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Curiouser and Curiouser: The Kashrut of Genetically Engineered Foodstuffs

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שאלה

Modern science has succeeded in circumventing the natural process of sexual reproduction by learning how to manipulate and engineer the DNA which is at the heart of all biological cells – that which is formally known as recombinant DNA technology. Increasingly, the market seeks to introduce genetically altered strains of common food items. If a genetic sequence is adapted from a non-kosher species and implanted in a new strain of a kosher foodstuff – for example, if a gene for swine growth hormone is introduced into a potato to induce larger growth, or if a gene from an insect is introduced into a tomato plant in order to give it unusual qualities of pest resistance – is that new strain rendered non-kosher?

תשובה

At the outset it is desirable to indicate what I *do not* deal with in this responsum. Much good might be derived medically from this ability to alter flawed genes to eliminate malformations and overcome disease. There is little question that that should be permitted under our broad conception of healing – but this responsum does not concern such human genetic engineering. Even the bio-engineering of plants and animals can be turned to medical uses. Thus, the ability to create transgenic animals who bear or lack traits that mimic human diseases has enormous potential for research.[1] Since the products are not for consumption,

[1] B. Davis, *The Genetic Revolution* (American Academy of Arts and Sciences, 1991), pp. 122-123. S. Donnelley, C.R. McCarthy and R. Singleton Jr., "The Brave New World of Animal Biotechnology," *The Hastings Report* Special Supplement (Jan.-Feb. 1994).

however, these are not the subject of this responsum. Or again, research has been undertaken with an eye toward developing products in plants and animals by genetic alteration, which products will then be available to treat human disease. Thus pigs have been altered to produce proteins that are active in humans and such pigs can be used as a resource for large scale production of medically necessary proteins that are in short supply. Similar uses as factories for the production of pharmaceuticals have been proposed for plants.[2] Here human consumption is precisely the intent behind the genetic alteration. In all these cases, however, Judaism's emphasis on healing individuals who are sick is likely to override any combination of concerns that might otherwise impact the technique. Whereas some consideration of the above cases is in order, these are not properly my concern here.

The concern here is that, absent health considerations, many genetic alterations are proposed for purely commercial reasons. Thus the majority of tests for specific traits of transgenic crops in industrialized countries prior to 1992 were for resistance to herbicides, so that it might be possible to treat a field with a substance to kill other growth and leave the crop plant unaffected. Similarly, most of the other traits tested were for insect and disease resistance, altered ripening qualities and other such matters important to the farmer and marketer, but morally neutral.[3] It is in such cases that the question of the kashrut of the resulting hybrid is relevant.

The Kashrut Issue

Superficially, the primary potential problem with such a hybrid is the problem of the admixture of a non-kosher product with a kosher product. With regard to admixtures the primary rule is that they are forbidden בנותן טעם – when they impart a flavor to the resultant product. This is estimated, as a matter of law, at one part in sixty, such that a lesser admixture is permitted, a greater admixture forbidden. Several caveats are affixed to this basic ruling. First, the ruling is taken as applicable only in accidental admixtures. Thus intentionally mixing less than one part in sixty of a non-kosher product in one's preparation bars use of the resultant product altogether. Here there is an open debate as to whether an admixture of a non-kosher product prepared intentionally by a non-Jew is to be treated at law as an intentional admixture, hence non-kosher, or as an unintentional admixture, since the non-Jew was permitted to prepare the food in that way, and the Jew first addresses the question only after it already was completed, as he does with an accidental admixture. Further, an exception is made for non-kosher ingredients that serve as stabilizers and flavoring agents which are deemed to have a perceptible effect even in tiny proportions, thereby rendering the final product non-kosher.[4]

Were it the case that the rules of admixture should, in fact, be applied here, then it would be appropriate to consider whether a genetic alteration using a gene from a non-

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[2] Donnelley, McCarthy and Singleton, ibid. J. Rissler and M. Mellon, "Perils Amidst the Promise," *The Union of Concerned Scientists*, (Dec. 1993): 6.

[3] Rissler and Mellon, ibid., p. 9. On the matter of the moral neutrality of these considerations, see below.

[4] Joseph Karo, S.A. Yoreh De'ah 98ff.

On the matter of non-Jewish commercial preparations manufactured intentionally for public (non-Jewish) use, the CJLS has gone on record with the more stringent ruling in its 1985 responsum by Rabbi Elliot N. Dorff on "The Use of All Wines" (*PCJLS 86-90*, pp. 203-226). But many of the national kashrut agencies apparently rely on the lenient opinion, see *Kashrut Magazine* 44 (Mar.-Apr. 1989): 54-56. Indeed that position was cited by R. Max Arzt in his 1940 responsum on eating fish out. It is cited as the normative position by R. Eliezer Wolff in his book, *Keeping Kosher in a Non-Kosher World*, no. 100.

kosher source, always much less than one part in sixty,[5] but intentionally administered, albeit largely by non-Jews, having a perceptible effect, for it changes the attributes of the animal or vegetable in some way, otherwise it would not be desirable, but most often an invisible effect – whether such an alteration renders the resultant product non-kosher or whether it does not. However, these common sense criteria prove to be altogether immaterial. And the reason is contained within the essential nature of these very criteria.

Halakhah had to distinguish between that which is counted and that which is nullified, that which is perceptible and that which is not. In the matter of stabilizers and flavoring agents it needed to determine in every case whether the standard rules of nullification or the specialized rules for "perceptible substances" should apply. In so doing, Jewish law in the modern period has settled on the rule of thumb that microscopic items, not visible to the naked eye, are discounted altogether is determining Jewish law. This ruling was made by R. Yehiel Michel Epstein in his work Arukh Hashulhan, Yoreh De'ah 84:36, published in the 1890s, and is generally accepted. As he rightly points out, were we to consider microscopic life forms we would be unable to drink the water or breathe the air.[6] It is for this reason among others that the major kashrut agencies have permitted the use of genetically engineered chymosin (microbial rennet) in the production of cheese, wherein a microbe is induced to produce an enzyme generally found only in animal stomachs and that enzyme is then used to curdle milk. Similarly, here, genetic transfer happens at a submicroscopic level which the halakhah is hard-pressed to consider.[7]

Several other considerations similarly conspire to nullify any kashrut concerns here. Transfer of material from a non-kosher animal at the genetic level would not constitute prohibited "eating" under the laws of foods. It has already been determined that eating must include "oral stimulation," and that absent that no blessings are required. Similarly, most authorities rule gastric tube feeding would not constitute a transgression of the restrictions of Yom Kippur. This insight serves as the basis variously for permitting transfusion, though the eating of blood is prohibited, and of permitting the use in a Jewish patient of a porcine heart valve. Indeed, all Jewish law on transplantation begins with the assumption that to receive a transplant is not, at heart, a prohibited act of cannibalism. Rather, the principle is clearly enunciated by R. Isser Yehudah Unterman, the late chief rabbi of Israel, in his responsum which opened the path to all subsequent considerations of transplantation in Jewish law, that an organ that is implanted in a body and flourishes by connection to that body's functions becomes a part of the host in all respects.[8] Thus the rules of kashrut, the

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[5] In natural cross-breeding, if one of the animals were non-kosher the offspring would be non-kosher, see S.A. 297:5. However, in such a case 50% of the DNA would be from the non-kosher animal. Not so, here.

[6] A similar response by R. Moshe Feinstein, *Iggrot Moshe*, Yoreh De'ah 3, 120:5 with regard to measurement considers that the law cannot possibly demand microscopic exactness, since microscopes were not available to our ancestors. Reference to this standard without attribution, among other points, is made, as well, by the late twentieth century Jerusalem sage R. Shlomo Zalman Auerbach in his responsa, *Minhat Shlomo*, p. 87 about transient sparks which may be invisible to the naked eye. Dr. Fred Rosner makes reference to this ruling, without source, in "Genetic Engineering and Judaism," *Jewish Bioethics*, p. 417. This nullification of microscopic agents is true only of those agents that are by their nature invisible to the naked eye, and not to ingredients which are visible in the form in which they are used, but become imperceptible to the consumer, being dissolved or integrated in the final product.

[7] See M.M. Chaudry and J.M. Regenstein, "Implications of Biotechnology and Genetic Engineering for Kosher and Halal Foods," *Trends in Food Science & Technology*, May 1994, pp. 165-168.

[8] See *Sha'arei T'shuvah* to S.A. Orah Hayyim 197:8 and R. Eliezer Waldenberg, *Tzitz Eliezer* 10:25:21.

R. Isser Yehudah Unterman's famous responsum is in his volume *Shevet Mi Y'hudah* (vol. 1, 1.21). See also the interesting example provided by R. Judah Greenwald, cited in Fred Rosner, *Jewish Bioethics*, p. 363.

rules of admixtures, simply fail to address the nature of transgenic creations. Absent a reason to declare the new product non-kosher, it would appear to be fit for consumption.

The כלאים *Question*

The more relevant question is that of כלאים, or Biblically prohibited mixing across species lines. Are transgenic creations to be prohibited as extensions of the Biblical rule of כלאים? The question is somewhat vexing, because the Biblical laws of כלאים are unclear as to their reason and scope. Several different forms of כלאים are recorded. It is prohibited to mix seed of different agricultural species, called כלאי זרעים (Lev. 19:19); it is also prohibited to plant different species adjacent to one another in the same field, called כלאי הכרם (Deut. 22:9). It is prohibited to cross-breed animals or to graft plants, together the class of הרכבה (Lev. 19:19); or simply to yoke an ox and donkey, or any other two species, together to the plow (Deut. 22:10). It is even prohibited to interweave specifically wool and linen, known as שעטנז (Lev. 19:19 and Deut. 22:11). But at no time is any reason presented. The tradition faced a problem in analyzing these rules precisely because it needed first to give them a context and an explanation.

A context is, in fact, suggested by the text of Lev. 19:19. In full, the verse reads:

> את חקתי תשמרו: בהמתך לא תרביע כלאים, שדך לא תזרע כלאים, ובגד כלאים שעטנז לא יעלה עליך.
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> You shall observe my laws. You shall not mate your cattle with a different kind; you shall not sow your field with two kinds of seed; you shall not put on cloth from a mixture of two kinds of material.

The introductory phrase begs an explanation. One is offered by Samuel in reflecting on the (minority!) Tannaitic opinion that כלאים (cross-breeding but not interweaving) is among the laws applicable to gentiles (מצות בני נח):

> מנא הני מילי? אמר שמואל – דאמר קרא: "את חקתי תשמרו" – חוקים שחקקתי לך כבר: "בהמתך לא תרביע כלאים," ו"שדך לא תזרע כלאים." מה בהמתך בהרבעה אף שדך בהרכבה....
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> Whence this assertion? Said Samuel – Scripture says: "You shall observe my laws" – the laws I have already enacted for you. "You shall not mate your cattle with a different kind" and "you shall not sow your field with two kinds of seed." Just as this refers to cross-breeding of your cattle, so it refers to hybridization of your field (i.e. your produce).[9]

Mr. Steven Drucker of the Alliance for Bio-Integrity argues that since a genetic transfer, unlike an admixture, is dynamic, it will grow over time and become significant, wherefore it should not be nullified, as a gelling agent (מעמיד) is not null. The concept is itself significant, for some halakhists do argue that, despite earlier nullification (ביטול), if more of the original forbidden substance was added, bringing the total volume of the forbidden substance over the one-in-sixty limit, that the previously nullified material is rekindled (חוזר וניעור) and is no longer null. This position is clearly taken by Moses Isserles, Yoreh De'ah 99:6 and, while opinions to the contrary are brought by Shabtai Hakohen, Shakh 21, ibid., he concludes, "My (more lenient) view is nullified against theirs." Counter to this argument is precisely the understanding that once a gene is incorporated in an organism, its products are not foreign products at all, thus adding mass to the alien, forbidden matter, but they are to be treated as a part of that organism itself.

[9] The Tannaitic position is recorded in a ברייתא on Sanhedrin 56a-b. Samuel's commentary is there, on 60a. This and many other rabbinic texts cited here were first called to my attention by the introduction to Yehuda Feliks' work on the first chapter of Mishnah כלאים, "Mixed Sowing, Breeding and Grafting" (Hebrew).

This position appears to be that of the Sifra, Kedoshim 4:17 cited in Yerushalmi Kilayim 1:7:

מנין שאין מרכיבין... ת"ל: "את חקותי תשמרו."

> Whence [the ruling] that we do not hybridize? . . .The teaching is: "You shall observe my laws."

as it is interpreted by R. Yonah and R. 'Lezer in the name of Rav Kahana to apply even to Adam. In that light, an elaboration of this reason is offered, there, "Why? Because 'of every kind' [Gen. 1:21] is written about them." But R. Yosi interprets this text from Sifra, in the name of R. Hila, in line with the majority opinion which holds that כלאים is only prohibited to Jews as of Sinai. Either way, transgenic creations might be prohibited as כלאים, a fundamental rebellion against the species created by God in the beginning.

Ramban (Nahmanides) takes that tack in his commentary on כלאים on the relevant passages in Kedoshim (Leviticus 19). "The reason for כלאים is that God created species in the world. . .and gave them the ability to procreate in order that said species should continue forever, [that is] for as long as God wishes for the world to continue. . . .Whoever intermingles two species changes and denies the Creation, as if he thought that God did not complete the work of His world as much as necessary, and he wishes to aid in the creation of the world, to add creatures to it." And he adds, as well, another observation, that in nature "the species of animals do not cross-breed, and even [with regard to] close relatives in nature, those that may be born to them. . .are infertile. We see that, as far as this is concerned, the act of cross-breeding species is a repugnant and futile act." Indeed, in the modern day, Mary Douglas has seconded Ramban's appreciation, arguing that the very rules of kashrut are intended to reflect a pure speciation of the universe, with natural creatures that cross the lines of the classes that the Torah perceives being declared non-kosher thereby.[10] Thus in the growing secular debate about transgenic plants and animals, Ramban is prominently quoted by an organization called "The Alliance for Bio-Integrity" which seeks to form an interfaith lobby against transgenic foods or for their labeling. They write, "Genetic engineering rejects the idea that man must defer to a higher power, and its underlying theology has no room for a purposeful Creator whose plan must he respected."[11] To repeat the question: Are transgenic creations to be prohibited as extensions of the Biblical rule of כלאים? This reasoning would appear to argue strongly that they should be.

The above is based, as we said, on a particular interpretation of the reasons behind the commandment of כלאים which are nowhere stated explicitly. There is another way to explain the leading words at the beginning of the cited verse in Leviticus. It is possible to understand that the rules of כלאים as stated are without cognitive reason. That the acceptance of the divine commandment, in this case, is to be taken on faith. Indeed, the very word חוקה (law) which appears prominently in that verse, is taken to refer to divine decrees without stated reason.[12] In this light Rashi's comment to this verse takes on legal significance. To wit:

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[10] Mary Douglas, *Purity and Danger* (London: Ark, 1984), pp. 53-57.

[11] The Alliance for Bio-Integrity, P.O. Box 2927, Iowa City, IA 52244, *www.bio-integrity.org*.

[12] The classic example of a חוקה – a decree without reason – is the red heifer. The Torah begins its description of the red heifer with the words זאת חקת התורה, "These are the laws of the Torah" (Num. 19:2). The Midrash notes that this rule appears internally contradictory, for in performing the very purification rite, the priest becomes impure. It sees the very unreasonableness of the rite as an occasion for doubts. It responds unambiguously: אמר הקדוש ברוך הוא: חקה חקקתי, גזרה גזרתי. אי אתה רשאי לעבר על גזרתי, "Said the Holy One [praised be He]: I have enacted a rule, decreed a decree. You may not transgress my decree!" (Bamidbar Rabbah 19:1 and 5). It relates the well known story in which a gentile asks Rabban Yohanan ben Zakkai if the red heifer ceremony isn't just hocus-pocus. Rabban Yohanan ben Zakkai answers that it is just like an exor-

> את חקתי תשמרו – ואלו הן: בהמתך לא תרביע כלאים וגו׳. חקים אלו גזרות מלך שאין טעם לדבר.
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> "You shall observe my laws" – and these are they: "You shall not mate your cattle with a different kind," etc. These laws are decrees of the sovereign which have no reason.

Such a classification has clear and clearly relevant ramifications. That which is taken as a decree of the written word is taken to be specific and precise, limited exactly as written. As Rashi notes on the second Mishnah on Menahot 27a, reflecting the reasoning of the gemara, there: "כתיב ׳חוקה׳... ו׳חוקה׳ עיכובא – The Torah writes 'decree' – and a 'decree' is limiting." Throughout Rabbinic literature, a חידוש – an unprecedented turn in the Torah's decrees, may not be extended, for to extend it would be hubris when the very intent and meaning is unclear. By this interpretation, then, only the specific examples in the Biblical text are prohibited as כלאים, that is, cross-breeding and hybridization through natural means, and any extension we seek to take to transgenic species arrived at through means unimaginable to the Bible may not be valid.[13]

The Law of כלאים

An assessment of the settled law of כלאים as codified, leads me to conclude that the Rabbis chose the more lenient approach with regard to the laws of כלאים. In the first instance, the midrash חוקים שחקקתי לך כבר, "The laws I have already enacted for you," is tailor made for the conclusion at which Ramban arrives about the laws of כלאים, that כלאים is in contravention of God's creation, wherefore כלאים should be forbidden to humankind. Indeed, it was brought with regard to a minority position that the law of כלאים applies to Adam. But the majority rules that only Israel is prohibited כלאים, and offers the barely modified version of the midrash חוקים שחקקתי בעולמי, "The laws I have enacted in my world," as referring to the laws given at Sinai to Israel alone.[14] Only if we favor Rashi's interpretation does it make any sense to permit כלאים to gentiles while forbidding it to Israelites.[15] This leniency is suggested in Shulhan Arukh, Yoreh De'ah 297:4, by the prohibition of allow-

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cism, which answer satisfies the gentile but perplexes his students. They seek a better answer, and he tells them: חייכם! לא המת מטמא ולא המים מטהרין! "By your life! A corpse does not cause impurity and water does not purify!" He then cites the above (Bamidbar Rabbah 19:8). Indeed, the term חוקה is specifically used to mean 'without reason' in 19:6: "The Holy One [praised be He] said to Moses: I will reveal the reason for the [red] heifer to you. But to others – it is a חוקה – a decree."

[13] R. Abraham Karelitz writes, in Hilkhot Kilayim 1: "אי לאו דומיא דבהמתך, אין לנו לבדות מעצמנו איסור הרכבה – If it is not similar to [cross-breeding] your cattle, we may not create on our own a prohibition of hybridization." Maimonides, in the *Guide for the Perplexed* 3:49, presents a different reason altogether for the prohibition of כלאים. He understands the laws against animal cross-breeding as a function of the rules against aberrant sexual relations and the laws against hybridization as a function of the rules against idolatry and idolatrous fertility rites. Maimonides' positions in this regard are not normative, as the *Guide* is not a halakhic work, and at any rate, his positions are also subject to some of the comments which will follow.

[14] See B. Menahot 60a and J. Kilayim cited and Tosafot and Ritba ad locum. Despite its familiarity, the rule of the seven Noahide commandments does not appear in Shulhan Arukh. It can be found in Maimonides, *Hilkhot Melachim*, ch. 9. Having codified the seven, Rambam writes in 10:6 that these are also traditionally prohibited for non-Jews. See the comments of *Kesef Mishneh* and *Lehem Mishneh ad locum*. *Mishnah LaMelech* satisfies himself by pointing out that in Hilkhot כלאים 1.6, Maimonides himself seems to accept that a gentile may cross-breed his own livestock; that position is accepted without question by both Kesef Mishneh and Radbaz. This is the dominant ruling, see Shach to Yoreh De'ah 297:3. See also S. Lieberman, *Tosefta Kifshuta*, Kilayim, p. 619.

[15] Indeed, particularly if Ramban is correct that speciation is inherent in the very acts of Creation, then Rashi would be correct, as well, that such a dichotomy is logically untenable. It is a dichotomy which can occasion

ing non-Jews to cross-breed an animal owned by a Jew, implying, of course, that to do so with his own animal would be permitted.

But the law is more liberal still. In his comments to Rambam, Hilkhot Kilayim 1:6, Radbaz offers the following:

> ומותר לומר לנכרי להרביע בהמתו של הנכרי ולהרכיב אילנו של הנכרי אע"ג דאומר לו אני אקנה אח"כ.
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> It is permissible to tell a gentile to cross-breed the cattle of the gentile or to hybridize the tree of the gentile, even though he says to him that he will buy [the product] subsequently.

No attempt is made or suggested to reduce the incidence of Jews suborning כלאים.

In a third point the law's leniency is also evident. Shulhan Arukh, Yoreh De'ah 297:5 reads as follows:

> מי שעבר והרכיב בהמתו כלאים, הרי הנולד מהם מותר בהנאה, ואם מין טהורה עם מין טהורה מותר באכילה.
>
> If one transgressed and cross-bred one's animal, the offspring is permissible for use, and if the species were both pure (kosher), it is permissible to eat it.

A similar rule is enunciated concerning hybridization of plants in 295:7:

> אסור לקיים המורכב כלאים, אבל פרי היוצא ממנו מותר ואפילו לזה שעבר והרכיבו. ומותר ליקח ענף מהמורכב ולנטעו במקום אחר.
>
> It is forbidden to maintain כלאים but the fruit produced thereby is permitted even to him who transgressed and produced the hybrid. It is permitted to take a branch from the hybrid and plant it elsewhere.[16]

Elsewhere in Jewish tradition a monetary fine is levied against willful transgressors to prevent them from disregarding the law.[17] The principle of אין חוטא נשכר – that the transgressor should not be rewarded, is well established. But here, no such defensive fine is contemplated. On the contrary, use of the product of the hybridization is affirmatively permitted. In fact, many hybrids are presently on the market, both hybrids of different strains of the same type of plant, which would not be כלאים, and those of separate species, which would be considered כלאים, the product of agricultural and animal husbandry techniques honed before the advent of genetic engineering. No such product is banned. Indeed, this is not even a modern leniency, having its earliest source in the Tosefta.[18]

In the most direct application to our issue, the great twentieth century sage R. Avraham Karelitz, known as the Hazon Ish, reports the ruling that כלאים is to be for-

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doubts, and if we hold it nonetheless, that is because we hold it to be a decree without reason, whose limits are opaque to us, therefore a decree which we cannot extend.

[16] S.A. Orah Hayyim 318:1 and 307:20. See also Rambam, *Hilkhot Kilayim* 1:7 and Radbaz, ibid.

[17] The classic case concerns items cooked illicitly on Shabbat. In T. Shabbat 2:15, as reported widely, R. Meir, R. Yehudah and R. Yohanan haSandlar all agree that one who intentionally cooks on Shabbat is forbidden to eat that food on Shabbat. They differ about whether it is permissible to eat it after Shabbat or not and whether it is permitted for another to eat it or not. Much diversity attends the proper interpretation, but all agree that a fine is called for. Even were one only to transgress the Rabbinic prohibition by instructing a gentile to transgress the Sabbath for you, one may not benefit until enough time has elapsed after Shabbat that it could have been prepared afterward. A closer case, that of castration, sees a similar fine. R. Joshua Falk tries to justify that distinction, see Drisha to Tur, Yoreh De'ah 297, the latter half beginning וכתב ז"ל הנולד מכלאים on the last line of p. 243a.

[18] T. Kilayim 2:15 and S. Lieberman, *Tosefta Kifshuta*, ibid.

bidden exclusively where there is genital contact, but that "there is no prohibition against placing the seed of one species into another."[19] If artificial insemination does not cross the boundaries of כלאים even though it introduces the entire genome of one species into another, certainly the transfer of a few genes by genetic engineering techniques far removed from natural sexual contact cannot be seen as prohibited.

A Caveat

The Union of Concerned Scientists, the Alliance for Bio-Integrity and others raise some serious concerns of potential damage to the earth's ecosystems through genetic engineering run amok.[20] They raise concerns that a damaging genetically engineered strain will be unleashed into the world's ecosystems and prove unstoppable. This type of concern animated the Michael Crichton thriller, *The Andromeda Strain*, and its successors. The scientific community has always responded that such a scenario is unlikely, that its track record is exemplary, and that they had put in place careful research protocols to lessen the likelihood of any such mishap. But candor requires admitting that no safeguards are foolproof and that not all potential damage will prove predictable. A case in point was reported by the *New York Times* on August 16, 1997. Under the headline, "A Delicate Pacific Seaweed is Now A Monster Of The Deep," Marlise Simons reports that a strain of seaweed, engineered two decades ago in Germany for its looks, was widely distributed to various aquariums. In a renovation, the Oceanographic Museum in Monaco emptied its tanks some 15 years ago. Now, that strain of seaweed is propagating out of control in sections of the Mediterranean, crowding out and killing most other plants and animals in the regions it controls. Moreover, it is resistant to all attempts that have been made to kill it or halt its advance.

Potentially, this concern is of halakhic import. There are clear rulings which prohibit experimental medical procedures under the rubric of ונשמרתם מאד לנפשותיכם, "You shall be exceedingly careful" (Deut. 4:15). But there are equally clear permissions granted where the danger is remote and the benefit great.[21] Some would prohibit smoking,[22] but the majority clearly do not. Skiing and bungee jumping could both be prohibited on this basis. Clearly we permit risk taking when the danger has not risen to the level of our concern. The relevant question is whether concern here is in order. Thus it could reasonably be argued that the current AIDS epidemic was facilitated by the ease of international air travel, but we would not consider the distant concern of some unknown virus sufficient to prohibit air travel. Despite the current case of the rampant seaweed, where potential strategies of control are also being discussed, the harm proposed appears to me to be too fanciful

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[19] R. Avraham Karelitz, *Hazon Ish*, Kilayim 2:16.

[20] J. Rissler and M. Mellon, *Perils Amidst the Promise: Ecological Risks of Transgenic Crops in a Global Market*, Union of Concerned Scientists, Dec. 1993; *Genetically Engineered Food: Why It Is Wrong*, the Alliance for Bio-Integrity; "Views Differ Sharply Over Benefits, Risks of Agricultural Biotechnology," *Chemical and Engineering News*, 21 Aug. 1995.

[21] This issue comes up, inter alia, in R. David Bleich's discussion of plastic surgery, *Contemporary Halakhic Problems I (CHP I)*, pp. 119-123, and Hazardous Medical Procedures, *CHP II*, pp. 80-84. A section is dedicated to the question in Dr. Fred Rosner's *Jewish Bioethics*, pp. 377-397.

[22] Such was the position of R. Seymour Siegel in a responsum, "Smoking: A Jewish Perspective," *PCJLS 86-90*, pp. 7-11. A similar position has been reported, of late, in the name of former Israeli Sephardic Chief Rabbi Ovadiah Yosef.

and unspecific to elicit our halakhic prohibition of any and all genetic engineering. Specific cases, should they come to our attention, may merit further consideration. At the very least, our secular legislatures must consider any potential risk to human health and establish appropriate regulations as a matter of public policy.

Thus, the Alliance further argues, in the alternative, for clear labeling laws that will require producers to indicate if a product has been genetically engineered. While implementation of such rules is not required by this responsum, and while the technical difficulties in enforcing such a standard are significant, there is sufficient minority warrant for a halakhic position which would prohibit said products as כלאים. Labeling rules would permit those who seek to follow the חומרא (the added restriction) to do so.[23]

Beyond my concern for these matters, there is a point at which, it seems to me, the חומרא (the added restriction) might be cogent and the pull of Ramban's concern for Creation's integrity may yet require our consideration. While we have permitted genetic engineering to produce desirable traits within the foods we consume, there is a point at which the product of genetic engineering is less like a hybrid and more like a differing creature. Imagine, if you will, producing a small winged lamb that does, indeed, fly. The aerodynamic problem, of course, is primary, but heavier-than-air craft can fly, and even this is not beyond our imaginings. Is such a creature to be treated as permitted? Can such genetic mixing be allowed?

The arguments, herein, present a prima facie case to answer these questions in the affirmative. But my heart wishes to answer in the negative. Why? There seems to be a qualitative difference between traits that, while they may be tested for, are expressed invisibly within an apparently unchanged creature and those gross characteristics that make up our traditional taxonomic observations. Thus, for instance, the Torah's very kashrut criteria are of gross features such as split hooves, scales, or number of legs (Leviticus 11). Rambam seeks to codify just such a distinction when he writes, in Hilkhot Kilayim 3:5: אין הולכים בכלאים אלא אחר מראית העין, "With regard to [the laws of] כלאים, one follows appearances." This dovetails rather well with the concept that we discovered concerning kashrut that halakhah disregards the microscopic, that which is invisible. Yet small genetic changes can effect large scale, visible results. Among the early experiments with genetic engineering was an experiment transplanting the illuminating mechanism of a firefly into a plant, producing a luminescent plant. Is that to be treated as permissible, a human-induced mutation not unlike the mutations which occur naturally, or has the species line been crossed? The burden of this paper is להקל and would permit even such a genetically engineered plant. Still, when we are able to change not a single trait, but much of the genome of a creature, to create, as it were, a creature of our own devising, then we must ask, is that the point at which we must stop?

There is an odd Tannaitic text which reflects both sides of this question. On Pesahim 54a we find the following:

> ר' יוסי אומר: שני דברים עלו במחשבה ליבראות בערב שבת ולא נבראו עד מוצאי שבת, ובמוצאי שבת נתן הקב"ה דיעה באדם הראשון מעין דוגמא של מעלה והביא שני אבנים וטחנן זו בזו ויצא מהן אור והביא שתי בהמות והרכיב זו בזו ויצא מהן פרד. רבן שמעון בן גמליאל אומר: פרד בימי ענה היה.... דורשי חמורות היו אומרים: ענה פסול היה לפיכך הביא פסול לעולם.

[23] This concern has recently had significant support in the lead article in the current issue of *The Hastings Center Report*, Paul B. Thompson, "Food Biotechnology's Challenge to Cultural Integrity and Individual Consent" (July-Aug. 1997).

> R. Yosi says: Two things were planned for creation on Friday but were not created until Saturday night. On Saturday night the Holy One (praised be He) granted Adam wisdom similar to that in heaven and he took two stones and ground them against each other and created fire, and he took two animals and mated them and created a mule. Rabban Shimon ben Gamaliel says: The mule was [created] in the days of Ana. . . .The allegorical interpreters would say: Ana was impure, so he created an impurity.

Rabban Shimon ben Gamaliel and the allegorical interpreters clearly understood that כלאים was an aberration. R. Yosi, however, argued that כלאים was a piece of divine wisdom.[24] Yet כלאים, shown by God to Adam, was nevertheless forbidden to Jews. Are we ready to challenge this, "the wisdom of heaven?"

Josephus, not a halakhic authority, to be sure, but an early interpreter of Rabbinic traditions, was aware of the potential of cross-breeding to denigrate the respect in which we hold Creation, and ultimately humankind. In Antiquities 4.8.20 he speculated on the ultimate reason behind the prohibition. He wrote:

> Nature does not rejoice in the union of things that are not in their own nature alike. You are not to permit beasts of different kinds together, for there is reason to fear that this unnatural abuse may extend from beasts of different kinds to men. . .by imitation whereof any degree of subversion may creep into the constitution.

It is excessive to place barriers against manipulation of the human species at the point of genetic manipulation of protein expression. It may not be excessive to place such barriers at manipulation of the very characteristics by which species are identified. I reserve final judgment in this area.

Conclusion

The kashrut laws of prohibited admixtures do not apply to the submicroscopic manipulation of genetic material. The laws of כלאים, which might apply, show an extraordinary tendency toward leniency. "Natural" כלאים products, though the fruit of an illicit operation of כלאים, have nonetheless been permitted as early as the Tosefta and the rationale tying the laws of כלאים to the Creation, while often tempting exegetes, has not become the dominant law. Of genetically engineered foodstuffs it should be minimally said that even if genetic engineering is to be prohibited, the products thereof are permissible.

Of the process of genetic engineering itself, moreover, I think there is ample reason to permit it even to the Jew. (1) The process of genetic engineering bears only a very minimal resemblance to the sexual and grafting processes that the Torah bans. If, indeed, we are enjoined to treat the Torah's ban as a חוקה – a *ukase* – and not to expand its parameters beyond the parameters given, then it seems that no extension to

[24] The medieval sage Maharal MiPrague (Judah Loew ben Bezalel) is cited by R. Michael Broyde in the *Journal of Halacha and Contemporary Society* 34, p. 64 (Be'er HaGolah [Jerusalem 5731], pp. 38-39), thus: "The creativity of people is greater than nature. When God created in the six days of creation the laws of nature, the simple and the complex, and finished creating the world, there remained additional power to create anew, just like people can create new animal species through interspecies breeding. . . .People bring to fruition things that are not found in nature; nonetheless, since these are activities that occur through nature, it is as if it entered the world to be created. . . ."

genetic techniques is warranted. (2) Although the question was formulated to focus on commercial use of genetic engineering, a fuller review of those very commercial considerations would find that most commercial considerations have a ramification which could be life-saving. Thus, for instance, increased pest resistance, though useful to the food conglomerates in terms of their efficiency, will also prove useful in the endeavor to feed the world's starving population. Already such reports are mixed in among the early results of genetic engineering.[25] Nothing appears more crassly commercial than engineering for greater shelf-life, but this, too, can facilitate distribution of foodstuffs to the needy. Given the law's tendency to limit the scope of the prohibition of כלאים, this would appear to be sufficient reason to permit genetic engineering to continue. (3) On the matter of gross changes in the characteristics by which species are recognized it remains necessary to engage in further study and consideration.

[25] "Higher Content of Essential Amino Acids May Aid in Fight Against Malnutrition," reports the Weizmann Institute in their newsletter. Clipping without date, 1994.