compelling insights into various skin color phenomena. Some of the insights described in this manuscript, particularly regarding Chom and Queen Esther, have their basis in *midrash*, which is well known for its allegorical *aggadot*. While the credence of *Torah* supercedes that of modern science, modern scientific knowledge can reinforce the degree of certainty to which *midrashim* can be explained literally. And with the medical knowledge available today, science can offer explanations for phenomena referenced to in *Chumash,* the *Talmud*, and *midrashic aggadot* that include a vast range of topics not only skin deep.

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REFERENCES

[1] Babich, H. (2001). Noach and the *Tavya*: Some Torah, Some biology. Derech Hateva: a Journal of Torah and Science. 5: 59-65.
[2] Black and White Twins. Mail Online. http://www.dailymail.co.uk/news/article. (retrieved January 15, 2009).
[3] Dickey, N.H. (1972). Jaundice or Icterus. Funk and Wagnall's New Encyclopedia, Vol. 15. Funk and Wagnall's Inc, United States.
[4] Westreich, M. (1990). Liver disease in the Talmud. J. Clin. Gastroenterol., 12:57-62.
[5] Rh Factor in Pregnancy. Pregnancy and Childbirth. http://pregnancy.about.com/cs/rhfactor. (retrieved January 16, 2009).
[6] Neonatal Jaundice. Wikipedia. http://en.wikipedia.org/wiki/Neonatal_jaundice. (retrieved January 16, 2009).
[7] Flug, J. (2005). Jaundice and circumcision. Jewish Med. Ethics, 5:40-48.
[8] Hoenig, L.J. (2006). Queen Esther: strong as steel but iron deficient. www.FloridaJewishNews.com
[9] Guggenheim, K.Y. (1995). Chlorosis: The rise and disappearance of a nutritional disease. J. Nutr. 125:1822-1825.
[10] Loundon, I.S.L. (1980). Chlorosis, anemia, and anorexia nervosa. Brit. Med. J. 281:1669-1675.
[11] Queen Esther the Vegetarian. The Jew and the Carrot. http://www.jcarrot.org/queen-esther-the-vegetarian/ (retrieved January 15, 2009).
[12] Iron Rich Foods for Iron Deficiency Anemia. Health Castle: Simply Better Health. http://www.healthcastle.com/iron.shtml (retrieved January 15, 2009).
[13] Greene, C.L. (1917). Medical Diagnosis for the Student and Practitioner. P. Blakiston's Son and Co., Philadelphia, P.A.
[14] Hemoglobin. Wikipedia. http://en.wikipedia.org/wiki/Hemoglobin (retrieved January 18, 2009).

VACCINATIONS: AN EXPLORATION OF THEIR HISTORY, DEVELOPMENT AND *HALACHIC* RAMIFICATIONS

DEBRA ZHARNEST

The importance of caring for and protecting one's *guf* is prevalent throughout *halachic* discussions and literature. The *Rambam* states in *Mishneh Torah* (*Hilchot De'ot* 4:1) that a person "must avoid things which have a harmful effect on the body" and should instead "acclimate himself towards things that cure and fortify it" [1]. It is clear that *halachic* authorities, such as the *Rambam,* support the concept of taking preventive measures to avoid physical afflictions. In the United States, one form of preventative medicine regularly practiced is vaccination. In addition to providing a brief overview regarding the history and development of vaccinations and the reaction of the Jewish community, this article will touch upon some of the controversies and concerns associated with this form of preventive medicine and discuss this topic from a *halachic* perspective.

In the United States, immunization is usually performed via an injection of a vaccine in the upper arm or thigh. Typically, these vaccines contain a weakened (attenuated) or killed (inactivated) strain of a certain virus as their active ingredient. A vaccine enables the human immune system to learn how to make the specific antibodies necessary to combat a particular virus or microbial illness. As the active ingredients in vaccinations are killed or significantly weakened viruses, there is little risk that the immune system will become overwhelmed by the viral content of a vaccine. Upon future exposures to the virus that the individual was vaccinated against, the human immune system recalls how to make the antibodies needed to combat that viral illness; thus immunity is established. Generally, the risks associated with the vaccinations given in the present day are mild; one might feel sore at the site of injection or develop a low grade fever. While more substantial side effects, such as a severe allergic reaction, can occur, these risks are extremely rare [2].

The concept that one could develop immunity towards a specific disease upon exposure to it was actually common knowledge years before the creation of formal vaccinations. During the eighteenth century, groups throughout Europe and Colonial America relied on variolation to circumvent the spread of smallpox. Using this method, individuals would deliberately expose themselves to smallpox in the hopes of becoming infected with a mild form of the disease; rendering them immune to future outbreaks. Several techniques were used to variolate individuals, including blowing smallpox scabs into the noses of those being variolated or inserting the scab into a superficial scratch on the arm [3]. Similarly, Rabbi Shalom Buzagli, who served on the *beis din* in London during the late 1700s, recounted a method used in the Jewish community to immunize children against smallpox. Children who had suffered from the disease but were thankfully near recovery would be given several raisins to hold. After these raisins were warmed by the hand of the recovering child, they would be given to uninfected children to eat. The healthy children would then develop a mild form of smallpox, rendering them immune to future outbreaks of the disease [1].

It is clear that the face of medicine is constantly changing and as situations in the medical field change, *halachic* rulings regarding those situations are reevaluated as well.

However, although variolation did occasionally work in establishing immunity towards smallpox, overall, it was not widely successful. In fact, in Colonial America, due to fear that variolated individuals could transmit smallpox to others, several antivariolation laws were passed and the use of variolation was strictly limited [3].

Though variolation was not a foolproof technique, its mortality rate was still only about 0.5-2%, significantly lower than the 30% death rate associated with smallpox

[4]. Perhaps because of this, the concept of variolation was widely supported in the Jewish community; even endorsed. For example, in 1785, Rabbi Abraham Nanzig, a *Rav* in London whose two sons had died of smallpox, wrote a treatise entitled *Aleh Terufah*. In this document, Rabbi Nanzig strongly advocated for use of variolation against smallpox in order to prevent further spread of the disease. Interestingly, in this brief text, he referred to variolation as "inoculation" and urged *Rabbanim* to support this course of action. Although there was a slight risk involved with variolation, Rabbi Nanzig argued that "inoculation" was indeed permissible because it would prevent the even greater risk of full blown smallpox [1].

In fact, "inoculation" was considered so important that several *poskim* even allowed for the variolation of healthy individuals on *shabbos*. This *halachic* ruling was dependent on the status of the individuals being inoculated; whether merely one's presence in a smallpox ridden area was enough to render him a *choleh she'ain bo sakanah,* (one experiencing a non-life threatening illness) due to the probable chance that he would catch the disease. For an individual granted such a status, one is allowed to transgress *issurei dirabbanan* (*rabbinical* prohibitions) in order to aid the person medically [5]. In more recent times, Rav Shlomo Zalman Auerbach declared that one is allowed to receive a vaccination on *shabbos* if delaying the injection until after *shabbos* could cause a situation of *sakanah* [1, 5].

Numerous *Rabbanim* similarly supported and stressed the importance of vaccination following the development of the first smallpox vaccine in the late eighteenth century. Dr. Edward Jenner vaccinated an eight year old boy named James Phipps against smallpox using material taken from a cowpox pustule on the hand of a milkmaid named Sarah Nelmes on May 14, 1796. Jenner had observed that individuals who contracted cowpox were immune to smallpox and indeed did not show symptoms of smallpox upon variolation. However, previous attempts to immunize individuals using material taken directly from the cowpox pustules on infected cows were highly unsuccessful [3].

Additionally, Jenner noticed that in certain instances, individuals who had been infected with cowpox, due to exposure to pustules on contagious cows, were not necessarily immune to smallpox. Because of this, Jenner decided to avoid use of material taken from infected cows all together, and instead transferred the disease directly from person to person using material taken only from cowpox pustules found on the hands of infected humans. Jenner's method successfully immunized James Phipps who was later variolated with smallpox over twenty times to prove that he had indeed developed an immunity to the disease. Although Jenner was met with skepticism and opposition, his research led to the further development and widespread use of the smallpox vaccine and other vaccinations [3].

Interestingly, Rabbi Israel Lifschutz, author *Tiferet Yisrael*, a commentary on the *Mishna*, called Jenner a "righteous gentile" for his contributions to the medical field. Similarly, Rabbi Nachman of Bratzlav stressed the opinion that vaccination was compulsory for Jewish individuals. He felt that parents must have their infants vaccinated against smallpox before the age of three months and considered not doing so to be equivalent to murder [1]. Dr. Edward Reichman notes in his article "*Halachic* Aspects of Vaccination" that several other well-known *Rabbanim* also endorsed Jenner and vaccination; including Rabbi Eliezer Fleckles (1754-1826), Rabbi Ishmael HaKohen (1723-1811) and Rabbi Mordechai Banet (1753-1829) [5].

The *pasuk* in *Vayikra* (18:5) states, *"Ushemartem es chukosai v'es mishpati asher yaa'se osam ha'adam v'chai bahem,"* that one must keep the *chukim* and *mishpatim* and live by them. This *Gemara* discusses the meaning of the phrase "live by them" and bases several of its rulings regarding the concept of *pikuach nefesh*, what one should do to save another Jew's life, on this *pasuk*. The *Gemara* (*Yoma* 82A) rules that an individual must be willing to do anything and everything, even transgress certain *mitzvos,* in order to save a human life [1]. Similarly, the *Shulchan Aruch* (*Yoreh De'ah* 263:1) states, *"Sakanos nefashos docheh es hakol,"* that saving lives overrides everything [1]. This idea is helpful in understanding why major *poskim* may have encouraged vaccination. If preservation of human life overrides observance of *mitzvos* in certain cases, certainly taking preventative measures against diseases that could potentially lead to life threatening situations is encouraged, if not required, by *halacha*.

The smallpox vaccine was improved over time; different strains of the disease and other viruses related to smallpox were gradually substituted in vaccinations in place of the cowpox strain that Jenner had used. The virus presently used for the smallpox injection is known as vaccinia. Although it does show similarity to smallpox, vaccinia is considered a distinct virus. There is an estimated risk of death of approximately 1 per 1, 000, 00 among individuals inoculated with the vaccinia vaccine due to complications [3]. However, despite these risks, use of the smallpox vaccine was successful in effectively halting outbreaks of the disease in the United States, thereby minimizing risk of exposure to the illness. Because of this, the practice of vaccinating children and hospital employees against the disease was

discontinued in 1971 and 1976 [3]. Presently, the Center for Disease Control and Prevention does not recommend vaccination against smallpox.

It is clear that the face of medicine is constantly changing and as situations in the medical field change, *halachic* rulings regarding those situations are reevaluated as well. For example, although *poskim* once ruled that the smallpox vaccine was a crucial, if not a required, procedure, in the present day this ruling has changed [4]. As inoculation against smallpox is no longer recommended in the United States, and as there are some risks, however minimal, associated with the vaccination, religious individuals cannot simply request the unnecessary injection.

The issue of undergoing a needless vaccination is brought to light based on a concept discussed in the *Gemara* (*Bava Kama* 90B) known as *chovel b'atzmo, i.e.*-A Jew is forbidden to deliberately cause harm to himself. There are exceptions to this ruling however; for example, if the benefits of the harm performed outweigh the actual harm, then one is permitted to harm oneself or have others induce harm for him. This idea is one of the reasons why an individual is allowed to undergo necessary surgery; although most surgical procedures cause some form of harm, the benefits of these procedures far outweigh the injury [4]. In the case of the smallpox vaccine, because there is virtually no risk of an individual becoming exposed to smallpox in the United States, the vaccination has little purpose. Therefore, the benefits associated with the injection should not outweigh the prohibition of *chovel b'atzmo*. However, should an individual be in a situation where smallpox exposure is a risk, he should certainly consult with a *posek* regarding inoculation.

A similar issue can be debated concerning poliomyelitis vaccination. During the 1950s, the outbreak of polio in the United States led to the development of the Salk vaccine. This vaccine, however, was not ideal because although it did provide immunity against polio for the individual being vaccinated, it did not stop that individual from possibly spreading the polio virus to others. A few years later, a more effective oral vaccine known as the Sabin vaccine was created, which did prevent the spread of polio to others, thus halting the epidemic. The basic difference between these vaccines was that the Salk vaccine contained a killed strain of the polio virus, while the Sabin oral vaccine contained a weakened, live strain. This meant that individuals inoculated with the Sabin version had a slight risk of actually contracting polio from the vaccine. Although during the polio epidemic the Sabin vaccine was used, once the risk of contracting polio in the United States became minimal, utilization of the Salk vaccine was reinstituted. *Rabbanim* allowed Jews to be vaccinated with the Sabin vaccine during the 1950s, but in present day, requesting an unnecessary Sabin oral vaccine given the known risks certainly has *halachic* implications [4].

Vaccination in general, however, is widely supported and encouraged by major *poskim* for various reasons. For example, Rabbi Hershel Schacter has stated that in places where vaccination is required by the state for the purpose of attending school, "one would be obligated to be immunized based on the concept of *Dina d'Malchuta Dina,"* meaning the law where an individual lives is the law [1]. Similarly, Rabbi Elliot N. Doroff has noted that in cases where a vaccination has proven to be effective, if one refuses the injection or does not allow their children to be vaccinated, it is a direct violation of *Halacha*. He also expresses the opinion that since vaccines prevent illness, they have the status of a *mitzvah*, even when there is only a small the risk of catching that particular disease [1].

Presently, the United States Department of Public Health and the Centers for Disease Control and Prevention recommend the following vaccinations for infants and children: hepatitis A, hepatitis B, diphtheria, tetanus, acellular pertussis, polio, human papilloma virus (girls), varicella, measles, mumps, rubella, influenza, rotavirus, meningococcusand pneumococcus [2].

Currently in the United States, individuals in 48 out of the 50 states can be granted religious exemption from the required childhood immunizations if they believe that these vaccinations are in opposition to religious belief [1]. Interestingly, there are members of the Jewish community who do choose not to have themselves or their children vaccinated based on the concept discussed in the *Gemara* (*Yevamos* 12B, *Yevamos* 72A) of *shomer p'saim Hashem (Tehilim 116:6)*, that G-d protects the "simpleton" [5]. For example, this idea is sighted by the *Gemara* as the reason why one can perform a *bris* on a cloudy day. Even though there is an apparent risk of holding a *bris* on such a day, one can rely on the fact that G-d will guard him and have the *bris* anyway. Similarly, according to this train of thought, G-d will protect individuals from diseases even if they do not take preventative measures by undergoing vaccination. However, the majority of *poskim* agree that mandated vaccination does not contradict religious beliefs, but is actually recommended according to *Halacha*.

Rabbi Bachya ibn Pakuda, who lived during the 11th century in Spain, stated that although one's "days are decided beforehand by G-d, one should engage in obtaining…his needs…one should not endanger himself relying solely on

his trust in G-d" (*Chovot ha-Levavot, Shaar Ha-Bitachon*, Ch. 4.). This means that an individual should not simply depend on G-d to take care of his physical needs; but rather, he personally has to do whatever he can to care for his *guf* [1]. One should therefore not forego necessary sustenance or procedures based on this idea.

Additionally, *Mishlei* (23:13) states, "*Al timnah mina'ar mussar ki takeneh bashevet lo yumas,"* that one should not withhold rebuke from a child; even though one is 'beating' him, he will not die. The *Ralbag* on this *pasuk* explains that not only is one obligated to protect one's child spiritually, but he also must ensure that a child is protected physically so that the body which houses the child's *neshama* does not come to any harm [1]. This would indicate that individuals are encouraged by *Halacha* to have their children undergo recommended vaccination procedures. For this reason, one should consult with a reliable *halachic* authority before deciding against vaccination.

Recently, there are also members of both the Jewish and non-Jewish communities who have resisted having their children vaccinated due to the possible correlation between certain vaccinations and autism. A particular concern is that vaccines made with thimerosal, a preservative material containing mercury, which can be found in vaccinations such as the hepatitus B vaccine Engerix B, the influenza vaccines Fluvirin and Fluarix, and the diptheria vaccine Tripedia, lead to the development of autism in young children. However, the Centers for Disease Control and Prevention state that these specific vaccinations contain less than 0.3 mcg of mercury and should be considered thimerosal free products, as these amounts have no biological effects [2].

Similarly, although certain vaccinations do contain amounts of thimerosal as a significant ingredient, this component is derived from ethymercury as opposed to methylmercury. As ethylmercury is quickly broken down by the human body and excreted, it is unlikely that enough mercury from these vaccinations could accumulate in the body to cause any harm [2].

A second concern voiced regarding vaccination is the possible correlation between the recommended measles-mumps-rubella (MMR) vaccine and autism. However, an evaluation of the research supporting this correlation revealed that the studies performed were inaccurate and contained flaws. Further studies have been conducted in recent years which support the notion that the MMR vaccine does not cause autism, rather autism occurs during early prenatal development of the nervous system [2]. Although *Rabbanim* do advise against undergoing unnecessary, risky vaccinations, one should not assume that these and other concerns regarding vaccinations render them *halachicly* questionable or forbidden.

The *Shulchan Aruch* (*Yoreh De'ah* 116:5) states that a person should be careful "not to put coins in his mouth in case they carry the dried saliva of one suffering from a skin disease." The *Rema* explains regarding this idea that an individual must be careful regarding any potential dangers because *Halacha* considers "a danger more stringently than a matter forbidden as a matter of ritual law" [1]. This implies that while the risks of vaccination are minimal, individuals still have an obligation to inform themselves of the various concerns and dangers. Similarly, individuals are obligated to investigate and make themselves aware of the possible ramifications of refraining from vaccination and are urged to consult with a *halachic* authority before making any decisions.

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REFERENCES

[1] Prouser, J.H. (2005). Compulsory Immunization in Jewish Day Schools. HM 427:8. http://www.rabbinicalassembly.org/law/teshuvot_public.html/ (retrieved January 2, 2009).
[2] Centers for Disease Control and Prevention. http://www.cdc.gov/vaccines/ (retrieved January 2, 2009).
[3] Behbehani, A.M. (1983). The Smallpox story: life and death of an old disease. Microbiol. Rev. 47:455–509.
[4] http://www.aish.com/societyWork/sciencenature/The_Ethics_of_Smallpox_Immunization.asp/ (retrieved January 6, 2009).
[5] Reichman, E. (2008). The *halachic* aspects of vaccination. Jewish Action. 69: 10-14.

BIRCAS HACHAMMAH

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This past erev *Pesach* (5769) was the first time in twenty-eight years that the Jewish people had the rare opportunity to perform a particular *mitzvah*. That *mitzvah* was *Bircas haChammah*, the recitation of the blessing of the sun. The occasion for this *mitzvah* is the return of the sun to the exact position, at the very same time of day and day of the week, at which it was placed in the heavens on the fourth day of creation. This alignment occurs just once every twenty-eight years, and marks a unique milestone since creation. With the recitation of a *bracha*, man acknowledges and reaffirms his belief in the Creator.

The Source of the Mitzvah

Bircas haChammah's source is found in the Gemara (*Berachos* 59b) which states,

"Our Rabbis taught: He who sees the sun at its turning point (*tekufasah*)...should say: 'Blessed are You Who makes the work of creation (*Baruch oseh b'reishis*).' And when does this happen? Abaye said: Every twenty-eight years when the cycle begins again and the *Nisan* [spring] equinox falls in Saturn on the evening of Tuesday going into Wednesday."

The Jewish Calendar

In order to understand the details of *Bircas haChammah*, one must be familiar with certain aspects of the Jewish calendar. The calendrical system utilized by Judaism is lunisolar; that is, it takes into account both the lunar month and the solar year and reconciles the two with each other. The use of a lunisolar calendar is mandated by two distinct Torah commandments. The first is, *"Ha'chodesh ha'zeh lachem,"* the commandment to determine the months according to the new moon (*Shemos* 12:2). The second is to "watch [preserve] the month of *Aviv*" (*Devarim* 16:1) such that *Pesach* always occurs in the spring season, a condition that is wholly dependent on the sun. Since, according to Rav Shmuel (*Eruvin* 56), the time it takes for the Earth to complete a full rotation around the sun (a solar year) is approximately 365 1/4 days, and the length of time of one rotation of the moon around the Earth (a lunar month) is approximately 29.5 days, twelve lunar months is about eleven days short of a solar year (29.5 x 12 = 354). If Judaism operated solely on a lunar calendar, *Pesach* would be celebrated approximately eleven days earlier with each subsequent year and would wander through the seasons. To preserve the seasonal aspect of the holidays, Judaism reconciles the eleven day discrepancy between the solar and lunar years by integrating an extra month of *Adar* (*Adar Sheni*) seven times in a nineteen year cycle. Therefore, the lunisolar nature of the Jewish calendrical system is indispensable; while each month and its holidays are determined by the cycle of the moon, reconciliation with the solar year ensures the maintenance of the Jewish holidays in their appropriate seasons [1, 2].

With the recitation of a *bracha*, man acknowledges and reaffirms his belief in the Creator.

The Tekufos

The Gemara mentions the *"chamah b'tekufasah,"* the "sun at its turning point," as the appropriate occasion for this mitzvah. When is this *"tekufah"*?

The sun, in its apparent motion around the Earth (actually the revolution of the Earth around the sun), appears to "turn", or begin a shift in position, four times a year at the start of each season. During the summer and winter solstices (the longest and shortest days of the year, respectively), the sun is at its maximum north/south distance from the equator and "turns back" to approach the equator instead of progressively moving farther away from it. The equinoxes are the two days of the year- the first day of spring and the fist day of autumn- when the hours of night and day are approximately equal (hence "equinox" from the Latin "aequus"-equal and "nox"-night). This occurs when the sun is positioned directly over the earth's equator. The equinox is the transitional day when the sun "turns" from one side of

the equator to the other. It was at the position of the vernal equinox that the sun was first placed in the heavens on the eve of the fourth day of creation (approximately 6:00 pm Tuesday evening) [1].

While the vernal equinox occurs every year as the earth initiates a new revolution around the sun, it only occurs at the precise time of day and day of the week that it was created once in twenty-eight years. This is due to the fact that a solar year is (approximately) 365.25 days, which is about thirty hours in excess of fifty-two weeks. Thus, the start of each solar cycle is thirty hours (one day plus six hours) later than the previous year. Thus, if *Tekufas Nisan* occurred at 6:00 p.m. in year 1 of the cycle, the following year it will occur at 12 a.m., the third year at 6 a.m., the fourth year at 12 a.m., and then again at 6 p.m. in the fifth year. Thus, the *tekufah* occurs at the same time of day as the first year after a cycle of four years. However, consecutive years push the *tekufah* 1.25 days ahead of the previous year and thus occurs on a different day of the week; after four cycles, the *tekufah* will begin five days later than at the start of the cycle (thirty hours x four repetitions = 120 hours = 5 days). For example, if the *tekufah* began on Tuesday evening in the first year of the cycle, four years later it will occur at 6 p.m. on Sunday. For the cycles to bring the *tekufah* back to the same time of day and the same day of the week, seven of the four-year cycles are required. Thus, it takes twenty-eight years for the sun to return to the point of its orbit on the same day of the week and at the same time of day that it stood at the moment of its creation.

Calculations of the cycles: then and now

The twenty-eight year cycle is based upon the calculations of the Talmudic sage, Shmuel. However, contemporary astronomy tells us that Shmuel's calculations were slightly inaccurate. In fact, even in Talmudic times the calendar of Shmuel was disputed by Rav Adda, whose calculations were even closer to that of modern day astronomy's. The length of a solar year according to contemporary astronomy is 365 days, 5 hours, 48 minutes and 46 seconds. The lunar month is 29 days, 12 hours, 44 minutes and 2.841 seconds. Rav Shmuel assumes a solar year of 365.25 days and a lunar month of 29.5 days. Rav Adda, on the other hand, is closer to the calculations of modern astronomers, with a solar year of 365 days, five hours, fifty-five minutes and 25 and 25/57 seconds, and the lunar month of 29 days, 12 hours, 44 minutes and 3 1/3 seconds. Thus, the solar year of the Jewish calendar according to Rav Adda is just 6 2/3 minutes more than its true astronomical time, and the lunar month is approximately half a second longer than its true astronomical time. Considering the complexity of the calculations, the accuracy of the Jewish calendar, instituted 2000 years ago, is remarkable. Moreover, certain approximations are utilized in every calendrical system. The Roman calendar, which is the basis of civil calendars of the Western world, assumes a solar year of 365.25 days, which is approximately eleven minutes longer than the solar year's actual astronomical length [1, 2].

If, however, the Sages did indeed have Rav Adda's calendrical system, which was known to be the more accurate, and was in fact used for various halachic purposes, why is the twenty-eight year cycle based on the less accurate approximations of Shmuel? The *Chazon Ish* suggests that in all cases where the Sages approximated a mathematical value, (for example, the Sages approximate the value of pi as three instead of the more accurate 3.141592...) it was for the purpose of preserving harmony and preventing controversy among the Jewish nation. While intricate scientific details were preserved for the expert few, approximations, while retaining as much accuracy as possible, were passed on to the masses to maintain a degree of simplicity such that the common man could perform the *mitzvah* [1, 2].

Creation in *Nisan* or *Tishrei*?

The timing of *Bircas haChammah* is based on the view of Rabbi Yehoshua that *Adam ha'rishon* was created in *Nisan*. However, according to opinion of Rabbi Eliezer, *Adam* was created in *Tishrei* (Gemara Rosh Hashana 10-12). Various Jewish laws are predicated on the view that the world was created in *Tishrei*. For example, *Rosh HaShanah* is on the first of *Tishrei*, *Shmittah* and *Yovel* (sabbatical and jubilee years) are counted from *Tishrei*. Why, then, do we not recite *Bircas haChammah* in *Tishrei*? The *Tosafos* explains that the opinion of Rabbi Yehoshua is an empirical fact and thus utilized for calculation of the *tekufos*. The view of Rabbi Eliezer, on the other hand, is accepted as a Halachic convention.

There is another interesting explanation that may reconcile this ambiguity regarding the date of the creation of the world. The *Midrash* (*Bereishis Rabbah* 10:4) states that the planets traveled more rapidly prior to the sin of *Adam ha'rishon*. In fact, according to Einstein's theory of relativity, all physical processes were massively accelerated when the world first came into being [1, 3, 4]. According to this view, it is possible that the positioning of the sun, moon and stars in their orbits did in fact occur during *Nisan*, however, by the sixth day of creation when man entered the world, they had completed a six-month journey and were in the position occupied in *tekufas Tishrei*.

Prominence of the sun in our world

The reciting of a *bracha* upon witnessing the event reminiscent of the sun's inception in the heavens is meant to move man to a greater appreciation of the creation and belief in the Creator. As such, an understanding of the significance of the sun in the functioning of man's world is quintessential.

The sun is the "battery of the world". Its energy is captured by plants and used to generate organic material via the chemical processes of photosynthesis. The energy stored in this organic material is then consumed by animals and humans, and harnessed to drive all life processes. Thus, without the light of the sun, there would be no life on Earth. The sun is ultimately the source of all energy on Earth.

In addition to providing energy, the sun also provides light. The temperature of the outer layer of the sun is approximately 6000º Celsius. The electromagnetic waves that emanate from the sun, affected by its temperature, correspond to the color yellow in the visible light range of the electromagnetic spectrum. Had the temperature of the sun been different, the electromagnetic waves emitted by the sun would not be in the visible wavelength and the sun would be invisible to man [3].

The sun, moon and stars were placed in the heavens with extreme accuracy such that their masses and gravitational forces created an equilibrium and result in the stability of the celestial bodies. Alteration of the mass of one planet or its distance from another, the two factors

that determine the forces responsible for the orbiting of the planets within the solar system, would result in cosmic cataclysm [1].

When asked if he believed in G-d, Einstein replied that he believed in a G-d "Who reveals Himself in the order and harmony of what exists" [4]. What greater harmony than the precise movements of all the heavenly bodies through the universe?

Orchestration of the intricate laws of nature must inspire one who contemplates the universe. As King David wrote, "The heavens speak of G-d's honor" (*Tehillim* 19:2). It is this idea of the infinite glory and honor that the recitation of *Bircas haChammah* is intended to evoke within man.

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REFERENCES

[1] Bleich, Rabbi D.J. (1981). *Bircas HaChammah*. Mesorah Publications, Ltd., New York, N.Y.
[2] Elkin, C. (1980) *Birkath hachamah*: blessing of the sun. Proc. Assoc. Orthodox Jewish Sci. 6:91-115.
[3] Kaveh, M." Parashat Breishit, And G-d made two great luminaries. Bar Ilan University's Parshat Hashavua Study Center. October 6, 1999.
[4] Jastrow,R. G-d and the Astronomers. (1978). W.W. Norton and Company, New York, N.Y.
[5] Campbell, N. A. and Reece, J.B.(2005) Biology, 7th edition. Pearson Education, Inc., San Francisco, CA.

BIBLICAL AND TALMUDIC MICROBES

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Microbiology is the study of organisms that cannot be viewed with the unaided or naked eye, but rather they must be viewed through a microscope. This category of organisms is rather broad and includes bacteria, algae, protozoa, and yeasts, which are types of fungus. Viruses are acellular and, although not considered to be life forms, are usually included in the study of microbiology. Some varieties of microorganisms are actually macroscopic and can be seen without the use of a microscope. Examples are filamentous fungi, which include mushrooms and truffles, and some multicellular algae. Microscopic life forms were first recognized by Antony van Leeuwenhoek, who developed a simple compound microscope and reported the existence of protozoa in 1674 and bacteria in 1676. Thus, there is no mention of microbes in *Ta'nach* or in the Talmud. Mushrooms and truffles, however, are noted in the Talmud.

Leeuvenhoek, dubbed the "father of microbiology," was the first to view "wee animalcules," which today are recognized as unicellular microbes. When examining wine vinegar he noticed that this food item was swarming with microscopic worms, termed "vinegar eels." Orthodox Jewry, not living in a vacuum, once made aware of this finding then needed to reevaluate the *kashrus* status of wine vinegar. Podolak [1] reviewed the *halachic* dilemma caused by discovery of microscopic worms (s*heratzim*) in wine vinegar. Rav Pinchas Eliyahu ben Meir Horowitz in his *Sefer Habrit* was of the opinion that, prior to consumption, wine vinegar must be boiled and then filtered through a very fine cloth. This opinion was not universally accepted, and others, such as Rav Avraham Danziger (*Chochmas Adom* section 34:49) disagreed and stated that the Torah forbade only those s*heratzim* that were visible to the unaided eye [1].

Levi [2] summarized the rabbinical responses to the *kashrus* status of microscopic life forms. (a) Rabbi Epstein in *Aruch HaShulchan* wrote, "The Torah did not forbid that which the eye cannot view, since the Torah was not given to angels, because, if not, as some scientists wrote, the air is filled with very small creatures and a person swallows some of them when opening his mouth" (*Yorah Deiyah* 84, 36). (b) Rabbi Shlomo Kluger determined that an aided eye, i.e., viewing through a microscope, was not *halachically* considered vision. And, (c) in *Igrot Moshe*, Rav Moshe Feinstein (*Yoreh Deiyah* part II, 146) wrote, "these are not the s*heratzim* which the Torah forbade. Using magnification is not mentioned in the *Gemora*, our forefathers did not use a microscope, and it is clear that they kept all the *mitzvoth* and did not fail anywhere, even by way of *oness*." Rav Shlomo Zalman Auerbach (see *Meorot HaDaf HaYomi*, vol. 325; 9th *Av*, 2004) explained, "The *halacha* very often takes into account only those phenomena that are visible to the naked eye and ignores that which is invisible. For example, we may drink water and breathe air, even though they are filled with countless microorganisms."

> However, another possibility is that the Nile River was overgrown with the red dinoflagellate protozoan, *Gonyaulax polyhedra*, the causative agent of the red tides experienced in waters off southern California and Florida.

The above cited *halachic* decision clarifies the need to filter NYC tap water, which comes from reservoirs in upstate New York. The water is contaminated with minute crustaceans, termed copepods, which are visible to the unaided eye. Thus, according to many prominent Rabbinic authorities, NYC tap water must be filtered prior to its use [3].

The role of microbes as causative agents of diseases is traced to the end of the 19th century through the research of Robert Koch, Louis Pasteur, and Joseph Lister. The microbial etiology of disease was unknown in the *Ta'nach* and Talmud. The term, *dever*, translated as "pestilence," refers to lethal, contagious diseases affecting humans (e.g., *Shemos* 5:3; *Devorim* 28:21) as well as animals (e.g., *Shemos* 9:3),

rather than to a specific disease. For most diseases recorded in *Ta'nach*, no clinical descriptions were presented, with the number of deaths being the only relevant information. The Mishnah (Jerusalem Talmud, *Ta'anis* 3:1) defined a disease as *dever* if, in a town that mobilized 500 footmen, 3 cases of death occurred over a period of 3 consecutive days, i.e., Rashi - one new case daily for 3 consecutive days. The mortality rate, rather than the total number of deaths, was used to categorize a disease as *dever* [4, 5].

Viruses

As viruses can be visualized only through an electron microscope, these agents were unknown in Biblical and Talmudic times. However, specific diseases, now recognized to be spread by viruses, were known. One such disease is rabies, transmitted to humans through bites of animals infected with the rabies virus. The virus multiplies within the salivary glands of infected animals and enters humans in the animal's saliva through a bite. In urban settings, dogs were frequently the animals that transmitted rabies. The Talmud (*Yoma* 83b) described a rabid animal as follows: "Our Rabbis taught that five things were mentioned in connection with a mad dog: its mouth is open, its saliva is dripping, its ear flap, its tail hangs between its thighs, and it walks on the edge of the road. Some say, it barks without its voice being heard." As a rabid dog is considered life-threatening, it may be killed on *shabbos* (*Shabbos* 121b). (see Rosner [6] for a detailed discussion of rabies as discussed in the Talmud and by the *Rambam*).

Influenza is a viral disease that is transmitted by inhalation of aerosols containing influenza viruses, released as droplets originating from the respiratory tract of the infected organism. The influenza virus often occurs in a multitude of strains, including animal and human types. Today, many strains of the influenza virus originate in the Far East, where the most common reservoirs for influenza viruses are animal hosts, including ducks, chickens, and pigs, which live in close proximity to each other and to humans. This creates conditions that favor the mixing of viral gene pools within a common host, resulting in genetic recombination and the formation of new strains of influenza virus. Such genetic recombination generally occurs within the intestines of an infected animal and may produce new viral strains containing a mixture of human influenza virus and animal influenza virus genes. The addition of new genes generates new strains of the influenza virus, previously not recognized by the immune system and which could lead to epidemics or pandemics. The worldwide outbreak of influenza that occurred in 1918 killed over 20 million people [7] and was later identified, through DNA analyses, as having originated in swine, pigs [8]. Interestingly, the ability of influenza virus to spread from pigs to humans was suggested in the Talmud (*Ta'anis* 21b). Rabbi Yehudah was once informed that pestilence was raging among the swine. He immediately ordered a public fast. When asked whether he thought epidemics spread from one species to another, he answered in the negative. However he noted that pigs are a special case because these intestines are similar to that of humans.The *Meiri* noted that unlike other domesticated animals, pigs and humans are non-ruminates and therefore have a similar intestinal physiology [9].

Bacteria

It is a common mistake to associate the Biblical disease of *tzara'as* with the bacterial disease, leprosy (Hansen's disease). The causative agent of leprosy is *Mycobacterium leprae*. The strongest proof that clinical leprosy is not *tzara'as* is their comparative modes of growth. *M. leprae* is a most difficult bacterium to grow and, until recently, could not be grown on artificial laboratory medium. Typically, it was propagated in the foot pads of armadillos and mice [10]. Biblical *tzara'as*, however, grows on clothing and buildings. In addition, while leprosy is a slowly progressing disease with clinical changes seen over a period of years, *tzara'as* appears within a period of 1 to 2 weeks [11, 12].

In listing those plagues that *HaShem* will inflict upon *B'nei Yisroel*, note was made of a "withering disease" (*Devarim*, 28:22), which has been suggested to be tuberculosis, resulting from the causative agent, *Mycobacterium tuberculosis* [13]. The respiratory disease, *askara*, affects both children (*Ta'anis* 27b) and adults (*Sotah* 35a; *Yevamos* 62b), and causes death by asphyxiation, is thought to be diphtheria, resulting from the causative agent, *Corynebacterium diphtheriae*. As a*skara* is inflicted as a punishment for slander, it affects the mouth and the throat and is thought to be the disease that afflicted Rabbi Akiva's students (*Yevamos* 62b).

Protozoa

Although most Torah commentaries interpret the first of the ten plagues, *d'am*, as "blood," some commentaries (e.g., *Targum Yerushalmi HsShalam*; *Targum Yonassan*; *Rav Bachya*; *Rav Naftali Zvi* (see *Haamek Davar*, *Shemos* 7:9) suggested that although the Nile River turned red, it was not actual blood. Rav Avigdor Miller [14] stated, "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." If not blood, then what may have caused the Nile River to become red in color and thereafter to be polluted? Rav E.

Munk [15] suggested the Nile River was overgrown with reddish aquatic vegetation. However, another possibility is that the Nile River was overgrown with the red dinoflagellate protozoan, *Gonyaulax polyhedra*, the causative agent of the red tides experienced in waters off southern California and Florida. Although microscopic, when in great abundance, their countless numbers cause the waters to take on a red hue. The die-off of the dinoflagellates and their subsequent decomposition by aquatic bacteria, depletes the dissolved oxygen in the waters. The waters, now anaerobic, are lethal to fish and vegetation, which in turn decay and rot [16]. This sequence of ecologic events, the water turning red, bacterial decomposition of the protozoans, death of the fish and the aquatic vegetation, and their subsequent bacterial decomposition and emanation of a rotting stink, are similar to the events of the Nile River catastrophe.

Algae

The Mishnah in *Shabbos* (2:1) noted those materials acceptable or disqualified for wicks and for oil for the *shabbos* lights. Wicks must be made from material that draws oil well so that the flame will burn steadily, neither flickering nor fluttering. Materials listed as unacceptable include "the green which is on the surface of the water." Feliks [17] suggested that this refers to the filamentous green alga, *Spirogyra,* which was dried and rolled into wicks. However, these *Spirogyra*-derived wicks poorly drew up oil and thus were disqualified for usage. [For those who completed the laboratory section of Principles of Biology 1012, *Spirogyra* is the alga used to demonstrate conjugation]. .

Fungi

Fungi occur both as unicellular organisms, termed yeasts, and as multicellular, filamentous organisms, termed molds. Fungi, lacking the chlorophyll which is present in green plants, are mostly saprophytic, and obtain their nutrients from dead organic material.

Yeasts are key players in the food industry. Traditionally, wine production relied upon sugar fermentation by yeasts indigenous on the grape skins and bread production relied upon fermentation by yeasts, either on the grains themselves or on the hands of those kneading the dough. Today, the food industry does not rely on random microbial contaminants to produce the desired fermentation, but rather starter cultures are used. The *halachic* status of a microbial culture is directly connected to the kosher status of the microbial medium in which it was grown. A microbe assumes the kosher status of the medium or material on which it grows and this status is based upon known substrates. Unless a reason exists to assume that a microbe was cultured on a non-kosher laboratory medium, it is considered to be kosher. For yeasts and their metabolic extracts to be kosher for use on *Pesach*, they are cultured on molasses [18] rather than on a grain-derived growth medium. For example, if the yeast, *Saccharomyces cerevisiae,* was maintained on Cornmeal Agar (assuming, it can be considered kosher), presumably, the yeast and its fermentation products would be considered *kitniyos* and not useable on *Pesach* by Ashkenazim. If the yeasts were grown on Nutrient Agar, which contains protein digests of skeletal muscle from cows, the yeasts and their metabolic extracts would be *treif*.

Bread is dough made from flour of any of the five major grains, wheat, rye, oats, barley and spelt, water, and yeast. In contrast to *matzah*, unleavened bread, bread is leavened. In the leavening process, yeast, from the *Saccharomyces* species, ferments the grain sugars to ethanol and carbon dioxide, a gas, causing the bread to rise. The small amount of alcohol produced is dissipated during the baking process and, in part, contributes to the fresh-baked aroma of bread [18]. As an aside, it is interesting to note that *pas Yisroel,* kosher bread baked by Jews, is traced to Daniel, who abstained from Nebuchadnezzar's bread when in the king's palace (Daniel 1:8; *Avodah Zarah* 36a).

Grapes are high in glucose and, classically, their fermentation to wine occurred through the metabolic activities of natural-occurring yeasts on the grape surfaces. The inebriating effects of wine were first recorded with Noach (*Bereishis* 8:20-21). Wine played an important role in idolatry rituals, and the wine actually used for idolatry or prepared for use in their pagan practices is termed *Ya'yin Ne'sech* and is forbidden for use by Jews.

Mushrooms and truffles are mentioned in the Talmud. A mushroom is the fleshy, basidiospore-bearing fruiting body of a fungus, typically produced above ground, obtaining its nourishment from decaying organic matter by a complex system of underground vegetative, filamentous mycelia. In the United States, the most consumed mushroom is the white button mushroom, *Agaricus bisporus*. Portabello mushroom is the same *A. bisporus*, but picked when fully mature. Truffles are a type of mushroom that grows beneath the soil's surface. It is considered a delicacy, especially in Europe, and in France truffles are collected with the aid of trained dogs or pigs that locate the scent of the underground fungus [19].

Although mushrooms grow from the ground, the proper blessing prior to their eating is "*shehakol*," rather than "*borei pri ha'adama*." The rationale, as explained in the Talmud (*Berachos* 40b), is that mushrooms do not get their primary

nourishment from soil, as do other plants, which is essential for the designation, *"borei pri ha'adama."*

It may seem strange that, according to the Talmud, mushrooms do not obtain their primary nutrition from soil, apparently, this is the case. The commercial mushroom, *A. bisporus,* is cultivated in windowless buildings that can easily be environmentally controlled. The substratum used to support growth of mushrooms is compost, which is prepared from horse dung and straw. The horse dung is placed in large heaps and is allowed to undergo a natural fermentation process during which bacteria and fungi decompose the sugars, starch, and hemicelluloses and leave behind the resistant lignins and cellulose [19]. For their growth, mushrooms require a highly enriched organic substratum. Interestingly, soil is the one component not listed as a necessity for mushroom growth. When discussing truffles, the *Ritva* (*Berachos* 40b) noted that they grow underground from the "fat" in the soil. In the terminology of today, "fat" would be described as an organic-rich material. Thus, both for mushrooms and truffles, their source of nourishment is an organic-rich substratum, such as dung, rather than soil.

Mushrooms seem to grow overnight, usually after a rain. In actuality, mushrooms take several days to form primordial mushroom fruiting bodies, which, however, expand rapidly as they absorb water and thus appear to sprout overnight. The sudden appearance of mushrooms after a rain was noted in a story in *Ta'anis* (23b). *Choni* the Circle-Maker was asked by his community to pray for rain. He prayed and *Hashem* sent a gentle rain, which apparently, was not sufficient. So, *Choni* prayed for stronger rains. *Hashem* granted this request, but now the stronger and more abundant rains were potentially detrimental. Again *Choni* prayed; winds blew, clouds dispersed, and the sun appeared. The community went to the fields and collected newly sprouted mushrooms and truffles. A similar mushrooming event was mentioned in *Shabbos* (30b). Rabban Gamliel, teaching his students the wonders to occur in the time of the Messiah, cited the verse, "May there be abundant grain on the earth of the mountain tops" (*Tehillim*72:16), and interpreted it to mean that *Eretz Yisroel* would yield fresh bread every morning. An arrogant student questioned the plausibility of this wonder. Rabban Gamliel told the student to observe the mushrooms that seem to sprout overnight from the ground.

There is some other mention of mushrooms in the Talmud. When discussing which food items can be used for an *eruv t'chumin* it stated, "An *eruv* may be made with any food, except water or salt" (*Eruvin* 27a). The Talmud went on to state that mushrooms were also excluded for use as an *eruv t'chumin.* In his commentary to the Mishnah, the *Rambam* explained that mushrooms were so terribly unhealthy, that they could hardly be considered food. Perhaps, for this reason, *Cha'zal* deemed them unfit for an *eruv t'chumin*. Elsewhere, the *Rambam* set forth principles for healthy living and wrote of mushrooms, 'They are extremely unhealthy and a person best abstain from eating them at all' (*Hilchos Deios* 4:2). In the Frankel printing of the *Rambam*, the commentary, *Aish L'Trufa* explained that many species of mushrooms are poisonous, but there are also edible mushrooms. A person with sufficient experience can distinguish between them (see *Meorot HaDaf HaYomi*, vol. 336, 27th *Tishrei*, 2005). Yet, in Talmudic times, mushrooms were eaten as a desert after meals (*Rasbam*, *Pesachim* 119b).

Concluding Remarks

Although *Cha'zal* could not have known about microorganisms, they must have had an intuitive feeling that there was more than meets the eye [20]. For example, yeasts are ubiquitous in nature and breads were easily made by simply leaving sweetened dough in an open, warm environment, i.e., in conditions conducive to yeast proliferation. Eventually, people noted that if the dough was left longer, beyond the required time to make bread, the resulting dough, termed sour dough or *s'or*, could be saved as a future source to hasten fermentation of subsequent batches of dough. They did not know that *s'or* had elevated populations of yeasts, only that there was something different in sour dough as compared to normal dough [18]. Robert Koch, in the mid-1800s, discovered that bacteria were the causative agents of some diseases. Centuries before, in the *Shulchan Aruch* (*Orach Chaim* 170, 8), when discussing proper manners for drinking liquids, the *T'az* stated that because of life-threatening danger, a man should not drink from a cup and then give it to another to drink. He cited Rabbi Eliezer HaGadol who explained, "For perhaps there is an illness in his body, which might go from his mouth into the cup, making his friend ill." This explanation hints of microbial transmission of disease. A wound caused by a sword (*Avodah Zarah* 28a), iron, or any metallic object (*Orach Chaim* 328, 7) is considered life threatening, thereby necessitating treatment on *shabbos*. Again, this hints as a concern of a microbial infection [20]. Here, apparently, the stress is on a lesion caused by a metallic object, rather than by a sharp piece of wood, broken pottery, glass, etc. Perhaps, the worry was of an infection by the bacterium, *Clostridium tetani*, the causative agent of tetanus, a potential lethal disease. *C. tetani* is an anaerobe and for it to proliferate in the human body, the wound by which it enters the body must be deep enough to provide anaerobic conditions, as,

for example, those wounds caused by rusty, and therefore presumably dirty, nails. In addition, many cases of tetanus arise from minor punctures, such as sitting on a tack, that are considered too trivial to bring to the attention of a physician [21].

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REFERENCES

[1] Podolak, M. (1996). When science confronts *halakhah*. Bekhol Derakhekha Daehu 3:21-34.

[2] Levi, Y. (2005). *Shmin*i - *kashrut* of microorganisms. Jerusalem College of Technology, Machon Lev, http://www.jct.ac.il/judaica/dvarTorah/dt28.html

[3] Bleich, J.D. (2004). New York City water. Tradition 38:70-111.

[4] Kottek, S.S. (1996). Epidemics in ancient Jewish lore. Isr. J. Med. Sci. 32:587-588.

[5] Zilber, N., and S. Kottek (1985). Pestilence in Bible and Talmud. Some aspects related to public health. Koroth 9:249-262).

[6] Rosner, F. (1974). Rabies in the Talmud. Med. Hist. 18:198-200.

[7] Atlas, R.M. (1997). Principles of Microbiology. Wm. C. Brown Publ., Dubuque, IA.

[8] Pennisi, E. (1997). First genes isolated from the deadly 1918 flu virus. Science 275:173.

[9] Goldstein, S. (1997). Fasting and praying for pigs. Jewish Press (March 28th).

[10] Willey, J.M., Sherwood, L.M., and Woolverton, C.J., 2008, Prescott, Harley, and Klein's Microbiology, 7th edition. McGraw Hill, NY, NY.

[11] Freilich, A.R. (1982). *Tzaraat* – "biblical leprosy." J. Amer. Acad. Dermatol., 6:131-134.

[12] Kaplan, D.L.(1993). Biblical leprosy: an anachronism whose time has come. J. Amer. Acad. Dermatol. 28:507-510.

[13] Daniel, V.S. and Daniel, T.M. (1999). Old Testament Biblical references to tuberculosis. Clin. Infect. Dis. 29:1557-1558.

[14] Miller, A. (1992). Narrate to Your Son. Yeshivah Gedolah Bais Yisroel, Brooklyn, NY.

[15] Munk, E. (1993). The Call of the Torah, Volume 2, *Shemos*. Mesorah Publ., Ltd., Brooklyn, NY.

[16] Reish, D. (1968). Marine Life of Alamitos Bay. cited in: Red Tides, http://www.geocities.com/rovvandehoek/redtidesreish1968alamitos.htm?20098 .

[17] Feliks, Y. (1985). Plants and Animals of the Mishna. Moriah Offset Co., Brooklyn, NY.

[18] Blech, Z.Y. (2004). Kosher Food Production. Blackwell Publ. Ltd., Oxford, United Kingdom.

[19] Moore-Landecker, E. (1972). Fundamentals of the Fungi. Prentice-Hall, Inc., Englewood Cliffs, NJ.

[20] Cohen, Z. (2008). The Coming Revolution. Science Discovers the Truths of the Bible. Hidabroot, Jerusalem, Israel.

[21] Tortora, G.J., Funke, B.R., and Case, C.L. (2004). Microbiology. An Introduction. 8th edition, Benjamin Cummings, San Francisco, CA.

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