The Father of Genetics

Yaakov Avinu or Gregor Mendel?

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Ever wonder why some children are vertically challenged? Or why others have poor eyesight? Is it genetically determined or are other factors involved? Dating back to 1860,the Austrian monk, Gregor Mendel, developed the laws of heredity while experimenting with garden pea plants. Mendel, for example, performed a mating, or cross, between plants that differed in the trait seed color, yellow or green. When yellow seed plants were crossed with green seed plants, the offspring always resembled the yellow seed parents. When these yellow seed plants were self-fertilized (the mating termed the monohybrid cross), a 3:1 ratio of yellow seed plants to green seed plants was noted in the offspring. For every three yellow seed plants there was one green seed plant. Mendel evaluated seven different traits and the 3:1 ratio was a constant. Through these observations, Mendel developed the concept that a specific trait is controlled by one gene that exists in two allelic forms, a dominant and a recessive allelic form. For the dominant trait to be apparent, the organism need possess only one dominant allele, as in the case of the monohybrid yellow seed plant. However, for the recessive trait to be apparent, the organism must possess a double dosage of the recessive allele.[1]

Is this the primary source for the concepts of inheritance or, perhaps, was there an earlier time in history when this logic was used for breeding? This article discusses the theory, developed by Dr. Yehudah Feliks of Bar-Ilan University, that Yaakov Avinu was the originator of the monohybrid cross.[2] However, first a brief discussion of some basic genetics in the Talmud is presented. Resh Lakish stated that "an abnormally tall man should not marry an abnormally tall woman, lest their offspring be like a mast... A man with an abnormally white-complexion should not marry an equally white-complexioned woman, lest their offspring be excessively white complexioned..."(Bekoroth 45b). Thus, centuries prior to Gregor Mendel learning the wonders of genetics, this great Torah scholar advised his people in the ways of inheritance. Furthermore, the Talmud is credited as the first written source to recognize a genetically determined disease.[3] This disease, postulated to be hemophilia,[4,5] or bleeder's disease, occurs when there is a deficiency in specific blood plasma clotting factors. It is a potentially fatal disease, evident primarily in males and usually transmitted by asymptomatic females who are carriers of this X-linked recessive gene. The Talmudic citation for hemophilia is found in Yevamos 64b. Rabbi Yehuda Hanasi stated, "If she circumcised her first child and he died (as a result of bleeding from the operation), and a second one died (similarly), she must not circumcise her third child..." With modern technology, hemophilia, albeit a serious disease, need not be fatal. The development of clot-

ting factors and the use of blood transfusions have been most beneficial. But, what about circumcision; can a hemophiliac male infant have a bris milah? In Israel in 1998, Dr. Shlomo Wallfish performed laser surgery on a two-month old baby. The baby suffered from hemophilia and was therefore unable to undergo the ritual circumcision in the usual manner. To prevent potentially fatal bleeding, a laser, instead of a knife, was used. According to Talmudic law, if two brothers die after a circumcision (due to hemophilia), the next son is exempt from a bris milah. However, as noted by Wallfish, today any hemophiliac baby can receive the ritual by undergoing this new laser technique.[6]

Back to the theory of Dr. Feliks that Yaakov Avinu, not Gregor Mendel, is the father of modern genetics.[2] The theory centers around the agreement between Yaakov Avinu and his father-in-law, Lavan, regarding the breeding of sheep and goats (Bereshis 30:32-43). The agreement required Yaakov to tend and breed Lavan's sheep and for his wages Yaakov would keep some of the resultant offspring. To make this agreement more interesting, Lavan removed all the spotted sheep from the flock, leaving only white sheep. Any spotted sheep born subsequently from matings between the white sheep would belong to Yaakov, whereas any white offspring would belong to Lavan. Lavan expected the majority of the offspring to be white, with only a small probability of spotted offspring. Yaakov peeled white streaks on rods, placed them at the watering troughs in which the females drank opposite the males, and after their matings, many of these white sheep produced spotted progeny. Apparently, these rods "magically" created offspring that were speckled and spotted. From this story Dr. Feliks suggests that Yaakov Avinu discovered the laws of genetics. How?

Dr. Feliks postulates the following. The trait for the color of sheep wool exists in two allelic forms, W which encodes for white wool and w which encodes for spotted wool; white is dominant over spotted. Thus, with sheep three genotypes are possible: WW and Ww, which encode for white wool and ww, which encodes for spotted wool. Lavan removed all the spotted (ww) sheep, leaving Yaakov only with white (WW and Ww) sheep. Lavan distanced these spotted sheep from Yaakov's white flock for fear that the two groups would interbreed. Yaakov's flock of white sheep included homozygote dominants (WW) and heterozygotes (Ww) and both appeared white to the same degree. In his matings of the sheep, Yaakov crossed heterozygote (Ww) males with heterozygote (Ww) females, thus yielding offspring in a 3:1 ratio of white to spotted. Yaakov kept the spotted (ww) sheep for himself, gave the homozygous white (WW) sheep to Lavan, and retained the hybrid (Ww) white sheep to continue performing the monohybrid cross. Matings between homozygotes (WW x WW) or between a homozygote and a heterozygote (WW x Ww) would yield only white offspring and would be detrimental to Yaakov's business. So, apparently, Yaakov was the initial scientist to perform the monohybrid cross.

The next obvious question is how did Yaakov distinguish between homozygous white (WW) and heterozygous white (Ww) sheep, as both appeared white to the same extent?

Yaakov observed the sheep and noted differences in mating behavior; white sheep that carried the recessive gene for "spottedness" (i.e., the heterozygotes or hybrids) conceived earlier than the homozygous dominants. This phenomenon, termed "hybrid vigor," expresses the concept that the hybrid is more fit than either extreme (homozygous dominant or homozygous recessive). The sheep that showed hybrid vigor are called mekusharos (the stronger ones) and were the heterozygotes; the others are called atufim (the feebler ones) and were the homozygous dominants. Thus, by watching their mating behavior Yaakov was able to differentiate the white Ww sheep from the white WW sheep. Yaakov placed the peeled rods before the stronger sheep and, apparently, they conceived early. However, in reality, Yaakov understood the principles of genetics and the peeled rods that were placed before the conceiving sheep were only to mislead Lavan into believing that this was the usual procedure done by sheperds.

To more fully understand the concept of hybrid vigor, attention is focused on the illness, sickle cell disease. Anemia, a swollen spleen, joint pain, and infections manifest this disease, caused by an autosomal recessive gene. This condition is potentially fatal to the homozygous recessive. A healthy homozygous dominant, however, is hypersusceptible to malaria, a protozoan disease

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that also may be fatal. When a mosquito carrying the malarial parasite bites a person, protozoa enter the person's red blood cells, which then travel to the liver, burst, and release parasites throughout the body. However, the hybrid individual, with sickle cell trait, is less susceptible to malaria than the homozygous dominant and does not exhibit the detrimental affects of sickle cell anemia as the homozygous recessive.[7] We can clearly see that carriers of sickle cell anemia are the potential healthier individuals and will therefore live a normal life. Those with the sickle cell disease may perish even before being the bitten by a malarial-contaminated mosquito; healthy humans without the genes for sickle cell, can G-d forbid, be infected with malaria. The same concept of hybrid vigor is shown in Yaakov Avinu's analysis of his sheep. Yaakov could only have accomplished this scientific feat with a precise knowledge of the laws of heredity. We, thus, can conclude that Yaakov Avinu understood and utilized the laws of heredity long before Gregor Mendel performed studies with garden pea plants. Therefore, Yaakov Avinu is not only our Patriarch, but also our father of genetics.

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N O T E S

1. Mader, S.S. (2000) Inquiry Into Life, 9th edition, McGraw-Hill, New York, NY
2. Feliks, Y. (1981) Nature & Man in the Bible. The Soncino Press, New York, NY
3. Haq, M.M. (1993) Medical Genetics and the Human Genome Project: a Historical Review. Texas Med. 89:68-73.
4. Rosner, F. (1969) Hemophilia in the Talmud and Rabbinic Writings. Ann. Intern. Med. 70: 833-837.
5. Rosner, F, (2000) Encyclopedia of Medicine in the Bible and the Talmud, Jason Aronson Inc., Northvale, NJ
6. Siegel, J.(1998) Baby Undergoes Laser Circumcision. Jerusalem Post International Edition, Sept. 5th
7. Lewis, R. (2001) Human Genetics. McGraw-Hill, New York, NY