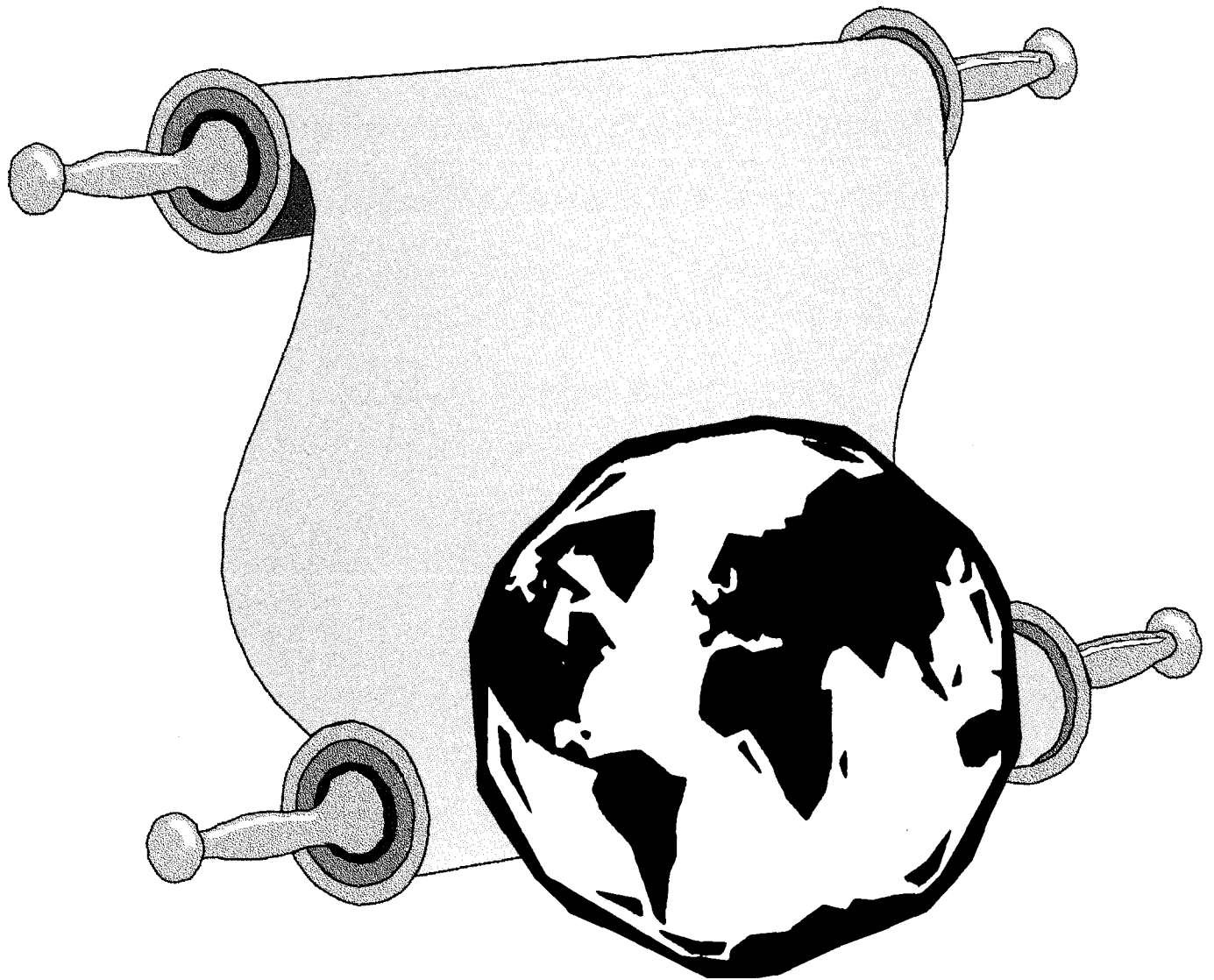


DERECH HATEVA

A Journal Relating Torah and Science



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Stern College for Women

Yeshiva University Spring 1997

*This journal is dedicated
in loving memory of*

Yonah Avraham ben Moshe HaKohen, א"ח

Derech HaTeva literally translated means 'the way of nature.' The central theme of the articles in this journal is the symbiotic relationship between Torah and science. Torah is the blueprint of the world, therefore all of science is naturally incorporated into Torah. In reading the following essays, we hope the reader will gain a greater appreciation for the beautiful interface of Torah and science.

The authors of this Journal would like to express their appreciation to the Stern College for Women Student Council and the Torah Activities Council, and to the following individuals for their assistance and support:

Dr. Harvey Babich, Dean Karen Bacon, Ms. Lee-at Elefant, Rabbi Robert S. Hirt, Rabbi Shlomo Hochberg, Mrs. Marcia Schwartz.

Derech HaTeva is published by the Torah U-Madda Project of the Max Stern Division of Communal Services of the Rabbi Issac Elchanan Theological Seminary, an affiliate of Yeshiva University.

***Derech HaTeva* gratefully acknowledges the support of the Joseph J. and Bertha K. Green Memorial Fund at the Rabbi Issac Elchanan Theological Seminary.**

Volume I, No. 1

Sivan 5757

Spring 1997

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A GENETIC ANALYSIS OF THE EVENTS LEADING TO THE BIRTH OF DINAH

An individual's understanding of any subject matter is influenced by life experiences and prior knowledge. People with divergent secular backgrounds will interpret specific aspects of the Torah from their own distinctive viewpoints. For example, Rabbi Aryeh Kaplan had a strong scientific background and his understanding of the resurrection of the dead focused on molecular genetics.¹ Apparently, he assumed that the miracles surrounding resurrection would occur according to established biological principles (or, simply, the laws of nature). In a similar approach, this presentation is a biologist's view of a specific miraculous birth described in the Torah and expounded upon by the commentaries; the event will be explained as being guided by *HaShem* to occur through existing biological principles.

Verse 21 in chapter 30 (*Parshat Vayaisay*) of *Beraisheit* states, "And afterwards she bore a daughter and called her name, Dinah." This refers to the birth of Dinah to Leah. On the surface, this seems a typical birth of a girl; however, as will be noted, this pregnancy was far from typical. Rashi and the *Gemara Berachot* (page 60a) comment on the word "afterwards" and on the choice of the name, "Dinah."

"Afterwards" implies that initially the fetus was male and only afterwards was the fetus female. Leah already had six sons and the maid-servants, Bilha and Zilpa, each had two sons. Thus, the forerunners of ten of the twelve tribes were already born. Leah reasoned that if this seventh pregnancy produced another son, subsequently, Rachel would be destined to have only one son. If so, then Rachel would not even contribute to the people of Israel as many tribes as did the maid-servants. Therefore, Leah prayed that this fetus be changed from a male to a female. This judgment that Leah passed on herself was evident in the name, Dinah, which stems from the word for judgment ("*din*").

Another explanation for the name, Dinah, is found in *Beraisheit Rabbah* (72, 6), which states that the origin of the name is from the word, "*dayainu*" (or, "we have enough"). In this scenario, Leah, Bilha, and Zilpa all prayed "*dayainu*." Based on either explanation, the prayers focused on Leah's seventh pregnancy producing a female, rather than a male, child. *HaShem's* response was that Leah's fetus was changed *in utero* from a male to a female.

The Maharsha commenting on *Gemara Berachot* (60a) quotes the *Midrash Tanchuma*, which noted that the phrase "And afterwards..." ("*achar*") is in the masculine, rather than in the feminine, form. The use of the masculine form was an indication that initially the fetus was a male, but after the prayers, the developmental biology of the fetus was altered to yield a female.

The *Gemara Berachot* (60a) also notes that these prayers were offered during the first forty days of Leah's pregnancy. A *baraita* is then cited that until the fortieth day a husband is permitted to pray that his wife's pregnancy will result in a son; thereafter, it is prohibited. As will be noted, this specific time limit is in accord with present day concepts of human fetal development. However, the *in utero* change of the gender of a human fetus is not a normal occurrence. The *Gemara* refers to this specific gender alteration as a miracle. It states that *halacha* cannot be learned from Leah's pregnancy, because *halacha* may not be derived from a miraculous event. We suggest that this miracle was directed by *HaShem* to occur according to existing principles of molecular genetics.

The explanation, however, necessitates a brief background in basic genetics. Each human has 46 chromosomes, or more precisely, 23 pairs of chromosomes, in each nucleus of each body (somatic) cell. One chromosome from each pair is derived from that person's mother (contributed in the egg and termed the maternal chromosomes) and the other chromosome from each pair is derived from that person's father (contributed in the sperm and termed the paternal chromosomes). Chromosomes of a pair are morphologically alike. There is one exception, chromosome set number 23, which is referred to as the sex chromosomes. In a human male the chromosomes of this pair are dissimilar and consist of one large X chromosome with many genes and a much smaller Y chromosome with few genes. In a human female, however, this set consists of two large X chromosomes. Human females produce eggs, each with one X chromosome while males produce two types of sperm, an X chromosome-containing sperm and a Y chromosome-containing sperm. If an X chromosome-containing sperm fertilizes a human egg with its one X chromosome, the resulting individual will develop into a female (XX). If a Y chromosome-containing sperm fertilizes a human egg with its one X chromosome, the resulting individual will develop into a male (XY).^{2,3}

Initially, a human fetus is potentially hermaphroditic, in that it has two types of embryonic tubes, the Wolffian and Mullerian tubes, and a bipotential gonad, that is, tissue that has the potential to develop into either the ovary or the testes. The Wolffian tubes are forerunners of the male reproductive tract and the Mullerian tubes are forerunners of the female reproductive tract. If the fetus is female(XX), the Wolffian tubes degenerate and the Mullerian tubes develop into the oviduct and uterus and the bipotential gonad into the ovary. This process can be viewed as passive, in that, the fetus will develop into a female unless something actively hinders this process.^{2,3}

If the fetus is male (XY), a gene on the Y chromosome becomes activated at about the fortieth day and produces a regulatory protein that induces the bipotential gonad to differentiate into the testes. This gene, initially termed the testis-determining factor (TDF)-gene and now termed the sex-reversal on Y (SRY)-gene, is located on the terminal portion of the small arm of the Y chromosome and is believed to play a major role in directing a series of events that culminate in the development of a male. In this sequence, the bipotential gonad develops into the testes and produces testosterone, which stimulates the Wolffian tubes to develop into the male reproductive system; Mullerian inhibiting substance is also produced by the testes and the Mullerian tubes never develop and eventually degenerate.^{2,3}

It should now be evident why the *Gemara* stresses day forty. It states that prayers regarding the gender of the fetus are fruitless after this time; after the fortieth day the fetus is already programmed to follow a specific developmental pathway regarding its gender. It is also

interesting to note that embryological development follows the scheme established by *HaShem* in creating the first Adam. Rashi (*Beraisheit* 1:27) notes that the first Adam was an hermaphrodite. Similarly, every fetus initially has both the Mullerian and Wolffian tubes and a bipotential gonad. Later in development, the gender is determined by the absence or presence of the Y chromosome.^{2,3}

Chromosomes, at times, break and the wrong ends may recombine. Suppose a mistake occurs and the terminal portion of the Y chromosome breaks and reattaches to an X chromosome; this type of chromosomal aberration is termed a nonreciprocal translocation. Further suppose that this occurs in the testes, specifically in a cell destined to become a sperm. This sperm then carries one full X chromosome that has attached to it the small portion of a Y chromosome with the TDF gene. If this sperm fertilizes a normal egg, the resulting fertilized cell, or zygote, will eventually develop into a sterile male. In human populations, about 1 in 20,000 males is XX with the TDF gene on a small portion of the Y chromosome that has attached to the paternal X chromosome. This male is sterile because the gene for male fertility is on the long arm of the Y chromosome.^{2,3}

To further explain the nature of the miracle, the concept of dosage compensation needs to be understood. Under normal circumstances, all cells of a human male contain 46 chromosomes, which include an X and a Y chromosome; all human females have cells with 46 chromosomes, that include two X chromosomes. However, at about day 16 of embryonic development, one X chromosome inactivates in each cell of the female fetus. This inactivated chromosome is evident as the so-called Barr body noted in epithelial cells only from females. Which X chromosome inactivates, the one contributed by the person's father or the X chromosome contributed by the person's mother? Research has shown that the pattern is random and in some cells the paternal X chromosome inactivates and in other cells it is the maternal X chromosome that inactivates. Inactivation of the X chromosome does not occur in the male. Thus, both human males and females have only one active X chromosome (i.e., they have the same dosage of active X-linked genes).^{2,3}

With this brief background, we can now begin to understand, perhaps, the dynamics of the gender change with regard to Leah's seventh pregnancy. Genetically, this fetus was derived from the fusion of a normal egg with a sperm that contained a chromosomal translocation, specifically, an X chromosome with the small portion of the Y chromosome with the TDF gene. Thus, this fetus would be destined to develop into a male, albeit, a sterile male. In cases of structural abnormalities in an X chromosome, dosage compensation may not be entirely random, as the abnormal X chromosome is preferentially inactivated. The prayers offered by Leah and apparently accepted by *HaShem* may have lead to the inactivation of only the paternal X chromosome with the TDF gene in each embryonic cell of the fetus. The result of such a nonrandom dosage compensation would lead to the inactivation of the TDF gene and, thus, subsequently to the development of a female fetus, or Dinah.

This explanation also appreciates the merit received by Leah for her unselfish prayers regarding Rachel's welfare. Without Leah's prayers the fetus would have developed into a male, who as a result of sterility could not have been a founder of one of the 12 tribes. Thus, Leah was rewarded with a healthy female child.

The miracle was extended to Dinah. Dosage compensation, most probably does not occur in the ovarian cells destined to become eggs. Thus, some of Dinah's eggs would contain a

normal X chromosome and others would contain the X chromosome bearing the translocated small portion of the Y chromosome. What about Dinah's probability of having normal children?

For Dinah to have normal children, whether sons or daughters, requires that only those eggs with the normal X chromosome are fertilized. Each conception had a one in two chance of resulting in a healthy child. As no "unusual" offspring are noted in the Torah, it can be assumed that the miracle may have extended to the offspring of Dinah, in that, these children were normal.

The above presented hypothesis is most probably oversimplified. It is not intended to suggest that the birth of Dinah occurred naturally, without the intervention of *HaShem's* will. The *in utero* sex change was a miracle! However, it is suggested that this miracle may have followed a prescribed pattern of molecular genetics. The probability of a father producing a sperm with a translocated piece of the Y chromosome on an X chromosome, coupled with the probability of this specific sperm out competing the other millions of sperm that are produced and race to fertilize the egg, and further coupled with the probability of a nonrandomized dosage compensation occurring in each cell of the fetus, resulting in inactivation only of the translocated paternally-derived X chromosome, is highly improbable and unlikely. The probability of such independent events occurring is expressed by the "product law," which states that the probability of two or more outcomes occurring simultaneously is equal to the product of their individual probabilities. For example, the probability of the paternally-derived X chromosome inactivating in a single fetal cell is $\frac{1}{2}$; the probability of this occurring in two fetal cells is $\frac{1}{2} \times \frac{1}{2}$; the probability for inactivation of the paternally-derived X chromosome in each fetal cell is $(\frac{1}{2})^n$, where n is the total number of fetal cells at the time of dosage compensation. The resulting probability value would then be multiplied by the probability (1:20,000) of the birth of a viable fetus with two X chromosomes, with the paternally-derived X chromosome bearing the terminal portion of the Y chromosome with the gene for maleness. That the above-noted sequence of improbable events may have occurred according to biological principles, albeit under the direction of a Divine plan, is precisely why it is a miracle.

NOTES

1. Aryeh Kaplan, Encounters (Brooklyn: Moznaim Publishing Corporation, 1990), pp. 125-128.
2. N. V. Rothwell, Understanding Genetics. A Molecular Approach (New York: Wiley-Liss, Inc., 1993), pp. 91-126.
3. P.J. Russell, Genetics (New York: Harper Collins College Publishers, 1996), pp. 47-96.

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DID OUR SAGES WRITE THE NUTRITION TIPS THAT MODERN RESEARCH HAS UNCOVERED?

The words of wisdom written by our sages centuries ago are being proven true today. Articles and books of study, in a wide range of areas from philosophy to cooking, are citing "modern" information that actually we have already been taught by Maimonides and by the Talmud. Nutrition is among one of these topics. "New" information about eating right and health precautions is being discovered continuously, though many of these facts have been known to those of us who have studied the traditional texts.

Maimonides, also known as the Rambam (1135-1204), was a famous doctor who wrote many medical works, was also a respected Torah authority, and authored great works on Jewish law and philosophy. The Rambam, combining his knowledge of medicine and Rabbinics, wrote about health and diet based on sources in the Talmud. He viewed eating as a way to G-dliness and as noted in the *Shulchan Aruch* (31:1), "It is written in *Mishlei* (3:6): 'In all thy ways acknowledge Him.' This means that in all our actions, even those which we must do in order to sustain life, we must acknowledge the Lord, and do them for the sake of His Name, blessed be He. For instance, eating, drinking...."¹ The *Shulchan Aruch* (31:2) continues with this theme and warns us "Not [to] eat whatever is palatable just like the dog and the donkey do, but we should eat only the things that are helpful to, and good for, the health of the body. There are some saintly people who, before partaking of food or drink say, "I am ready to eat and drink in order that I may gain health and strength to worship the Creator, blessed be His Name." The Rambam in his *Mishneh Torah*, Book of Knowledge (4:1), explains further that, "Since maintaining a healthy and sound body is among the ways of G-d - for one cannot understand or have any knowledge of the Creator, if he is ill. Therefore, one must avoid that which harms the body and accustom himself to that which is healthful and helps the body become stronger."¹

With this in mind we can now understand from a spiritual perspective the importance of maintaining our physical bodies. But what about understanding a physical perspective? The body needs a certain amount of carbohydrates, proteins, fats, vitamins, minerals and water to function optimally. We know how important the intake of water is from sources in the Talmud. For instance: *Shabbat*(41a) states, "If one ate and did not drink, his food is blood and is the beginning of indigestion."² Drinking fluids is very important especially when the body is working to fight an illness, as noted in *Gittin* (67b): "For quotidian fever drink a jug of water."³ The Talmud in *Bava Kama* (92b) tells us that "bread and salt in the morning and a jug of water will banish all illnesses."⁴ Here too we see the vitality of drinking fluids.

Another aspect of nutrition, besides eating healthy foods, is the avoidance of overeating. Here too the Rambam in his *Mishneh Torah*, Book of Knowledge (4:2) warns us, "One should not eat until his stomach is full. Rather, he should stop when he is close to three-quarters of full

satisfaction." ⁵ In *Gittin* (70a) we find a similar rule: "Eat a third (of the capacity of the stomach), drink a third, and leave a third empty." ⁴ From both of these sources we can see the stress on not eating until we are filled to capacity. Yaakov Levinson, a nutritionist, writes in his book, The Jewish Guide to Natural Nutrition, that over feeding in early childhood can increase the number of fat cells in the body. The number of fat cells acquired as a child does not decrease in an adult, therefore fat children will suffer from a weight problem for the rest of their lives. This type of weight problem could have been avoided if during early childhood the child was taught proper eating habits. ⁶

Being overweight and/or obese is very dangerous. The risk of heart disease, high blood pressure and diabetes are increased and over eating may be a causative factor in certain types of cancer. These pathologies are the four major health problems today. In addition, obesity is a factor in shortening the life span and in the increased incidence of orthopedic problems and gall bladder disease. ⁵ Obesity or being grossly overweight, in addition to being one of the eight risk factors of a heart attack, is found to effect the body's cholesterol level as well.

We can understand that not only what we eat is important but how much we eat is of importance too. The Talmud (*Eruv*. 83b) teaches us the following lesson: "Who eats the minimum quantity from which *challah* has to be offered is healthy and blessed; who eats more is a glutton, and who eats less suffers from intestinal trouble." ⁴

Another aspect of eating healthy that both the Rambam and modern nutritionists find important is the approach to meals. How and when we eat actually make a difference in our health. The way we eat affects our digestion and there is much said about when and how many meals to eat a day. Levinson notes that the Rambam, "advocated exercise before eating to warm the body for improved digestion... Meals should be eaten while sitting or reclining, and we should rest after meals for good digestion." ⁷ He further writes, "It is best to take meals and snack at the same time every day, in a relaxed, positive setting. Avoid skipping meals, especially breakfast, as doing so will weaken your body." ⁸ As a nutritionist, Levinson calls this approach, "relaxed eating." In the Talmud (*Gittin* 70a) we learn that, "a meal should be taken sitting, because 'to eat or drink standing shatters the body of a man'." ⁹ The importance of breakfast appears in many places throughout the Talmud. In *Bava Kama* (92b), as previously mentioned, "Bread with salt in the morning and a jug of water will banish all illnesses." ⁴ In *Bava Metzia* (107b) there are, "thirteen things said concerning bread eaten in the morning: it protects from heat, cold, injurious spirits, and demons;...helps him to learn and teach Torah...." ¹⁰ From the items listed we are able to understand that eating "bread" in the morning will give strength to combat stress during that day.

The few aspects of nutrition explored in this article, of what to eat, how much to eat, and the way to eat, carry great importance to us in both the spiritual and physical realms. They are so vital that our sages took the time to impress it upon us, just as doctors and nutritionists are doing today. This article brings just a few examples of the uncanny parallels between the wisdom of old and the modern research. There are many more parallels on this topic and on a significant number of other topics worthy of study. The idea that doctors and nutritionists today are saying the very same things as our sages said hundreds and thousands of years ago is thought provoking. Some may view our holy books as more valid based on modern proof, while others may view modern research more valid based on proof from our holy books.

NOTES

1. Y. Levinson, The Jewish Guide to Natural Nutrition (Jerusalem: Feldheim Publisher, 1995), p. 9.
2. A. Cohen, Everyman's Talmud (New York: E. P. Dutton & Co., Inc., 1949), p. 247.
3. *ibid.* p. 253.
4. *ibid.* p. 244.
5. Levinson *ibid.* p. 16.
6. *ibid.* p. 17.
7. *ibid.* p. 6.
8. *ibid.* p. 92.
9. Cohen *ibid.* p. 245.
10. *ibid.* pp. 246-247.

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THE NATURAL CHOICE

In Leviticus 23:39, the Torah commands, "on the fifteenth day of the seventh month when you have gathered in the fruits of the land, you shall keep the Feast of the L-rd...." Further references to this holiday in the Torah describe *Sukkot* as the "feast of the in gathering... (of the crops)." These two references indicate a strong connection between this *Chag* and the plant kingdom. Due to the emphasis placed on the aspect of gathering fruits, the sages learn the importance of making certain that *Sukkot* coincides with the harvest season. A leap month must sometimes be added to insure that the fifteenth of *Tishrei* falls out during the beginning of the harvest. There are two mitzvot of *Sukkot* that directly involve the plant kingdom. They are the mitzvot of *s'chach* and the four *minim*.

We learn from our sages that even though the *mitzvot* themselves are merely physical acts, they can bring us to higher spiritual levels. To better understand the spiritual implications of *mitzvot*, a closer look at their physical or in this case botanical aspects, is necessary.

The plant kingdom is an asset to society on many different levels. On the most basic level, Kingdom Plantae is our food source. Yet, the plant kingdom also provides us with the raw materials for industry, textiles, medicines, and fuel. Because there are 350,000 species of plant life on Earth, taxonomists have classified and divided these plants into categories based on biological relationships.¹ The most highly developed land plants produce seeds and belong to the division Spermatophytæ. This division contains two subdivisions, Gymnospermae and Angiospermae. These subdivisions further classify seed plants according to the formation of their seeds. Gymnosperms, which are considered the older plants, produce naked seeds that are not covered in a protective shell. In contrast, the subdivision Angiospermae contains the more modern plants that produce seeds enclosed in a protective vessel called the ovary. Later this seed containing unit can develop into either a nut or a fruit. Angiosperms are divided into two classes, the Dicotyledons and the Monocotyledons. The differences between these two classes arise from the formation of cotyledons, or embryonic leaves in the seed, from the symmetry of the flowers, and from the venation of the leaves.¹

The Torah's description of the four *minim* is not very specific, (Lev: 23:41), "the fruit of the goodly tree, branches of the palm trees, and boughs of thick trees and willows of the brook." The true identity of these fruits is only known through *Mesorah*.² The *etrog*, a fruit, is a type of citron, *Citrus medica*, and the *lulav* is taken from the branches of a date palm tree, *Phoenix dactylifera*. *Hadasim* are branches from the myrtle, *Mrytus communes*, and the *arovot* are branches from the willow, *Populus euphratica*. Interestingly, all four of these plants belong in the most highly developed plant category, Angiospermae. The *etrog*, a dicotyledon, and the *lulav*, a monocotyledon, are from the plants that produce edible fruits, whereas the *hadasim*, a dicotyledon and the *arovot*, a monocotyledon, do not yield edible fruits. As is clearly stated in

the *Gemara, Menachot 27a*, "two of these bear fruits and two of these do not bear fruit...those that produce fruit will compensate for those that do not..."

According to the *Encyclopedia Judaica*, a distinct climate is necessary for the growth and development of each one of these *minim*.³ The myrtle tree is grown in the upper Galilee on Mount Caramel. In the opposite direction, the palm tree requires the lowlands of the southern coast for fruition. Willow trees will grow near a river or a brook, while citron trees are in constant need of irrigation.

The distinctive qualities surrounding these specific, yet diverse, symbols are explained by *Chazal*. One explanation defines each *min* as a representation of a specific type of individual in *Klal Yisroel*.² The *etrog*, which is both fragrant and has a pleasant taste, represents those Jews who possess the knowledge of the Torah and also perform meritorious deeds. The palm tree bears a delicious fruit but does not have a fragrance. Analogously, some people possess a great deal of Torah but are void of good deeds. Myrtle branches have an aroma, but they do not bear fruit. Similarly some Jews perform many good deeds but do not contain Torah knowledge. Willows have neither a good scent, nor a sweet taste, symbolizing a person with neither good deeds nor Torah. According to the *Halacha*, the only way to fulfill this *mitzvah* is to make sure that all four species are held together as one unit. The *Gemara* in *Menachot 27a*, further states, "just like *HaShem* wants the four species to be bound together as a unit, so too does *HaShem* want *B'nei Yisroel* to join together..."

HaShem in His infinite wisdom specifically created symbols that best represent His unique, yet diverse nation. Since His nation is considered a "prince" among nations, He chose four symbols from the most complex of the highest plant life to represent their elevated status. Yet because they are a diverse nation as well, He chose plants with a different combination of traits. Just like the symbols chosen are able to come together in their "avodat *HaShem*," we too can overcome our diversities and differences to serve *HaShem*.

NOTES

1. Neil Campbell, Biology (Redwood City: Benjamin/Cummings Publishing Company, Inc., 1993), pp. 495-533.
2. Avraham Chill, The Minhagim (New York: Sepher Hermon Press, 1979), pp. 226-229.
3. Celcil Roth, "The Four Species," in The Encyclopedia Judaica, vol. 6 (Jerusalem: Keter Publishing House, 1972), p. 1448.

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YEAST AND THE *YEITZER HARA*: THE BIOLOGY BENEATH THE SYMBOLISM

Jewish ethicists invest the annual task of physically cleaning one's home in preparation for Passover with additional spiritual meaning. The removal of *chametz* is also an opportunity for introspection and for ridding oneself of the *yeitzer hara*, the evil inclination which tempts man to sin. In Jewish thought, leaven (or yeast) symbolizes the evil inclination, and the annual battle against the physical presence of *chametz* symbolizes an annual marshaling of forces against the *yeitzer hara* within man. A recent discovery about the growth patterns of baker's yeast, *Saccharomyces cerevisiae*, shows that the correlation between yeast and the *yeitzer hara* goes beyond broad symbolism. The biological details of the life cycle of baker's yeast match some of the aggadic descriptions of the *yeitzer hara*.

Chazal identify the evil inclination with leaven in *Berachot 17a*:

...R. Alexandri, on concluding his prayer, used to add the following:
Sovereign of the Universe, it is known full well to Thee that our Will is to perform Thy will, and what prevents us? The yeast in the dough and the subjugation to the foreign Powers. May it be Thy will to deliver us from their hand, so that we may return to perform the statutes of Thy will with a perfect heart!¹

Rashi comments: "The yeast in the dough [is] the evil inclination in our hearts, which causes a ferment in us." The Maharsha (1555-1631), in his commentary on the aggadic portions of the Talmud, explains the characterization of the *yeitzer hara* as yeast, based on Maimonides's ideal that in all behaviors, man should follow the middle way and go to neither extreme. Just as yeast causes dough to rise and take up greater space, the evil inclination causes man to indulge his desires and his ego too much. It encourages excess, one of Maimonides's undesirable extremes.

The commentators were struck by the evident parallel between yeast's capacity to make dough rise (by producing carbon dioxide gas that is trapped in the dough) and the *yeitzer hara*'s power to inflate man's ego. A more subtle parallel between yeast and the *yeitzer hara* hinges upon a recent discovery about the growth of baker's yeast in laboratory culture. Normally, when yeast reproduce, a genetically identical daughter cell buds from the mother cell. The new cell can either become an independent cell (unicellular phase) or remain attached to the mother cell (filamentous phase). Baker's yeast (*Saccharomyces cerevisiae*) was thought to exist only in the unicellular phase; a filamentous phase was never observed.

In 1992, scientists at the Whitehead Institute and MIT reported in the journal *Cell* that they determined conditions under which *Saccharomyces* can grow as a long filament. While trying to determine limiting factors in the growth of a culture of baker's yeast, they discovered that in a nitrogen-reduced environment, the yeast enters the filamentous phase. In other words, semi-starvation causes the yeast to grow not as a unicellular organism, but as a long filamentous organism. A filamentous phase had never before been observed because in a nutrient-rich environment, such as one that is usually provided in laboratories, the yeast remains unicellular.²

According to *Chazal*, the *yeitzer hara* has a similar growth pattern. *Succa 52a* states, "*Kol ha-gadol mei-chaveiro, yitzro gadol mi-menu*" -- whoever is greater than his friend, his *yeitzer hara* is [correspondingly] stronger than his friend's. The greatest *tzadikim* face the most colossal battles in overcoming their evil inclination. In other words, when the evil inclination is placed in a state of semi starvation by a *tzadik*, it grows. Two separate accounts in the *Gemara* bear this out.

First the *Gemara*, in *Kidushim 81a*, recounts stories of several of the great *Tana'im* (sages of the *Mishnah*), including R. Amram, R. Meir and R. Akiva, who very nearly gave into the temptations of their evil inclinations. Because they were *tzadikim*, their struggle against the *yeitzer hara* was immense. In addition, the *Gemara* in *Succa 52a*, says in the name of R. Yehuda:

In the time to come the Holy One, Blessed be He, will bring the Evil Inclination and slay It in the presence of the righteous and the wicked.

To the righteous it will have the appearance of a towering hill, and to the wicked it will have the appearance of a hair thread. Both the former and the latter will weep; the righteous will weep saying, "How were we able to overcome such a towering hill!" The wicked also will weep, saying, "How is it that we were unable to conquer this hair thread!"³

Again, the less a person gives in to his evil inclination, the bigger it grows, so that to the *tzadikim*, the *yeitzer hara* appears enormous. When the *yeitzer hara* is 'fed' by the overindulgence of the *resha'im*, it appears tiny.

Although the connection between the growth patterns of yeast and that of the *yeitzer hara* many not be obvious, once it is revealed it reminds us once again of the intimate relationship between God's Torah and His *tevah* (nature). The Rav, Rabbi Joseph Dov Soloveitchik, explains that just as the world was created with ten utterances in the first chapter of *Beraisheit*, there were ten commandments given to *B'nei Yisroel* at *Har Sinai*, which reflect the interrelationship between natural and moral law. According to R. Yehuda Copperman of Michlalah Jerusalem College, the *Navi* describes the connection between Torah and nature with the verse (Jer. 33:25), "If not for my covenant with the day and the night, that the statutes of heaven and earth I did not place...."⁴ If not for the upholding of the covenant of Torah which must be learned "day and night" the laws of nature (the statues of heaven and earth) could not exist.

NOTES

1. Translation from the Traditional Press edition.
2. Carlos Gimeno, et al. "Unipolar Cell Divisions in the Yeast *S. cerevisiae* Lead to Filamentous Growth: Regulation by Starvation and RAS," Cell 1992: 1077-1090.
3. Translation from the Traditional Press edition.
4. Translation from the Judaica Press edition.

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EITZ CHAIM

Many times throughout *Tanach* various forms of plant life are used allegorically to illustrate a particular point. In such cases when a specific plant is indicated, one may find upon further study that such botanical references are not made casually. Rather, the species mentioned has been especially selected based on its distinctive characteristics to properly reflect the specific concept under discussion. An oak tree and a vineyard serve as prime examples.

In Isaiah 6:13 it is stated: "And when there is a tenth left, it will again be purged (burned), like the terebinth and the oak, which in the fall only have a trunk, the holy seed is its trunk."* Rashi, following Targum, explains this to mean that *HaShem* will return to purge again and again until only the righteous will remain, who then will repent wholeheartedly. Rashi develops this further saying that the terebinth and the oak are used as a parable. Thus, these trees shed their leaves (*shalechet*) during the fall until there is nothing left except the trunk. Accordingly, those adhering to righteousness will be to *HaShem* as the holy trunk and will serve as the stock from which the nation will be renewed. Rashi continues to say that the word '*shalechet*' also refers to a gate in Jerusalem, where terebinths and oaks were planted.

Yehuda Feliks, professor of Biblical and Talmudic Botany at Bar-Ilan University, Israel, acknowledges that '*shalechet*' is also the name of a place. However, he comments that it cannot be translated as 'shedding leaves', because oak trees in Jerusalem and Judea are a species of evergreen, which do not shed their leaves. Rather, Feliks says, *shalechet* refers to the gate and the surrounding area through which the refuse of the city was carried out. There, on the outskirts of the city, the oak and terebinth trees flourished. However, people scavenging for fire wood robbed the trees until one tenth of their former splendor remained. They were further devastated until only their stock, the trunk, remained.¹

Numerous species of oak, each varying greatly in its characteristics, commonly grow in various regions of the world. *Quercus coccifera* L. and *Q. ilex* L. are the species of oak typical of Mediterranean vegetation.² These species are evergreens. *Q. coccifera* is a vegetatively regenerating pyrophyte, meaning that it has the capability to resprout after the destruction (by fire) of its above ground organs. Additionally, *Q. ilex* has been found to sprout from its stumps.³ In fact, in their article entitled *Vigour of Post-Fire Resprouting by Quercus coccifera L.*, Malanson and Trabaud site *Q. coccifera* as being prolific in its resprouting ability when compared to other vigorously resprouting Mediterranean-type plants.⁴ Throughout such studies, it was observed that "floristic richness" was consistently higher in burned sites as opposed to unburned ones. Moreover, although the proportion of life forms was greatly altered during the first two years after a fire in this region, the dominant species that ultimately reestablished were those initially present. Such exposure to fire has also resulted in the adaptation of traits allowing

the trees to survive such disturbances and proliferate within their ecosystems.

Thus, it is befitting that these trees are explicitly applied in Isaiah. They are an accurate symbol of the remaining holy remnant that will serve as a nucleus for the rise and development of a renewed and purified people. In fact, both of the words '*elah*' (terebinth) and '*alon*' (oak) are derived from the word '*E-l*', meaning strength and immortality.

Another example of such specificity with regards to botanical allegory in *Tanach* is seen in verses pertaining to a vineyard. Jeremiah 2:21 states: "I planted you a noble vine stock (*sorak*) of true seed; now how is it that you have turned yourself into a degenerate wild vine (*suray*) to Me?" Radak interprets the first part of this verse to mean the choicest species of vines, which produce seedless grapes. He continues to explain that *HaShem* is wondering, how is it possible that from the best vines from which the best grapes should grow, and the best branches to plant other vines, that you have turned yourself into the bad branches of a strange vine? Radak says that the word '*suray*' refers to bad branches that must be pruned.

In Isaiah 5:1-2, a vineyard is again used to illustrate *B'nei Yisroel*: "I will now sing for my beloved the song of my beloved about his vineyard; my beloved had a vineyard in a fertile corner. And he fenced it in, and he cleared it of stones, and he planted it with the choicest vines (*sorak*), and he built a tower in its midst, and also a vat he hewed therein; and he hoped to produce grapes, but it produced wild berries (*bushim*)." Again, in this verse, Radak interprets 'choicest vines' as those that produce seedless grapes. He continues to explain these verses as follows. *HaShem* guarded *B'nei Yisroel* when He brought them to *Eretz Yisroel*. He surrounded them with clouds and expelled the seven nations of Canaan and there He planted *B'nei Yisroel*, the seed of Avraham, Yitzchak, and Yaakov. Therefore, *HaShem* expected them to produce good fruit. He built a watchtower to guard over them and promised them His protection, that no evil will befall them, as long as they obey and trust in His Name. Radak continues that the vat, or winepress, represents the Prophets. The winepress is used to extract the wine from the grapes and subsequently put it to practical use, just as the Prophets serve to instruct the Jews to follow the Torah. *HaShem* expected the vineyard to produce grapes, the nation to do mitzvot. Instead, the vineyard produced wild berries, the people committed evil deeds.

Feliks proposes another interpretation. He says that the choicest vines are of a reddish hue that yield dark red grapes. However, the vineyard produced *bushim*, white grapes whose wine is sour. Biologically, both of these explanations are factual.

Vegetative (asexual) reproduction, using part of the plant body to regenerate the entire plant, allows for the perpetuation of naturally cross-pollinated plants and for propagating seedless progeny.⁵ Thereby, exceptional plants with the desired traits can be selected and genetically identical offspring can be produced. Vegetative reproduction also has the advantage of giving "parental" support, a nutrient supply, for the new plant during early stages of growth. However, grape vines in particular need to be pruned yearly in order to regulate fruit production.² Pruning involves carefully cutting away branches in order to modify the growth pattern. Although it reduces total plant size, the remaining plant becomes more productive and healthy. Thus, pruning "redirects the tree's resources to the desired form or product rather than to random, weaker vegetative growth".⁶ This fits Radak's explanation of seedless grapes producing bad branches that must be pruned.

Conversely, sexual reproduction, which yields seeds, permits genetic recombination. In other words, cross-pollination results in the genetic traits of both parents being expressed in

varying combinations. These progeny may differ from the parental generation in such qualities as size, shape, and palatability of the fruits.² Additionally, the new variant may be better adapted to a different environment.

Thus, Feliks' interpretation that a plant of '*sorak*' produced *bushim* is also plausible. Reproduction by seed formation does not allow for genetically identical plants. Indeed, offspring show traits of both the male and female parent plant. Thus, a plant with red grapes may yield offspring with white grapes.

The oak tree and vineyard serve as models for all other plants described in *Tanach*. They demonstrate that such botanical references are not coincidental, but rather that even such a seemingly minuscule detail as a plant is written with purpose and true to fact. By its specific properties, it properly conveys and aids in illustrating the message.

NOTES

- * All translations are adapted from those in Judaica Press Publications.
1. Yehuda Feliks, Nature and Man in the Bible: Chapters in Biblical Ecology (Jerusalem: The Soncino Press, 1981), pp. 77-82.
 2. D. Zohary and M. Hopf, Domestication of Plants in the Old World (Oxford: Clarendon Press, 1993), pp. 134-147.
 3. J. Moreno and W. Oechel, The Role of Fire in Mediterranean Type Ecosystems (New York: Springer-Verlag, 1994) pp. 2-13.
 4. G. Malanson and L. Trabaud, "Vigour of Post-Fire Resprouting by *Quercus coccifera* L.," Journal of Ecology vol. 76: 351-365.
 5. Encyclopedia Britannica (USA: Encyclopaedia Britannica, Inc., 1993), vol. 19 pp. 682-683.
 6. A. Galston, P. Davies, and R. Satter, The Life of the Green Plant (Prentice-Hall Inc., 1980), p. 370.

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FISH AND JUDAISM

"I am to my beloved as my beloved is to me (*Shir HaShirim* 6:3)." As a major theme during the month of *Elul*, this phrase represents the loving relationship between G-d and the Jewish people. As *Rosh HaShanah* approaches we must cry out to G-d as our tears will wash away all of our sins. Through this cleansing of our souls we are attempting to influence the events of the upcoming year. *Rosh HaShanah* is the climax of our *teshuvah*. We attain a level of closeness to G-d, as His willingness to accept our prayers and tears bears no bounds. The ten days of repentance mark the connection between *Rosh HaShanah* and *Yom Kippur* in that we are building ourselves up to that epic most climactic moment of our *teshuvah*, namely *Yom Kippur*. On this dynamic, G-d fearing, and most awesome day, G-d seals the fate of each and every Jew, in either life or G-d forbid, death. Within these high holidays, some powerful symbolism exists which ostensibly focuses around the major themes of the Jewish nation. A fascinating role is played by fish in reminding Jews of the significance of this holy period.

Fish play a significant role in the traditions of Judaism. For example, on *Rosh HaShanah* fish are an important source of food and their presence is symbolic in the *Tashlich* services. Many parables, as well as symbolism, associate fish with the Jewish people and illustrate the special relationship between the Jewish people and the Torah. It is customary to eat foods on *Rosh HaShanah* which symbolize our hope that the year will bring good fortune and success. *Rosh HaShanah*, one of the holiest days of the year, is the "head" of the year for the Jewish people. Fish are eaten on *Rosh HaShanah*; just as they multiply very quickly, we request from G-d that we too shall be fruitful and multiply.¹ Furthermore, fish are submerged under the water and thus are protected from the *ayin hara*, the evil eye. We pray that G-d should protect us from the evil eye, as well.² Gefilte fish is eaten because the word "gefilte" means filled and we hope all of our needs are fulfilled. Other Jewish communities eat cross fish, as its Hebrew translation, *karot*, means to cut off, in the hope that our enemies are cut off from the Jewish nation.³ Another Jewish custom is to eat the head of the fish, as part of the prayer that Israel be at the head of the nations, and not the tail. The head of the fish also represents the hope to be the "head", pious, and exemplary for all. In contrast, the Moroccan Jews avoid eating fish, on *Rosh HaShanah*. This is due to the similarity between the Hebrew word for fish (*dag*) and the Hebrew word for troubles (*daagah*).

The throwing away of our sins is symbolized in the *Tashlich* services by the tossing of bread crumbs into a body of water. *Tashlich* is recited near a body of water that contains fish. The presence of fish is symbolic, as it states in the *Kitzur Shulchan Aruch* 129:21, "Just as fish are caught in a net, we are caught in the net of death and judgment. The realization of this concept should make us think of repenting."¹ The emptying of pockets during *Tashlich* represents the passing over of our sins to the fish. *Midrash Rabbah Parshat Vayeichei* states: "Just as fish who live in water nevertheless drink with thirst every drop of rain that falls as

though they had never before tasted water, so too, Israel, who thrive on the waters of Torah, nevertheless drink with thirst each new saying of Torah." Therefore, through this comparison, during the *Tashlich* services while standing before water containing fish, we pray that Israel merits in its "thirst for Torah learning." ⁴ During the dangerous times of Roman persecution, in defending the study of Torah, Rabbi Akiva used this parable: A fox tried to convince some fish to come onto the shore because they were in danger in the water as it was filled with nets. The fish replied that if they were not safe in their own natural habitat, how safe could they possibly be on the shore? ⁵ All the more so, Rabbi Akiva explains to his students that the study of Torah is a tremendous part of our life and without it the danger is unmatched. Rabbi Akiva said that just as fish cannot live without water, he could not live without Torah. Without Torah he would be just like a fish out of water. The following statement is another significant prayer during the *Tashlich* services: Fish have no eyelids therefore their eyes are always open. We pray that the eternally compassionate eye of G-d will always watch over us and guard us from evil. ⁶ Observant Jews go to a river containing fish because, "Man is likened to a fish who may be caught in the net of troubles if he fails to watch his conduct." Just as fish are prey to nets and hooks, so too, we are in danger of the hooks and nets of the *yeitzer hara* (evil inclination). Without Torah observance we are defenseless. The ultimate freedom from these hooks and nets of sin lies in sincere repentance. ⁴ Rav Moshe Isserles saw the *Tashlich* ceremony as a tribute to G-d, because fish were the first witnesses to His work of creation, which began on *Rosh HaShanah*.⁷

The comparison of fish with the Jewish people and their future is of great significance. Fish live in the depths of the sea, therefore they are considered intriguing and mysterious. Because fish lay many eggs they are associated with fertility. Jacob blesses Joseph's two sons, Ephriam and Menasheh, saying: "Let them multiply in the midst of the earth." The Hebrew word for "multiply", *veyidgu*, is obtained from fish (*dagim*).⁶ When Jacob blessed Joseph's two sons and all of their descendants he compared them to fish. As it is stated in *Gemara Berachot 20a*, just as the fish are protected and camouflaged by the sea, keeping away the evil eye, so too, the evil eye has no affect over the "seed of Joseph," the Jewish people, because of this blessing.

Fish, human beings, and the Sabbath, are linked as a foundation of blessings in the story of creation, Genesis 1:22, as follows: "And G-d blessed them." It is a household custom to eat fish on the Sabbath, the seventh day of the week as the numerical equivalent of "dag" is seven.⁶ The largest of all the sea creatures that G-d created is the Leviathan. The Sages state that in the future G-d will feed the righteous from the flesh of the Leviathan. The Leviathan fish symbolizes the hidden Torah concepts which will be revealed to the righteous by G-d. These new revelations, which have never been discussed with anyone since the six days of creation, will be enjoyed by the *tzadikim*.⁸

Fish also bring good luck. Pisces, which is the Zodiac sign for the month of *Adar*, is also when the lucky and joyful holiday of *Purim* takes place. Eastern European boys were named Fishl, which is a name considered to be lucky and keeps away the evil eye.⁶

The great *tzadik*, Rabbi Eliyahu Lopian, inspired people to avoid the terrible sin of *loshon hara*, evil gossip and slander. He noted that even if one is righteous, as well as scrupulous in all areas of mitzvah observance and Torah learning, if he speaks ill of others, "He will not escape the hook of punishment." Man and fish are compared as follows. When a fish sticks its tongue to grab the bait, it is immediately hooked. The body of the fish may still be dangling

freely, yet, the more the fish wiggles the deeper it is hooked. The fish's death is sealed by its tongue.⁵ A message well delivered.

In *Sefer* Jonah - the "great Fish" was created by G-d to save Jonah from drowning, as well as from himself. When Jonah was trying to flee from G-d's eyes, a great fish acting as G-d's messenger swallowed him. According to Rav Tarfon, Jonah's entrance into the great fish was compared to entering a synagogue. Jonah stood in this great fish in order to pray comfortably for G-d's mercy. Jonah resided in the fish's belly for three days and three nights until he accepted his mission from G-d. Rashi mentions that Jonah was originally swallowed by a male fish whose insides were quite spacious. Being comfortable, prayer did not readily enter Jonah's mind. This angered G-d and the male fish was commanded to spit Jonah into a pregnant female fish, in which Jonah was uncomfortable because of the lack of space due to the abundance of eggs. Jonah, now uncomfortable, finally began to pray. However, according to Rabbi Elazar, Jonah was never transferred into another fish. The only difference was that "*dag*" refers to a live fish where "*daagah*" refers to a dead one. Jonah, comfortable in the live fish, did not feel a need to pray. Since Jonah failed to pray, G-d killed this fish, making it food for the other fish. Consequently, Jonah prayed. According to Rav Bachya, when it says G-d designated a "large Fish," this refers not to the size but to the age of the fish. This specific fish was formed during the six days of creation.

Thus, it is clear that fish have played an important role in Jewish tradition and mysticism. Fish have been, and will continue to be, more than just an important source of food. Everything in this world has a purpose, and through Torah learning we can appreciate the many different roles that creatures, such as fish play in the Jewish lore.

NOTES

1. "The Celebration of *Rosh HaShanah*," *Kitzur Shulchan Aruch* p. 525.
2. Aaron Levine, *The New Rosh HaShanah Anthology* (Zichron Meir Publication, 1990), p. 74.
3. *ibid.* p. 75.
4. *ibid.* p. 130.
5. *ibid.* p. 131.
6. Ellen Frankel and Betsy P. Teutsch, *The Encyclopedia of Jewish Symbols* (Northvale: Jason Aronson, 1992), p. 55.
7. *Torat Ha-Olah* (1858) 48b.
8. *Artscroll Sukkot* p. 34.