"Human Cloning: Halakhic and Liberal Halakhic Perspectives"

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DIGEST

One of the important bioethical topics discussed today is human cloning. Human cloning is a theoretical activity. (It does not currently exist and the prediction for its eventual development, as a protected, efficient and conventional treatment for the benefit of the humanity, is not clear yet). Still, cloning has been in the news, since the announcement of the birth of Dolly, the first sheep cloned, on February 23, 1997. On that day, *The Observer* told of Ian Wilmut, a Scottish scientist, and his group at the Roslin Institute. Since then, the idea of cloning had challenged with moral, ethical, religious, social, economical and political questions. Cloning produces a set of genetically identical individuals without sexual reproduction.

This thesis analyzes cloning in both its types: therapeutic and reproductive, from medical and liberal *halakhic* perspectives. In the introduction, I present the topic of human cloning, establishing some of the concerns of medical doctors and *halakhic* authorities. These concerns are physical, as well as moral as ethical.

Chapter 2 concerns the medical understanding of cloning. I will explain cloning in animals, knowing that similar procedures can be followed in humans. I will give a medical vocabulary as an appendix to help the reader.

Chapter 3 examines the thought process of *halakhic* authorities (Orthodox, Conservative, Reforms rabbis and doctors) regarding artificial insemination and in

vitro fertilization. Then, I will examine the material written until today regarding cloning.

Chapter 4 will be dedicated to my conclusions about human cloning from a medical and liberal *halakhic* standpoint. Knowing and respecting authorities that agree and disagree with these conclusions, I will base my responsa in my understanding of the sources that I have consulted.

This thesis deals with an important topic that moves the world today. The goal of this thesis is to show how Judaism, being an ancient civilization, understands one of the newest scientific discoveries. As the sanctity of the human being will be respected, there should be no conflict between the past and the future.

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CHAPTER I: Introduction

Human cloning is a "hot topic" in today's Western society. In 1997, the world was shocked by Dolly, the first mammal cloned from an adult cell. Dolly's birth was in 1996, although it was not announced until 1997. By the time I started my research in February 2002, there was not much information about cloning in the news. The increased discussion about cloning, especially the moral and ethical issues surrounding biomedical research, reinforced my conviction that a Jewish view needs to be heard. Since then, however, almost each month the media focuses on different issues regarding cloning. Cloning should be studied from two categories: therapeutic and reproductive. In both cases, human cloning is a real possibility. Cloning is not a fiction as one could have thought about Dr. Frankenstein or Dr. Faust's inventions. Human cloning is not horror literature or something from a science fiction movie. Human cloning is an issue that challenges humanity in ways both material and spiritual

My identity as medical doctor and a future rabbi piqued my curiosity about human cloning, too. This is my time to think seriously about this issue and to find deeper meaning. What is known about cloning already, from both a Jewish and scientific perspective, and what future problems could arise from this science? Rabbinical school prepares a person for his or her future profession in a spiritual and intellectual

way. One must really learn each topic with passion and devotion. One must study Jewish sources from Torah, Tanach, Talmud, and the rabbinical codes well. Of course, Hebrew and other educational subjects complete the curricula. Cloning is one of those issues not taught at rabbinical school as well as other issues that a rabbinical candidate does not have, in the curricula.

Deriving meaning and drawing conclusions from study refers to the lessons that I have learned daily through out my experience at rabbinical school. One lesson, however, occurred inside my family and taught us a lot. This is the lesson that inspires me to research about human cloning. The birth my nephew, Julian, was brought about by new reproductive techniques. My family went through the process of navigating these techniques together. Through the efforts of science and the hand of God, my nephew, Julian, was born on July 7, 2000, exactly thirteen years after the passing of my mother, Susana, z'l.

Studying mysticism at the Hebrew Union College, led me to believe that the number seven is very special in the Jewish tradition. That Julian was born thirteen years after my mother passed away is something more special. This reminds me of the Torah portion *Chaiei Sarah*, which instead of speaking about the life of our first mother, speaks about her dead. We learn from this portion that the deceased has to be remembered with happiness. Julian's birth symbolizes the happiness with which my family recalls my mother, and both science and God played a role in this miracle.

The lesson I have learned is that something seemingly impossible in the past can take place in the present. Speaking about reproductive techniques, forty years ago such science was something very impossible, very strange, and maybe even crazy. Today, reproductive techniques are common medical procedures followed by many couples who could not have babies in the classical way. Even the *halakhic* authorities did not discussed these issues forty years ago. But today, artificial insemination and in vitro fertilization have *halakhic* views.

Artificial insemination and in vitro fertilization show how the scientific knowledge could be used positively, helping families' dreams come true by having children. How wonderful it is for couple that in the past could not have children, to have renewed hope today. The same hope is inside Judaism. *Peru urevu*, "being fruitful and multiply," is a *mitzvah* that each Jewish couple wants to achieve. Judaism believes that each Jewish child has the potential to become the *messiah*; that it is why a new baby is a new hope.

Hope and serious research made medicine what is today. Medical advancements have reduced morbidity and raised mortality, reduced the rates of pregnancy diseases and raised the number of healthy babies. So, too, has medical science reduced cases of infertility and raised the number of babies born to otherwise infertile couples.

To help those couples still suffering from severe cases of infertility, reproductive human cloning could be an answer. Although there is no medical or halakhic precedent for human cloning, the science will be a reality in the near future and we must address it as if it were already a reality. Speaking about new answers, I remember when I did not had a telephone back in my childhood in Argentina. I was dreaming about the day I could speak with my friends. Today, new technology allows for each person in a house to carry a cell phone. What was a dream yesterday today is a reality. I can find many examples like that.

Popular culture provides us with more examples of new things that we do not have today but will gain through technology. Science fiction shows automatic cars, computerized appliances, and even companies that clone human beings. And some of the clones are cloned more than one time.

Although I do not always agree with the idea of science fiction, this genre presents all the moral and religious issues we will grapple with when the future becomes the present. We wonder, through the medium of science fiction, what will happen if science too closely emulates God? This is almost the same issue that our Bible teaches thousands years ago. I am referring to the Tower of Babel. Humanity at that time tried to build a tower to "be close to God." At the end, the tower was destroyed and this is one of the reasons given for why people in the world speak many languages. Could human cloning be a present rendition of the Tower of Babel?

I do not believe human cloning intends to imitate God or to try to touch God's ability by cloning people. I do believe that any scientific advancement must show benefits that outweigh disaster. That is why science is amoral. One could use it in both ways, for good and for bad, for construction or destruction. Maybe this could be a reason why Genesis, does not mention the purpose of man's creation whereas all the animals have purpose. As our sages said, maybe this omission is intentional because we have the capacity to choose between good and evil.

Fortunately we choose good on many occasions, such as developing America, creating electricity, building houses, inventing automobiles, exploring the moon, and many other examples. But it is important to remember unfortunate atrocities that happened throughout the history, such as any killing and persecution in the name of God, pogroms, or in our recent history, the Holocaust.

Such dark events show the negative face humanity. The atrocities committed by the Nazis show how men could be animals without feelings, without emotions, without heart, and what they can do in name of hate. The Holocaust shows how, sometimes, the world was apathetic and did not feel compassion for others.

The Holocaust also showed how people, full of brutality and hatred used human beings as animals, for experiments. That is why the first thing when mention when we speak about human cloning, is caution. Caution prevents the past from repeating itself. Human beings should be respectful of nature and history.

It is crucial to learn from the past. That is why I will dedicate a chapter to speak about cloning from a medical perspective, both therapeutic and reproductive. Then, with the medical knowledge, I will discuss human cloning, both therapeutic and reproductive, from a Jewish perspective. Since there is no responsa regarding human cloning, I will investigate how *halakhic* authorities, medical doctors, and scientists regard artificial insemination and in vitro fertilization, two scientific methods of reproduction that do have a Jewish response. I will discuss what we know about these technologies and the problems they present. Finally, in my conclusions, I will come up with a liberal *halakhic* and medical answer, to human cloning (therapeutic and reproductive) and whether or not it should be practiced.

CHAPTER II: Medical Views

In the introduction, I have explained what is cloning, and what will be the general goals of this thesis. In this chapter, I will explain how medicine and Science understand Cloning. Cloning[1] is a precise genetic copy of a molecule, cell, plant, animal, or human being; it is a complex procedure that I will try to explain scientifically, so that later I will arrive at a bioethical Jewish liberal response. At the end of this chapter, there is a glossary of biological terms for reference.

Scientists, at the cellular and molecular levels, have been cloning human and animal cells and genes for long time. The scientific justification for such cloning is that it provides greater quantities of identical cells or genes for study; each cell or molecule is identical to the others.

Molecular biologists, at the simplest level, routinely make clones of deoxyribonucleic acid (DNA), the molecular basis of genes. DNA fragments containing genes are copied and amplified in a host cell, usually a bacterium. The availability of large quantities of identical DNA makes possible many scientific experiments. This process, often called molecular cloning, is the mainstay of recombinant DNA technology and has led to the production of such important medicines as insulin to treat diabetes, tissue plasminogen activator (TPA) to dissolve clots after a heart attack, and erythropoietin (EPO) to treat anemia associated with dialysis for kidney

[1] Rossant, 1986

disease.

At the cellular level, another type of cloning is developed. In cellular cloning copies are made of cells derived from the soma, or body, by growing these cells in culture in a laboratory. The genetic makeup of the resulting cloned cells, called a cell line, is identical to that of the original cell. This, too, is a highly reliable procedure, which is also used to test and sometimes to produce new medicines such as those listed above. Since molecular and cellular cloning of this sort does not involve germ cells (eggs or sperm), the cloned cells are not capable of developing into a baby.

The third type of cloning aims to reproduce genetically identical animals. Cloning of animals can typically be divided into two distinct processes:

a) Blastomere separation

b) Nuclear transplantation cloning

In blastomere separation, the developing embryo is split very soon after fertilization, when it is composed of two to eight cells. Each cell, called a blastomere, is able to produce a new individual organism.

These blastomeres are considered to be totipotent, that is, they possess the total potential to make an entire new organism. This totipotency allows scientists to split animal embryos into several cells to produce multiple organisms that are genetically

identical. This capability has tremendous relevance to breeding cattle and other livestock.

Nuclear transplantation cloning was developed in early 1980s. One of the scientists who has been working in cloning since that time is Dr. James Robl of Sioux falls, South Dakota.[2] He told me that this procedure is a more sophisticated way of cloning animal where the nucleus of somatic cells is diploid--that is, it contains two sets of genes, one from the mother and one from the father. Germ cells, however, contain a haploid nucleus, with only the maternal or paternal genes. In nuclear transplantation cloning, the nucleus is removed from an egg and replaced with the diploid nucleus of a somatic cell. In such nuclear transplantation cloning there is a single genetic "parent," unlike sexual reproduction where a new organism is formed when the genetic material of the egg and sperm fuse. These experiments were successful for the first time only when the donor cell was derived from an early embryo. Theoretically speaking, we can assume that large numbers of genetically identical animals could be produced through nuclear transplantation cloning. Practically, the nuclei from embryos that have developed beyond a certain number of cells seem to lose their totipotency, limiting the number of animals that can be produced in a given period of time from a single, originating embryo.

The use of much more developed somatic cells isolated from adult sheep as the

[2] Robl et al, 2002.

source of the donor nuclei led Ian Wilmut and his colleagues to produce Dolly.[3] This achievement of gestation and live birth of a sheep using an adult cell donor nucleus was important evidence that showed that cell differentiation and specialization are reversible. Knowing that cells develop and divide, after fertilization and differentiate, into specific tissue (e.g., neurons, bone, muscle), the development of a viable adult sheep from a differentiated adult cell nucleus provided important confirmation that the pattern of gene expression can be reprogrammed. Before this experiment, many scientists believed that reactivation of the genetic material of mammalian somatic cells would not be complete enough to allow for the production of a viable adult mammal from nuclear transfer cloning.

Dolly was the First

"Perhaps in recognition of the surrealistic circumstances they should have spelled it D-A-L-I, instead of D-O-L-L-Y."[4]

There was a history before and after Dolly. On July 5, 1996, a sheep named Dolly was born in Scotland and the head of the research group was Ian Wilmut. Dolly was the result of the transfer of the nucleus of an adult mammary tissue cell to the enucleated egg cell of an unrelated sheep, and gestation in a third, surrogate mother

[3] Wilmut, I. A. E. Scnieke, J. Mc Whir, A.J. Kind, and Campbell K.H.S., 1997.
[4] Siegel, R., Wertheimer, L., Rosenberg, D., Portillo, R., Peters, T., Kass, L., 1997.

sheep.[5] Until Dolly was born, developmental and molecular scientists tried to understand the processes of cellular differentiation, the regulation of genes during this process, the factors that stimulate differentiation, and the reversibility of this process. They have routinely cloned sheep and cow embryo cells.[6] This was the first successful cloning experiment where the nucleus of an adult cell was used.[7]

Scientists have studied whether, once cellular differentiation occurs, the process is reversible. These questions have by no means been fully answered by the appearance of Dolly. If anything, the existence of Dolly stimulates even more was speculation and inquiry. I will tried to explain how the science led to the birth of the cloned sheep, including early studies of differentiation and development, research on regulation of gene expression, experiments using nuclear transfer in animals, and studies of cell programming and division.

First Studies: Differentiation and Development

By biology, scientists know that almost every cell contains a nucleus, which contains almost all the genes of the organism. Genes are composed of DNA, which serves as a set of instructions to the cell to produce particular proteins. Although all

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[5] Specter, M., 1997.

[6] In 1993, embryologist at George Washington University split human embryos, making twins and triplets. K sawyer, Researchers clone human embryo cells: work is small step in aiding infertile, *The Washington Post*, October 25, 1993, A4. These embryos were not implanted into a woman for gestation. This procedure is distinguishable from cloning by nuclear transfer.

[7] Begley, S., 1997.

somatic cells contain the same genes in the nucleus, the particular genes that are activated vary by the type of cell. For example, a differentiated somatic cell, such as a neuron (nerve cell), must keep a set of neural-specific genes active and silence those genes specific to the development and functioning of other types of cells such as muscle or liver cells.

Scientists, beginning more than forty years ago, tried to determine if a differentiated somatic cell still contained all genes, even those it did not express. First experiments in frogs and toads,[8] provided strong evidence that the expression potential of the genes in differentiated cells is fundamentally unchanged from that of the early embryo.[9] Nuclei from donor-differentiated cells were injected into recipient eggs in which the nucleus had been inactivated. The first series of experiments used cells from tadpoles as the source of donor nuclei and adult frogs were produced, albeit at a very low efficiency.[10] Although the cells used were highly specialized, they were not derived from the adult frog, so the cells might not have been fully differentiated.

Here, scientists realized that because isolated nuclei were used, other cellular components were not transferred to the recipient egg. One of these components is an organelle called the mitochondrion. This organelle is in charge of the energy-producing component of the cell. Even though most of the genes are located in the

[8] Gurdon, J.B., 1962
[9] Gurdon (1962), Briggs and King (1952).
[10] Gurdon, 1962.

nucleus, the mitochondrion has itself some of its own genes. Therefore, in somatic cell nuclear transfer, mitochondrial genes are not transferred to the enucleated egg along with the nuclear genes. Because there are some serious diseases associated with mitochondrial genes, nuclear transplantation could permit an embryo to develop with new, healthy mitochondria from a donor.

Gurdon and colleagues performed an interesting series of experiments. They used nuclei from adult frog skin cells for transfer to an enucleated egg.[11] Four percent of the nuclei transferred eventually gave rise to fully developed tadpoles. Their results provided evidence that the genes contained in the nuclei of differentiated cells could be reactivated by the cytoplasm of the egg and thus direct normal development, but only up to a certain stage. No viable adult frog ever developed from these tadpoles, and there was a decrease in the number of tadpoles born as the age of the transferred nucleus increased. This gave rise to the possibility that complete reactivation of the adult nucleus was prevented by some irreversible change in the genetic material and that there was a progressive decline in nuclear potential with age.

Scientists asked about the major reason for developmental failure of the transplanted embryos. It appeared to them to be from chromosomal abnormalities that occurred during the process of nuclear transplantation itself. Scientists learned that the percentage of cell division of adult cells is much slower than that of the cells

[11] Gurdon, et al., 1975.

of the early frog embryo. Therefore, in reality, for this technique to work it would be necessary that the transplanted adult nucleus reprogram its gene expression, replicate its DNA, and enter the normal embryonic cell division cycle within an hour of nuclear transfer. It is remarkable, given the mechanics and timing of the process, that any nuclei from adult somatic cells were successful in generating an embryo. The important results of the experiments of Gurdon and others demonstrated that the differentiated state of adult somatic cells does not involve major irreversible changes in their DNA.

How is the Gene Expression regulated?

In the early 1990s, experiments show, that active control mechanisms maintained differentiated gene expression, in which particular genes are turned on or off by regulatory proteins.[12] Experiments after that made the scientists to think to reprogram the gene expression of somatic cells so that they would perform a different task. The role of a particular cell type (e.g., muscle, liver, or skin) depends on the combination of regulatory proteins it expresses. While in certain specialized cells, such as white blood cells, actual rearrangements and deletions of DNA occur, for the most part, gene expression is not regulated by the loss of DNA but by the turning off of specific genes. Therefore, it should be possible to activate or inactivate almost any gene in a cell, given the right cellular environment containing the

[12] Blau, 1992.

appropriate regulatory molecules.

Scientists know that it is not essential to fuse it with an egg to reprogram the gene expression of a somatic cell; reprogramming experiments can occur through fusion of two adult cells. Cell fusion experiments, in which different somatic cell types are fused, have demonstrated that extensive reprogramming of differentiated nuclei can occur. For example, when muscle cells are fused with non-muscle cells of various sorts, muscle-specific genes are activated in the non-muscle cells[13]; similarly, genes that code for hemoglobin can be activated in many cell types after fusion with red blood cells.[14] These and other kinds of experiments have led to the isolation of specific factors that regulate cell differentiation, such as the gene that regulates the formation of muscle cells.[15]

One of the results of these experiments demonstrated that the stability of the differentiated state is not absolute. Therefore, given the appropriate regulatory molecules and enough time to reprogram an adult nucleus, somatic cells can reinitiate earlier programs of differentiation.

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[13] Blau et al., 1985.
[14] Baron and Maniatis, 1986.
[15] Waintraub, 1993.

What happened in Mammals?

Scientists learned through experiments with amphibians that it is possible to reprogram adult somatic cells. Following success in the nuclear transfer experiments in frogs, scientists attempted to repeat the experiments in mice. It was known that early development occurs at a considerably slower percentage in mammals than amphibians; giving hope that reprogramming of the donor nucleus would occur more efficiently. Proof of that is the first cell division in mice occurs about a day after fertilization, giving ample time, it was thought, for the reprogramming of gene expression and adjustment of the cell division cycle. This proved not to be the case. Early experiments showed that nuclei from somatic cells fused with fertilized eggs did not undergo nuclear division.[16]

However, a series of experiments in mice in 1985 showed that nuclei could be successfully exchanged between fertilized eggs, with very high rate of reaching the blastocyst stage of embryonic development and beyond.[17] Nuclei recovered and transplanted from embryos at the two-cell stage could direct development to the blastocyst stage. Nuclei transferred from embryos at later stages, however, could not successfully recapitulate development. What happened in mice is that the nuclei show less totipotency than whole cells. Many experiments have shown that blastomeres up to the early blastocyst stage are still totipotent when combined with

[16] Graham, 1969.
[17] McGrath and Solter, 1984.

other embryonic cells.[18] This means the failure of nuclear reprogramming has to be the result of something other than irreversible changes to the genetic material of the cells. Willadsen has reported experiments with sheep. There were some differences in his experiments than what had been seen before in mice. He and his group learned that enucleated eggs from sheep could be fused with blastomeres taken from embryos at the eight-cell stage to provide donor nuclei, and viable offspring were produced. [19]

Another experiment used nuclear transfer into enucleated unfertilized eggs. Using these very early stage eggs prolonged the period of possible reprogramming before the donor nucleus has to undergo the first division. And the advent in the last few years of electrofusion for both fusion of cells and activation of the egg has been another major advance, because activation and fusion occur simultaneously. Because these experiments use fusion of two cells and not simple injection of an isolated nucleus, all of the cellular components are transferred. Therefore, the mitochondria, which contain some genes of their own, are transferred along with the nucleus.

As I explained before an enucleated egg also contains mitochondria. Therefore, the result of a fusion experiment is a cell with a mixture of mitochondria from both the donor and the recipient. As the mitochondrial genes represent an extremely small proportion of the total number of mammalian genes, mixing of mitochondria per se is

[18] Rossant and Pederson, 1986.
[19] Willadsen, 1986.

not expected to have any major effects on the cell. However, if the nucleus donor suffers from a mitochondria disease and the egg donor does not, then mixture of the mitochondria may significantly alleviate the disease.

In the past fifteen years, there have been numerous reports of successful nuclear transfer experiments in mammals, nearly all of them using cells taken directly from early embryos. The oldest embryonic nucleus that can successfully support development differs among species. Scientists studied pigs, rabbits, mice, cows and sheep. Four-cell blastomere nuclei have been successfully used in pigs.[20] In mice, no nucleus older than the eight-cell stage has been used successfully.[21] In rabbits, 32- to 64-cell early embryos can be used as nuclear donors.[22] In cows and sheep, cells from what is called the inner cell mass (ICM) of the 120-cell blastocyst stage have been used successfully.[23] Indeed, in both cows and sheep, cell lines have been made from these ICM cells and nuclei from these cells have been used to reprogram development after transfer into enucleated unfertilized eggs.

A research group[24] showed that cow cells derived from embryos were grown in the laboratory for up to 28 days and then used as nuclear donors, without any attempt at synchronization of the cell division cycle of the donor cells. Of those successfully fused with eggs, 24 percent developed to the blastocyst stage and approximately 12

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[20] Prather, et al., 1989.
[21] Cheong, et al., 1992.
[22] Yang, et al., 1992.
[23] Collas and Barnes (1994); Smith and Wilmut (1989).
[24] Sims and First, 1994.

percent of the blastocysts transferred to recipient cows developed into normal calves. This success rate compares favorably with those seen using earlier blastomeres and suggests that it might be possible to achieve successful nuclear transfer from permanent cell lines established from early embryos.

Is it possible to reprogram the Nuclei and to synchronize the Cell Division Cycle?

The process that takes place after a transferred nucleus is exposed to the cytoplasm of the egg was the goal of studying by some scientists, and some but not all of the parameters that affect success of nuclear transfer are known.[25] They learned that enucleated eggs used for fusion proceed to division only after activation by some artificial signal, such as the electrical current used in the electrofusion technique. When donor nuclei are introduced into the enucleated egg, they usually undergo DNA replication, nuclear envelope breakdown, and chromosome condensation. After activation of the egg, the nuclear envelope is reformed around the donor chromosomes. The nucleus now takes on the appearance of a typical egg nucleus at this stage, which is large and swollen. It is assumed that this process begins the reprogramming of the transferred donor nucleus by exposing the chromosomes to the egg cytoplasm and beginning the exchange of egg-derived proteins for the donor nucleus' own proteins. [26]

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[25] Fulka, et al., 1996.
[26] Prather and First, 1990.

But it is not clear if the exposure to proteins found in the earliest stages of development and/or nuclear swelling is a prerequisite for reprogramming for later development. Biological experiments in a number of species have shown that when nuclei are fused with eggs that have been activated some hours prior to fusion, no DNA replication, chromosome condensation, or nuclear swelling occurs, but normal development can transpire.[27]

Still, it is not clear if the procedure that I have described is required for normal development. In rabbits, cows, sheep, and mice experiments have shown that nuclei from cells in the early phases of the cell division cycle do better than cells in later stages.[28] In the first phase of the cell cycle, termed GI (for Gap phase 1), cells contain only one complete set of chromosomes and are relatively quiescent. They then enter a period of DNA synthesis or replication, called S-phase, followed by a rest phase, called G2 (Gap phase 2), at which time they each have a duplicate copy of each chromosome. This doubling of the chromosomes is in preparation for cell division where an equal number will be divided between the two daughter cells. Because DNA replication is induced after nuclear transfer, any nucleus that has initiated replication before transfer will end up with too much DNA, which will likely result in chromosome anomalies. Thus, the need to transfer nuclei in the GI phase, before replication is initiated, is likely to be important to avoid chromosome damage that will prevent development of the embryo into a viable offspring.

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[27] Campbell, et al., (1994); Stice, et al., (1994).
[28] Cheong, et al., (1993); Collas, et al., (1992).

What could happened by improving the technique that let Dolly to be born?

Before Dolly, Wilmut and colleagues established cell lines from early sheep embryos, or blastocysts, and used these cells as nuclear donors.[29] In an attempt to avoid the problems of nuclear transfer of non-GI nuclei into activated eggs, they starved the donor cell line by removing all nutrients from the medium prior to nuclear transfer. Under these hunger conditions, the cells exit the cell cycle and enter the so-called "GO" state (Gap phase 0), similar to the GI phase in which chromosomes have not replicated. Fusion of GO nuclei with eggs ensures that the donor chromosomes have not initiated replication prior to fusion. It was also suggested that the GO state might actually increase the capacity of the nucleus to be reprogrammed by the egg cytoplasm. However, there is currently no direct evidence to support this, nor to conclude that nuclei synchronized in the GO stage are better than nuclei synchronized in GI. For Wilmut and colleagues, approximately 1 percent of fusions resulted in development of blastocysts, and 12 percent of embryos transferred developed into live lambs. Two died shortly after birth. The success rate in sheep and cow experiments was almost identical, and suggests that division of cells in culture for many days does not inhibit the ability of their nuclei to be reprogrammed by the egg environment. Could the same be true of nuclei from fully differentiated somatic cells?

[29] Campbell, et al., 1996.

All of this experiments led Dolly to be born.[30] Wilmut and colleagues took a late embryo, fetal cell cultures, and cell cultures derived from the mammary gland of an adult sheep and applied the same approach of synchronizing the cells in the GO stage prior to nuclear transfer. They reported successful production of live offspring from all three-cell types, **although only 29 of 277 (11 percent) of successful fusions between adult mammary gland nuclei** and enucleated oocytes developed to the blastocyst stage, and **only 1 of 29 (3 percent) blastocysts transferred developed into a live lamb**. **This experiment was, in fact, the first time any fully developed animal had been born following transfer of a somatic cell nucleus, since the earlier frog experiments generated only tadpoles.**

It should be noted, however, that the amount of new information regarding the stability of the differentiated state derived from this experiment is small, as no attempt was made to document that the donor cells were fully differentiated cells, the genes of which expressed specialized mammary gland proteins. In the earlier experiments with frogs, the fact that the donor cells were fully differentiated was documented in such a manner. In the present case, Dolly could have been derived from a less-differentiated cell in the population, such as a mammary stem cell.

[30] Wilmut, et al., 1997.

Doubts held until 1997

Until 1997, several important questions remain unanswered about the possibility of nuclear transfer cloning in mammals using adult cells as the source of nuclei:

First, can the procedure that produced Dolly be carried out successfully in other cases? Only one animal has been produced to date. Thus, it is not clear that this technique is reproducible even in sheep.

Second, are there true species differences in the ability to achieve successful nuclear transfer? It has been shown that nuclear transfer in mice is much less successful than in larger domestic animals. Part of this difference may reflect the intensity of research in this area in the last ten years; agricultural interests have meant that more nuclear transfer work has been performed in domestic animals than in mice. But part of the species differences may be real and not simply reflect the greater recent effort in livestock. For example, in order for a differentiated nucleus to redirect development in the environment of the egg, those of the egg must replace its constellation of regulatory proteins in time for the embryo to use the donor nucleus to direct normal development of the embryo. The inability of certain species to clone themselves may be the result of the different times of embryonic gene activation.

In mammals, unlike many other species, the early embryo rapidly activates its genes

and cannot survive on the components stored in the egg. The time at which embryonic gene activation occurs varies between species--the late 2-cell stage in mice[31], the 4-8-cell stage in humans[32] and the 8-16 cell stage in sheep. The later onset of embryonic gene activation and transcription in sheep provides an additional round or two of cell divisions during which nuclear reprogramming can occur, unlike the rapid genome activation in the mouse. Further cross-species comparisons are needed to assess the importance of this difference in the time of genome activation for the success of nuclear transfer experiments. In humans, for example, the time period before gene activation is very short, which might not permit the proper reprogramming of genes after nuclear transfer to allow for subsequent normal development.

Third, will the phenomenon of genetic imprinting affect the ability of nuclei from later stages to reprogram development? In mammals, imprinting refers to the fact that the genes inherited on the chromosomes from the father (paternal genes) and those from the mother (maternal genes) are not equivalent in their effects on the developing embryo.[33] Some heritable imprint is established on the chromosomes during the development of the egg and the sperm such that certain genes are expressed only when inherited from the father or mother. Imprinting explains why parthenogenetic embryos, with only maternally inherited genes, and androgenetic

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[31] Schultz, 1993.
[32] Braude, et al., 1988.
[33] Solter, 1988.

embryos, with only paternally inherited genes, fail to complete development.[34] Nuclei transferred from diploid cells, whether embryonic or adult, should contain maternal and paternal copies of the genome, and thus not have an imbalance between the maternally and paternally derived genes.

The successful generation of an adult sheep from a somatic cell nucleus suggests that the imprint can be stable. However it is possible that some instability of the imprint, particularly in cells in culture, could limit the efficiency of nuclear transfer from somatic cells. It is known that disturbances in imprinting lead to growth abnormalities in mice and are associated with cancer and rare genetic conditions in children.

Fourth, will cellular aging affect the ability of somatic cell nuclei to program normal development? As somatic cells divide they progressively age, and there normally is a defined number of cell divisions they can undergo before senescence (the process or condition of growing old, especially the condition resulting from the transitions and accumulations of the deleterious aging process). Part of this aging process involves the progressive shortening of the ends of the chromosomes, the telomeres, and other genetic changes. Germ cells (eggs and sperm) evade telomere shortening by expressing an enzyme, telomerase, which can keep telomeres full length. It seems likely that returning an adult mammalian nucleus to the egg environment will expose it to sufficient telomerase activity to reset telomere length, since oocytes have been

[34] Fundele and Surani, 1994.

found to be potent sources of telomerase activity.[35]

Fifth, will the mutations that accumulate in somatic cells affect nuclear transfer efficiency and lead to cancer and other diseases in the offspring? As cells divide and organisms age, mistakes and alterations (mutations) in the DNA will inevitably occur and will accumulate with time. If these mistakes occur in the sperm or the egg, the mutation will be inherited in the offspring. Normally, mutations that occur in a soma genes can predispose a cell to become cancerous. Transfer of a nucleus from a somatic cell carrying such a mutation into an egg would transform a sporadic somatic mutation into a germline mutation that is transmitted to all of the cells of the body. If this mutation were present in all cells it might lead to a genetic disease or cancer. The risks of such events occurring following nuclear transfer are difficult to estimate.

Why is it still important to continue research of this topic in animals?

Research on nuclear transfer cloning in animals may provide information that will be useful in biotechnology, medicine, and basic science. Some of the immediate goals of this research are:

- To generate groups of genetically identical animals for research purposes.
- To rapidly propagate desirable animal stocks.
- To improve the efficiency of generating and propagating transgenic livestock.

[35] Mantell and Greider, 1994.

- To produce targeted genetic alterations in domestic animals.
- To pursue basic knowledge about cell differentiation.

Is it safe to clone Animals for Research Purposes?

Experiments with mice greatly help the development and cure of many diseases. Mice have been a foundation of biological research for years because they are essentially genetically identical and homozygous (i.e., both copies of each gene inherited from the mother and father are identical). Experimental analysis is simplified because differences in genetic background that often lead to experimental variation are eliminated. Generating such homozygous inbred lines in larger animals is difficult and time-consuming because of the long gestation times and small numbers of offspring. The concept of generating small groups of identical animals by nuclear transfer has, been proposed as an alternative strategy to obtaining a genetically identical group of animals, and apparently underlies a recent report from Oregon on successful nuclear transfer from early embryonic nuclei in rhesus macaque monkeys.[36]

By these kinds of experiments, science teaches that repeated cycles of nuclear transfer can expand the number of individual animals derived from one donor nucleus, allowing more identical animals to be generated. The first nuclear transfer embryo is allowed to divide to early blastomere stages and then those cells are used

[36] Meng , Ely, Stouffer and Wolf, 1997. Also , Nagy, Rossant, Nagy, Abramow-Newerley and Roder,1993.

as donor nuclei for another series of transfers. This process can be carried on indefinitely, in theory, although practice suggests that successful fusion rates decline with each cycle of transfer. One experiment in cows, for example, produced 54 early embryos after three cycles of transfer from a single blastomere nucleus from one initial embryo.[37] Viable calves were produced from all three cycles of nuclear transfer.

This approach is likely to be limited in its usefulness, however. A group of cloned animals derived from nuclear transfer from an individual animal is self-limited. Unless they are derived from an inbred stock initially, each clone derived from one individual will differ genetically from a clone derived from another individual. Once a cloned animal is mated to produce offspring, the offspring will no longer be identical due to the natural processes that shuffle or recombine genes during development of eggs and sperm. Therefore each member of a clone has to be made for each experiment by nuclear transfer, and generation of a large enough number of cloned animals to be useful as experimental groups is likely to be prohibitively expensive in most animals.

Which are the advantages of nuclear transfer cloning for breeding livestock?

In animal breeding, the rapid spread of certain traits within stocks of domestic animals is of obvious commercial importance and has a very long historical standing.

[37] Stice and Keefer, 1993.

Artificial insemination and embryo transfer can increase the effective reproductive output of individual elite male and female animals and are widely used in the livestock industry. Nuclear transfer cloning, especially from somatic cell nuclei, could provide an additional means of expanding the number of chosen livestock. The ability to make identical copies of adult prize cows, sheep, and pigs is a feature unique to nuclear transfer technologies and may well be used in livestock production, if the efficiencies of adult nuclear transfer can be improved. The net effect of multiplying chosen animals by cloning will be to reduce the overall genetic diversity in a given livestock line, likely with severe adverse long-term consequences. If this technique became widespread, efforts would have to be made to ensure a pool of genetically diverse animals for future livestock maintenance.

How can science improve to generate and propagate transgenic livestock?

Scientists have interested to genetically alter farm animals by introduction and expression of genes from other species, such as humans. So-called "transgenic animals" were first developed using mice, by microinjection of DNA into the nucleus of the egg. This ability to add genes to an organism has been a major research tool for understanding gene regulation and for using the mouse as a model in studies of certain human diseases. It has also been applied to other species, including livestock. Proposed applications of this technology to livestock improvement include the possible introduction of growth-enhancing genes, genes that affect milk quality or

wool fibers, or disease-resistance genes.[38] There have been few advances. Initial results of the manipulation of meat production by expression of excess growth hormone in pigs led to undesirable side effects.[39]

Up until 1997, the major activity in livestock transgenesis is focused on pharmaceutical and medical applications. The milk of livestock animals can be modified to contain large amounts of pharmaceutically important proteins such as insulin or factor VIII for treatment of human disease by expressing human genes in the mammary gland.[40] In sheep, more than 50 percent of the proteins in milk can be the product of a human gene.[41] Even the milk of transgenic mice can yield large (milligram) quantities of recombinant proteins. Since many such proteins are active at very low concentrations, it is estimated that production of human drugs from transgenic animals could be considerably more cost-effective than current methods.

An important and growing area of interest is the use of transgenic animals for organ transplantation into humans. In this way animal bodies will serve as growth chambers for human organs, and these organs will then be transplanted back into bodies. We already have heard about pig organs. An example is the use of insulin manufactured from pigs. Pigs' organs are similar enough to those of humans to be potentially useful in organ transplants, if problems of rejection can be overcome. Rejection can already be partly overcome by the expression of human complement

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[38] Ward and Nancarrow, 1995.
[39] Pursel, et al., 1989.
[40] Houdebine, 1994.
[41] Colman, 1996.

(a component of the immune system) regulatory proteins in transgenic pigs. Further transgenic manipulation, such as the expression of human antigens in pigs could alleviate organ shortages by minimizing or eliminating the rejection of pig organs transplanted into humans, although other barriers, such as the possible transmission of viruses from pigs to humans, must be overcome.

Thus, the current method of directly injecting genes into fertilized eggs was inefficient until 1997. Not all injected eggs will develop into transgenic animals, and then not all transgenic animals will express the added gene in the desired manner. The production of transgenic livestock is slow and expensive. Nuclear transfer would speed up the expansion of a successful transgenic line, but importantly, it would allow a more efficient generation of transgenic animals in the first place. Foreign DNA, such as a human gene, could be introduced into cell lines in culture and cells expressing the transgene could be characterized and used as a source of donor nuclei for cloning, and all offspring would likely express the human gene. This, in fact, was the motivation behind the experiments that led to the production of Dolly. If a human gene such as that used for insulin could be expressed in the mammary gland, the milk of the sheep would be an excellent source of insulin to treat diabetes.

Is it possible to generate targeted gene alterations?

The most powerful technology for gene replacement in mammals was developed in mice. This technique adds manipulated or foreign DNA to cells in culture to replace

the DNA present in the genome of the cells. Thus mutations or other alterations that would be useful in medical research can be introduced into an animal in a directed and controlled manner and their effects studied, a process called gene targeting.[42] This technology would be of limited use, however, without some means of taking the changes generated in cultured cells and reintroducing them into animals. In mice, this can be achieved by the use of embryonic stem (ES) cells that are capable of being cultured indefinitely in the undifferentiated state. ES cells retain the potential to form all cells of the animal, including the germ cells, when returned to the environment of the early embryo. As the technique is currently used in mice, the first generation of animals generated from the ES cells are "chimeric," that is, they are made up of a mixture of cells from two different animals. These mice must then be bred one more time to transmit altered genes to the next generation. Using this technique, any genetic alteration made in the embryonic stem cells in culture can be introduced back into mice.[43]

This use of gene replacement and embryonic stem cell technology has been responsible for the explosion in the generation of "knock-out" mice, in which specific genes have been deleted from the genome. These mice have been invaluable in current studies to understand normal gene function and to allow the generation of accurate models of human genetic disease. Gene targeting approaches can also be used to ensure correct tissue-specific expression of foreign genes and to suppress the expression of genes in inappropriate tissues. If applied to domestic animals, this

[42] Capecchi, 1989.
[43] Robertson, 1986.

technology could increase the efficiency of the expression of foreign genes by targeting the introduced genes to appropriate regions of the chromosome. It could also be used to directly alter the normal genes of the organism, which could influence animal health and productivity, or to help develop transgenic organs that are less likely to be rejected upon transplantation. However, to date, there are no fully validated embryonic stem cell lines in domestic animals. Nuclear transfer from somatic cell lines into an egg, as reported by Wilmut and colleagues, provides a possible alternative to the embryonic stem cell route for introduction of targeted gene alterations into the germ line of animals.

Until 1997 embryonic stem cell lines had not been produced from farm animals, the other argument for using nuclear transfer to introduce germ line genetic alterations in farm animals is that it eliminates one generation of breeding from the initial chimeric animals. This is an important time- and cost-saving factor in farm animals with long gestation times and small litter size. However, this factor might not be as important as once thought. In mice, it turns out, embryonic stem cells can also be used to generate cloned animals carrying gene alterations directly without the initial generation of chimeric animals. When "tetraploid" embryos that are not themselves capable of developing normally are used as the host cells, the entire mouse fetus can be derived directly from the normal diploid ES cells.[44] Although this procedure is not yet very efficient, it illustrates the remarkable properties of ES cells and suggests that similar approaches could be applied in other species such as farm animals.

[44] Nagy, et al., 1993.

I have been speaking about stem cells but what are they?

In May 2002, the New Journal of Medicine[45] defined stem cells as cell that have the unique capacity not only to give rise to more stem cells (self-renewal) but also generate differentiated progeny.[46] They are present at all stages of development and probably exist in all multicelular organisms. In the blast cyst stage of the embryo before implantation, the inner cell mass contains cells that will become the fetus. Some of these cells are pluripotent stem cells that give rise to all types of somatic and germ-line cells. When these pluripotent cells are grown in vitro, they become embryonic stem cell lines.[47]

When mouse embryonic stem cells are transplanted into mouse blastcysts, the offspring of such blastocysts are often somatic and germ-line chimeras that carry genes from both the embryonic stem cells and the original blast cysts. These chimeras are powerful tools for research. One can, for example, repair or mutate a gene in a transplantable embryonic stem cell and study the way this action alters the development or function of the stem cell's daughter cells in the mouse recipient. More over, the insertion of human disease genes into mouse embryonic stem cells has yielded useful animal models of human diseases. Human embryonic stem cells

[45] N. Engl. J. Med, 2002
[46] Becker, McCulloch and Till, 1963. also in Weissman, I.L., 2000.
[47] Evans, M.J.; Kaufman M.H., 1981. Also in Martin GR., 1981.

are now available and are at an early stage of validation.[48]

The developmental stages between pluripotent embryonic cells and multipotent tissue-specific stem cells, such as hematopoietic stem cells, are still unclear.

Pluripotent stem cells generate germ-line stem cells plus tissue-specific stem cells, perhaps by way of an intermediate class of multisomatic stem cells, which would differ from pluripotent cells by contributing to all somatic lineages, but not the germ line.[49] Multipotent tissue-specific stem cells can be found from the fetal stage onward. In adults, they can participate in the renewal and regeneration of tissue, and during fetal life they may be units of tissue generation.

It is likely that there are specific stem cells for most, if not all, tissues, but there is confusion about when the results of an experiment or a therapeutic intervention can be attributed to stem cells. Verification of the presence of the critical properties of stem cells—self-renewal and differentiation—should be the gold standard for all such studies. For example, autologous transplants of mobilized peripheral blood from patients with cancer may contain hematopoietic stem cells, cancer cells, and all types of blood cells, yet nearly every group calls these stem-cell transplants. This practice is incorrect and misleading. The term "hematopoietic stem-cell transplantation" should be used only when stem cells are the sole cell population in the transplant.

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[48] Thomson, J.A.; Itskovitz-Eldor J.: Shapiro S.S. et al., 1998.
[49] Weissman IL, 2000.

Is it possible that tissue-specific stem cells will our lives?

The scientific magazines and the public media announce an experiment showing that stem cells from one tissue can circulate to another tissue and adopt the developmental fate of the second tissue (a process called transdifferentiation). In fact, in only a few studies of transdifferentiation have authentic stem cells been prospectively isolated or marked to ensure the accurate identification of the original cells. In true transdifferentiation, the differentiated cells in the second tissue or organ must arise solely from single cells of the first tissue, and the transdifferentiated cells must have not only the appearance but also the function of the second tissue.[50] Moreover, it is important to determine whether the original stem cell is a multipotent tissue-restricted stem cell that transdifferentiates or an itinerant stem cell that has traveled through the blood from, say, the heart to the bone marrow and then back to the heart. (This is a common problem; in mice, more than 10,000 hematopoietic stem cells pass through the blood stream and tissues every day).[51] It is still unclear whether true multisomatic stem cells exist in adults, and very few published studies meet the rigorous criteria essential for the identification of such cells.[52] It will be important to have clear answer to this question. This means creating a rational public policy concerning stem-cell research and medical applications of stem-cell transplantation. I hope that this resolution will consider scientific, religious, political and economic fields.

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[50] Weissman I.L., Anderson DJ, Gage E., 2001
[51] Wright, D.E, Wagers AJ, Gulati AP, Johnson FL, Weissman IL. 2001.
[52] Morrison S.J, 2001.

Are medicine and science working with human embryonic stem cells?

Scientists have learned that a number of human embryonic stem-cell lines have the capacity to differentiate into a variety of types of tissue.[53] The diversity of these lines is limited both by their number and by the fact that they were derived from patients in fertility clinics. Medicine expects that valuable knowledge will come from the research use of these cells, which may make it possible to investigate the gene-expression patterns of all intermediates between pluripotent embryonic stem cells and various multipotent tissue-specific stem cells, as well as between these stages and mature tissue cells. Even more might be learned by following the differentiation of single human embryonic stem cells after they have been trans-planted into mouse blastocysts, but in my view, before embarking on such experiments, we must be able to guarantee that no human gametes could form. Scientifics believe that using the currently available embryonic stem-cell lines to delineate developmental lineages of human cells will be extremely valuable.

Scientists expect to gain knowledge from such studies that should spawn a search for molecules or factors that cause particular cells to follow particular pathways and inhibit them from following others. They expect such research to affect not only classic pharmaceutical research but also the development of cell-based therapies.

Scientifics believe, however, that new lines of human embryonic stem cells will be needed. Science already has taught that the presence of a genetic predilection to a

[53] Thomson JA, Itskovitz-Eldor J., Shapiro SS. Et al., 1998.

disease does not necessarily mean that the disease will develop. Germ line alterations at several loci and somatic mutations also may be necessary. For these reasons, it is almost certain that no line of embryonic stem cells derived from blastocysts produced in fertility clinics will have the right combination of genes to be useful in studies of a particular disease. They will not, for example, serve for studies of the many kinds of cancer that result from a succession of somatic mutations. It is self-evident that no available embryonic stem-cell line or, for that matter, any random somatic cell from an affected person carries the entire set of genes with relevance to the disease under investigation. Only the diseased cells have these genes. By contrast, embryonic stem-cell lines with the appropriate sets of inherited and acquired genes should prove invaluable for studying the cellular basis of many diseases.

One could ask, how could such stem-cell lines be generated? As I have described before, one way is by transferring somatic-cell nuclei into enucleated eggs **(nuclear transplantation)**. When stimulated to divide, the cell can form blastocysts of predefined nuclear genotype **(with the mitochondria DNA coming from the egg)**. Cells from the inner cell mass of these blastocysts can be isolated, cultured, and used to generate embryonic stem-cell lines of predefined genotype.[54] Some researchers plan to derive such stem-cell lines from and for persons, which need transplants of multipotent stem cells —a process called **therapeutic cloning**. The risk of immune rejection is minimal. There is some risk, however, since proteins

[54] Wakayama T., Tabar V., Rodriguez L., Perry AC, Studer L., Mombaerts P., 2001. Also Kawase, E. et al, 2000

encoded by mitochondrial genes can stimulate the immune system to attack the cloned cells.

What is the basic research on cell differentiation that has been doing until now?

Unfortunately, scientists do not have a good understanding of the basic cellular processes that allowed the birth of Dolly by nuclear transfer using the nucleus from an adult somatic donor cell. If indeed the donor cell was a fully differentiated cell and not a rare, less differentiated stem cell that resulted in this cloned sheep, there will be many questions to ask about how this process occurred. For example, how was the specialized cell from the mammary gland reprogrammed to allow the expression of a complete developmental program? Developmental biologists will want to know which genes are reprogrammed, when they are expressed, and in what order. This might shed light on the still poorly understood process of sequential specialization that must occur during development of all organisms.

Scientists will also likely learn much from studying how reprogramming and reactivation occurred. What regulatory proteins in the host egg participated in the reprogramming? How did these proteins interact with each other and the DNA so that inactive genes from the mammary gland cells might be activated again? Answers to these kinds of important questions will contribute to our overall understanding of how cells grow, divide, and become specialized.

Research also may lead to the development of new therapies to treat human disease. It is not possible to predict from where the essential new discoveries will come. Though, the birth of Dolly already has sparked ideas about potential benefits that might be realized. To explore the possibility of these new therapies, extensive basic research is needed.

Research in mice will be done, because this animal is widely used by developmental biologists, and thus a great deal is already known about its development. The use of cloning in other animals-such as cows, pigs, and sheep-by agricultural and biotechnology companies also will contribute to understanding of the basic processes involved. The study of nuclear transplantation cloning in a wide variety of animals will be very useful. Although many of the basic cellular mechanisms underlying animal development are the same in all mammals, there are subtle developmental variations that often lead to major technical differences in working with a particular species. As scientists realized, a technique is often perfected in one species before being applied to another. If they know which parts of the techniques are widely applicable and which might need to be perfected for the given species it will be of great value. This body of research into animal systems will answer many questions about the feasibility of various new therapeutic applications being proposed for human cells. The important thing is that great improvements in treating human disease can be tested in animal systems to determine if the basic foundation of the idea is sound before experiments using human cells would be

required. Therefore, the path to testing the potential therapies to treat human disease that I will describe should initially go through testing in animal models before progressing to human cell research.

What are the possible therapeutic applications of nuclear transfer cloning?

This is an important question. The demonstration that, in some animals (frogs), the egg environment can reprogram the nucleus of a somatic cell provides further impetus to studies on how to reactivate embryonic programs of development in adult cells showed a lot of interest to the scientific world. These studies have exciting prospects for regeneration and repair of diseased or damaged human tissues and organs, and may provide clues as to how to reprogram adult differentiated cells directly without the need for oocyte fusion. In addition, the use of nuclear transfer has potential application in the field of assisted reproduction.

What is the possible of uses in organ and tissue transplantation?

A lot of diseases, when they are severe enough, are treated effectively by organ or tissue transplantation, including some leukemias, liver failure, and heart and kidney disease. In some instances the organ transplant required is non-vital, that is, it can be taken from the donor without great risk (e.g., bone marrow, blood, kidney). In other cases, the organ is obviously vital and required for the survival of the

individual, such as the heart. All transplantation with the exception of that, which occurs between identical twins, is imperfect, because transplantation of organs between individuals requires genetic compatibility.

One important conclusion, speaking from a strictly medical point of view, is that the application of nuclear transfer cloning to humans could provide a potential source of organs or tissues of a predetermined genetic background. The notion of using human cloning to produce individuals for use solely as organ donors is repugnant, almost unimaginable, and morally unacceptable. A morally more acceptable and potentially feasible approach is to direct differentiation along a specific path to produce specific tissues (e.g., muscle or nerve) for therapeutic transplantation rather than to produce an entire individual. Given current uncertainties about its feasibility, however, much research would be needed in animal systems before it would be scientifically sound, and therefore potentially morally acceptable, to go forward with this approach.

Which are the possible uses of cell-based therapies?

Cloning could be very useful by transplanting cells or tissues not from an individual donor but from an early embryo or embryonic stem cells-the primitive, undifferentiated cells from the embryo that are still totipotent. This potential application would not require the generation and birth of a cloned individual. Embryonic stem cells provide an interesting model for such studies, since they

represent the precursors of all cell lineages in the body. Embryonic stem cells from mice can be stimulated to differentiate in vitro into precursors of the blood, neuronal, and muscle cell lineages, among others[55], and thus they provide a potential source of stem cells for regeneration of all tissues of the body.

One of the experiments interesting that will interesting to do is to take a cell from an early blastomere and treat it in such a manner as to direct its differentiation along a specific path. By this procedure it might be possible to generate in the laboratory sufficient numbers of specialized cells, for example bone marrow stem cells, liver cells, or pancreatic beta-cells (which produce insulin) for transplantation. If even a single tissue type could be generated from early embryonic cells by these methods and used clinically, it would constitute a major advance in transplantation medicine by providing cells that are genetically identical to the recipient.

It is reasonable to imagine the prospect of nuclear transfer from a somatic cell to generate an early embryo and from it an embryonic stem cell line for each individual human, which would be ideally tissue-matched for later transplant purposes. This might be a rather expensive and far-fetched scenario. An alternative scenario would involve the generation of a few, widely used and well-characterized human embryonic stem cell lines, genetically altered to prevent graft rejection in all possible recipients.

[55] Weiss and Orkin, 1995.

What I have described until this point is a situation depending on cells of early human embryos, generated either by in vitro fertilization or nuclear transfer into an egg. It is also important to look at these issues from a religious and ethical point of view. And because ethical and moral concerns raised by the use of embryos for research purposes, it would be far more desirable to explore the direct use of human cells of adult origin to produce specialized cells or tissues for transplantation into patients. It may not be necessary to reprogram terminally differentiated cells but rather to stimulate proliferation and differentiation of the quiescent stem cells, which are known to exist in many adult tissues, including even the nervous system.[56] Experiments in this area are likely to focus more on the conditions required for direct stimulation of the stem cells in specific tissues than actual use of nuclear transfer to activate novel developmental programs.

These approaches to cellular repair using adult stem cells will be greatly aided by an understanding of how stem cells are established during embryogenesis.

Other researchers could be oriented to cell-based therapies. This means they would identify methods by which somatic cells could be "de-differentiated" and then "re-differentiated" along a particular path. This strategy would eliminate the need to use cells obtained from embryos. Such an approach would permit the growth of specialized cells compatible with a specific individual person for transplantation. Although at present this strategy is highly speculative, ongoing research in animal systems may identify new approaches or new molecular targets that might make this

[56] Gage, et al., 1995.

approach feasible.

Scientists think it would be important to make experiments in animals and to see how the environment of the egg reprograms a somatic cell nucleus. What cellular mechanisms can be elucidated? What components are involved in these processes? Can we direct cells along particular developmental pathways in the laboratory and use these cells for therapy? The capacity to grow human cells of different lineages in culture would also dramatically improve prospects for effective somatic gene therapy.

How can this therapy help assisted reproduction?

Animals have provided a lot of experience and teaching in the field of assisted reproduction. Assisted reproduction technologies are already widely used and encompass a variety of parental and biological situations, that is, donor and recipient relationships. In most human cases, an infertile couple seeks remedy through either artificial insemination or in vitro fertilization using sperm from either the male or an anonymous donor, an egg from the woman or a donor, and in some cases surrogacy, where both egg and sperm are donated but the mother carries the baby to term. In those instances where both individuals of a couple are infertile or the prospective father has nonfunctional sperm, one might envision using cloning of the father or mothers cell nuclei to produce a child.

Although this situation constitutes an extension of current clinical practice, aside from the serious, moral, and ethical issues surrounding this approach, there are significant technical and medical causes for caution, some of which were described in the research questions enumerated above.

In most situations of assisted reproduction, aside from the intentional union of the gametes by in vitro techniques, the fertilized egg and initial cells of the early embryo are not otherwise manipulated. In some rare cases, such as preimplantation genetic diagnosis, the embryo is manipulated by the removal of one of the identical cells of the blastomere to test its genetic status. In contrast, if nuclear transfer were to be used as a reproductive option, it would entail substantially more invasive manipulation. Up until now, the animal cloning of Dolly is a singular success, one seemingly normal animal produced from 277 nuclear transfers. Until the experiment is replicated, the efficiency, and even the validity, of the procedure cannot be fully determined. It is likely that the mere act of manipulating a nucleus and transferring it into an egg could decrease the percentage of eggs that go on to develop and implant normally, as well as increase the rate of birth defects.

Are we afraid that these genetical techniques practicing in animal would be practiced in human beings?

Dolly flashed conjecture about a human child being created using somatic cell nuclear transfer. Much of the perceived fear that greeted this announcement

centered on the misperception that a child or many children could be produced who would be identical to an already existing person.

This fear reflects an erroneous belief that a person's genes bear a simple relationship to the physical and psychological traits that compose that individual. This belief that genes alone determine all aspects of an individual is called "genetic determinism." Although genes play an essential role in the formation of physical and behavioral characteristics, each individual is, in fact, the result of a complex interaction between his or her genes and the environment within which they develop, beginning at the time of fertilization and continuing throughout life. As social and biological beings, we are creatures of our biological, physical, social, political, historical, and psychological environments. Indeed, the great lesson of modem molecular genetics is the profound complexity of both gene-gene interactions and gene-environment interactions in the determination of whether a specific trait or characteristic is expressed. In other words, there will never be another you.

While the concept of complete genetic determinism is wrong and overly simplistic, genes do play a major role in determining biological characteristics, including a predisposition to certain diseases. Moreover, the existence of families in which many members are affected by these diseases suggests that there is a single gene that is passed down with each generation that causes the disease. When such a disease gene is identified, scientists often say they have "cloned the gene for" breast cancer, for instance, implying a direct cause and effect of gene and disease.

Indeed, the recent efforts of the Human Genome Project have led to the isolation of a large number of genes that are mutated in specific diseases, such as some muscular dystrophies and certain types of breast and colon cancer.

Though these experiments showed that a "one-gene, one-disease" approach is far too simplistic. Even in the relatively small list of genes currently associated with a specific disease, knowing the complete DNA sequence of the gene does not allow a scientist to predict if a given person will get the disease. For example, in breast cancer there can be many different changes in the DNA, and for some specific mutations there is a calculated risk of developing the disease, while for other changes the risk is unknown. Even when a specific genetic change is identified that "causes" the disease in some people, others may be found who have the same change but do not get the disease. This is because other factors, either genetic or environmental, are altered that mask or compensate for "the" disease gene. Thus even with the most sophisticated understanding of genes, one cannot determine with certainty what will happen to a given person with a single change in a single gene.

Once again, the reason rigid genetic determinism is false is that genes interact with each other and with the environment in extremely complex ways. For example, the likelihood of developing colon cancer, a disease with a strong hereditary component and for which researchers have identified a single "causative" gene, is also strongly influenced by diet. When one considers a human trait that is determined by multiple genes, the situation becomes even more complex. The number of interactions

between genes and environment increases dramatically. In fact, the ability to predict what a person will be like knowing only their genes becomes virtually impossible because it is not possible to know how the environment and chance factors will influence the outcome.

An example of what I have discussed above is that even identical twins who grow up together and thus share the same genes and a similar home environment have different likes and dislikes, and can have very different talents. The increasingly sophisticated studies coming out of human genetics research are showing that the better we understand gene function, the less likely it is we will ever be able to produce at will a person with any given complex trait.

Medical Conclusions

"Cloning" has many meanings, but in its simplest and most scientific sense it means the making of identical copies of molecules, cells, tissues, and even entire animals. Dolly, the first sheep that was cloned, involved somatic cell nuclear transplant cloning. In this process, the nucleus from an adult somatic cell is transplanted into an enucleated ovum to produce a developing animal that is a "delayed" genetic twin of the adult.

There are many uses that nuclear transfer cloning might have for biotechnology, livestock production, and new medical approaches. Work with embryonic stem cells

and genetic manipulation of early embryos in animal species (including nuclear transfer) is already providing unparalleled insights into fundamental biological processes and promises to provide great practical benefit in terms of improved livestock, improved means of producing pharmaceutical proteins, and prospects for regeneration and repair of human tissues.

However, the possibility of using human cloning for the purposes of creating a new individual entails significant scientific uncertainty and medical risk at this time. Potential risks include those known to be associated with the manipulation of nuclei and eggs and those yet unknown, such as the effects of aging, somatic mutation, and improper imprinting. These effects could result in high rates of failed attempts at pregnancy as well as the increased likelihood of developmentally and genetically abnormal embryos.

CHAPTER III: Jewish View

The previous chapter's explanation about cloning provided the necessary background for this chapter, which will explore a Jewish interpretation of this scientific procedure.

Since Jewish law is based entirely on ancient authority and precedent, and there is no pre-existing *halachik* position with respect to human cloning, I will explain artificial insemination and in vitro fertilization as classic examples for which the rabbis apply old principles to new circumstances. I choose artificial insemination and in vitro fertilization, because they both involve rabbinical responses to new technologies of human procreation. I will cite the different Jewish opinions and responsa given by sages from orthodox, conservative and reform movements, regarding those issues. From those opinions, I will consider how these opinions might apply to the subject of cloning.

Artificial insemination, in vitro fertilization and human cloning (if it would be permissible in the future) are medical answers to a big problem--infertility. A couple is defined as "infertile" when they are actively trying to have a child over the period of a year and cannot conceive. Seventy five percent of infertility cases are caused by a combination of factors. Ovulatory dysfunction is a factor in 25 to 45 percent of cases, spermatozoal disorders (mostly unexplained) constitute 20 to 35 percent, tubal

disease account for 15 to 30 percent, pelvic endometriosis cause 10 to 50 percent, poor sperm-mucus interaction result in 5 to 15 percent, and antispermatozoal antibodies are present in 5 to 15 percent (with some 5 to 10 percent being totally un-explained.[57] Overall, in approximately 20 percent of the cases, the cause for infertility cannot be determined.

In 1990, 1.2 million patients were treated in the United States for infertility problems. These numbers show how important it is to find solutions. One possible solution is artificial insemination. Because each movement draws its own conclusions about methods of reproduction, after explaining the meaning of them I will explain separately what each movement thinks about them. I will begin with the orthodox opinion because it is the most rigid and is based thoroughly on ancient text and rabbinic precedent. Then I will continue with the conservative and I will finish with the reform opinion, which are closest to my beliefs.

What is Artificial Insemination?

The medical procedure known as artificial insemination is a common treatment for infertility.[58] The procedure has grown popular over the last two decades. It consists of intentionally injecting sperm into the female genital tract for the purpose of impregnation without sexual intercourse. There are two types of insemination: AIH

[57] Yovich and Grudzinskas (1990), pages 1-2

[58] From an historical perspective in artificial insemination, see Zimmels, 1952 and Jacobovits,1975.

(artificial insemination, husband) and AID (artificial insemination, donor), also known as DI (donor insemination). Also, a mixture of semen obtained from the husband and a donor can be used[59]. Results of artificial insemination employing the husband's semen are good if the indication for the procedure is an anatomical defect, but fair to poor if there is moderate infertility in the male. It is important to mention that women with infertility problems are two times more likely to conceive through artificial insemination than through regular intercourse.[60]

Artificial insemination has been practiced in animals for many years, primarily to increase the usefulness of the best male animals. Procedures to bring about conception by artificial means are of fairly recent origin. Lord Immanuel Jakobovits, who is considered the father of Jewish bioethics, wrote about the procedure in the mid-twentieth century.[61] These medical techniques were used on horses as early as the fourteenth century.[62] The first scientific research on artificial insemination in domestic animals, however, was not carried out until late in the eighteenth century.[63] Experiments on human beings followed very soon afterwards, but no successful case was reported until 1866 when the first artificially inseminated baby appeared in the United States, credited to scientist J. Marion Sims. Since then, rapid and enormous advances have been made this field. In Britain, in 1848, artificial

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[59] This procedure could be possible and could arise some potential problems such as determining paternity of the child.

[60] Murphy, D.P. and Torrano, E.F., 1963

[61] Jakobovits, I., 1975 page 244

[62] Forbes, R., 1944.

[63] The first experiments were carried out on a dog by the Italian physiologist Spallanzani, in 1780; see Greenhill, J.P, 1947.

insemination was not practiced a very large scale,[64] but in America there were many thousands of human beings who were conceived as well born in a clinic, at that time whose fathers' identity is known only to God and the physician.[65]

As early as 1934, Hermann Rohleder wrote the first history of the artificial impregnation of human beings.[66] In the year 2000 approximately 250,000 people in United States were offspring of such inseminations, thousands of which are performed annually.[67]

Even though the application of this procedure is relatively recent, we can find a proliferation of rabbinic responsa dealing with every imaginable *halakhic* consequence of artificial insemination.[68]

There are four major ancient sources in the Talmud and the codes of Jewish law that form the basis of the discussion of this topic. The sources are a passage in the Babylonian Talmud, a pronouncement in the thirteenth century by Rabbi Peretz ben

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[64] *See the report of a* Commission Appointed by *the* Archbishop of Canterbury on Artificial Human Insemination, 1948, page 13.

[65] By the year 1941 already. 3649 such children were known to have p United States; see Schatkin, "Artificial Insemination and *New York Law Journal, vol. .cxiii,* no.148 (June 26, 1945). Quoted in The R*eport etc.* p.38. Other sources claim a much higher frequency of such inseminations; see *The Report etc.*, page 12. In Israel it is estimated that there were tens, perhaps hundreds, of cases of A.I.D. by 1949; see A.H. Merzbach, "The Religious Physician and His Mission in the Jewish State" , in *Dath Yisrael U-medinath Yisrael, 1951. v.151. Ct. Akiva Joel,* Artificial Insemination in Israel", in Hebrew Medical Journal, 1953), Page 190 ff.

[66] Test Tube Babies, 1934).

[67] Rosner, Fred. *Biomedical Ethics and Jewish Law.* Ktav Publishing House, Inc. Hoboken, NJ. Page127, 2001

[68] See, Rosner, M.D. Fred. *Modem Medicine and Jewish Law,* 2nd ed. New York, pages. 85-100, 1991; Steinberg M.D. Avraham, *Encyclopedia Hilkhatit Refuit* (Jerusalem, 1988), pp. 148-61. For a bibliography of responsa on this topic, see R. Yaakov Weinberg and R. Maier Zichal, "*Hazra'a Melakhutit,*"- *Assia* 55 (December, 1994), pages 75-89.

Elijah of Corbeil, the *midrashic* legend of Ben Sira and the commentary of Nachmanides to Leviticus 18:20.

1) Two early references to so-called "bathhouse insemination" have served as the source for virtually all the contemporary *halakhic* discussions of modern artificial insemination. In the Talmud it is written:

> Ben Zoma was asked: May a high priest marry a maiden who has become pregnant [yet who claims she is still a virgin]? Do we take into consideration Samuel's statement, for Samuel said: I can have repeated sexual connections without [causing] bleeding [i.e., without the woman losing her virginity], or is the case of Samuel rare? He replied: The case of Samuel is rare, but we do consider [the possibility] that she may have conceived in a bath [into which a male has discharged semen.[69]

This first case is mentioned in the *Gemara Hagiga* in the course of a discussion about whether a *kohen gadol,* who is prohibited from marrying any woman who is not a virgin (Lev:21-14), may marry a pregnant woman who claims she is still virginal.[70] How could a virgin become pregnant? Shmuel attests that it is possible to have intercourse without perforating the *betulim*, but the *Gemara* entertains another possibility, that of impregnation in the bathhouse, in which case the woman, still being a virgin, would be permitted to marry a *kohen gadol.*

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[69] *Talmud Babli*, *Chagigah* 14b-15a. Some have construed this passage to be a sarcastic allusion to the Christian doctrine of Immaculate Conception. See R. Yehoshua Boymel, *Emek Halakha,* 1:68; Jakobovits, op. cit., page 359, n. 31. Preuss, op. cit., page 477, claims that this cannot be, as the doctrine of maculate conception was not yet known at the time of Ben Zoma (1st century C. E.). Preuss historical interpretation however, is disputable.

[70] See *Tosafot,* loc. cit., s.v. *betula.*

This Talmudic passage teaches us that our sages recognized that generation *sine concubito* was and is possible. This ancient folk belief allows us to draw an analogy to other, scientifically-possible instances of conception *sine concubito.* This is how ancient literary source can serve as guidance for today—thorough the process of reasoning by analogy, of looking beyond externals to the essence of the thing.

Regarding this talmudic passage, though Rabbi Judah Rosanes of Constantinople, the renowned commentator on Maimonides' Mishneh Torah, expresses doubt that impregnation through bathing in water into which a man had previously discharged semen can occur,[71] many authorities, including Rabbi Chaim Joseph David Azulai, Rabbi Jonathan Eybeschutz, and Rabbi Jacob Ettlinger, differ with him and interpret the Talmudic passage literally.[72] Others, however, agree with Rabbi Rosanes.[73] I will expand on this issue latter.

2) The second case is mentioned in the *Alphabet of Ben Sira*[74] in reference to the nature of Ben Sira's birth. This narrative work, of questionable date and authorship (some date this work from the Geonic period, some scholars[75] think that first

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[71] Rosanes, Commentary *Mishneh Lemelech on Maimonides' Mishneh Torah, Hilchot Ishut* 15:4.

[72] Azulai, quoted by Jakobovits, I., in "Artificial Insemination, Birth Control and Abortion," *Harofe Haivri* 2 (1953): 169-183 (Eng.) and 114-129 (Heb.); Eybeschutz, Commentary *Bnei Ahuvah* on Maimonides' Code, *Hilchot Ishut* 15:6; Ettlinger. Commentary *Aruch Lenair* on Yebamot 12b.

[73] Schick,M. (known as Maharam Schick), *Taryag Mitzvoth.* no. 1; S.Schick, Responsa Rashbam, Even Haezer, no. 8.

[74] The text is based on an Oxford manuscript, which was published A.M. Haberman, *Hadashim Gam Yeshanim* (Jerusalem, 1976), pages. 125-7.

[75] Rosner, Fred. "Biomedical Ethics and Jewish Law," page 130

mentioned by Rabbi Jacob Molin Segal (1365-1427) in his work entitled *Likutei Maharil.*), details the life of Shimon Ben Sira (second century B.C.E.), the author of *Divrei Shimon Ben* Sira (The Wisdom of Ben Sira). The relevant passage appears in the first section of this work, which is a biography of Ben Sira from his conception to the age of one year. The passage, apparently omitted in many editions, describes how the prophet Jeremiah was simultaneously both the father and grandfather of Ben Sira. Ben Sira's mother was Jeremiah's daughter. Jeremiah was forced by evil men to perform an act of onanism in a bathhouse, and his daughter conceived from his emissions when she inadvertently entered the same bath. Ben Sira was born seven months later,[76] the product of artificial insemination[77]. The text further mentions that it is no mere coincidence that the numerical value (*gematria)* of Hebrew letters of "Sira" equals that of "Jeremiah," thereby hinting that Ben Sira is, in fact, the son of Jeremiah. After citing all the other sources, I will come to this case with opinions of different rabbis.

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[76] Also, in Pieter W. Van Der Horst, "Seven Months" Children in Jewish and Christian Literature from Antiquity," in his *Essays on the Jewish World in early Christianity* (Gottington, 1990), pages. 233-47. There is a notion in *Hazal* that babies born in the seventh and ninth are viable, whereas those born in the eighth month are not (T.B. *Shabbat* 135a and *Yevamot* 80a). This was a prevalent notion in antiquity and the Middle Ages and is another example of a topic where a medical historical analysis may shed light on rabbinic sources. This issue has been previously addressed by Neria Gutal, " *Ben Shemona:Pesher Shitat Hazal beNogea leVladot Benei Shemona, Assia 55-56* (1989) pages. 97-111; Dr. Rosemary Reiss and Dr. Avner Ash, "*Ben Shemona Mekorot Klasi'im LeEmuna Amamit,* " ibid., pp. 11 2-17. Also in Ron Barkai Medieval Hebrew Treatise on Obstetrics," *Medical History* 33 (1988)p. 96-119, esp. pp. 101-104. Also Ann Ellis Hanson, "The Eight Months' Child and the Etiquette of Birth: Obsit Omen!," *Bulletin of the History of Medicine* 61(1987), p. 589-602; Sarah George, op. cit., pages. 204-33

[77] The text also mentions that the *Ammoraim* Rav Zeira and Rav Pappa were also born by artificial insemination, but unlike Ben Sira, the identity of their fathers was unknown. Yechiel Halperin in his *Seder ha Dorot (Jerusalem,* 1988), section 2, 118, quotes *Sefer Yuhsin* by Abraham Zacutu, who, in turn, cites this notion from *Sefer Kabbalat haHasid. Hal*perin then cites the original source of this idea from the alphabet of Ben Sira and subsequently refutes the belief that R. Zeira and R. Pappa were products of artificial insemination. He does not, however, assail the belief that Ben Sira was a product of artificial insemination

3) Another important source showing the possibility of pregnancy without sexual intercourse is by Rabbi Peretz ben Elijah of Corbeil in his work *Hagahot Smak*, who states:

> ... a woman may lie on her husband's sheets but should be careful not to lie on sheets upon which another man slept lest she become impregnated from his sperm. Why are we not afraid that she become pregnant from her husband's sperm and the child will be conceived of a niddah [menstruating female]? The answer is that since there is no forbidden intercourse, the child is completely legitimate [lit. kosher] even from the sperm of another, just as Ben Sira was legitimate. However, we are concerned about the sperm of another man because the child may eventually marry his sister.[78]

From this passage we can learn:

a. Conception without intercourse is possible.

b. The offspring is considered legitimate.

c. No prohibition is mentioned concerning cohabitation of the woman with her husband afterwards, even if she has become pregnant from another. The only reason for her to avoid contact with the linen upon which another has lain is to prevent incest at a later date, i.e., the child marrying its own sibling.

d. Finally, only forbidden intercourse would make her forbidden to her husband, whether or not she has lost her virginity, and irrespective of whether or not the semen of another man has entered her genital tract.

4) Rabbi Moses ben Nahman (Nahmanides), in explaining the verse, "One may not have intercourse with one's neighbor's wife for seed [or sperm] " (Leviticus 18:20),

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[78] Quoted by J. Sirkes, known as *Bach* or *Beth Chadash*, in his commentary -on Jacob ben Asher's *Tur Shulchan Aruch,* Yoreh Deah 195. Also quoted by David ben Samuel Halevy, known as *Taz* or *Turei Zahav*, in his commentary on Joseph Karo's *Shulchan Aruch*, *Yoreh Deah* 195:7.

points out that the last two Hebrew words of that verse seem unnecessary. He then raises the possibility that they were included in the text to emphasize one reason for the prohibition of adultery, namely, that society will not know from whom the child is descended. On this basis, Rabbi Yoel Teitelbaum rules that donor insemination is biblically prohibited, for as with adultery, the identity of the biological father (in this case, the donor) is usually unknown. Rabbi Eliezer Waldenberg goes even further: he uses Nahmanides' interpretation as forbidding the very act of injecting a donor's semen into a married woman's womb as an act of adultery, regardless of the absence of sexual contact involved.[79] Contemporary authorities disagree with him, saying that adultery requires sexual intercourse. I am going to refer to them later.

Other Jewish references to artificial insemination are not rabbinic in origin. The next reference appears in the case studies of the famous Marrano physician Amatus Lusitanus (1511-1568).[80] This discussion is not found in all versions of Lusitanus' classic work, the Centuria, as censors expurgated it.[81] Here Lusitanus invokes the notion of artificial insemination (*sine concubito*) to exonerate a nun with a uterine mole who was accused of impropriety. He formulates his proofs from the case of Ben Sira.

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[79] Rabbi Moses ben Nachman, *Commentary to the Torah,* on Leviticus 18:20. Rabbi Yoel Teitelbaum, *Divrei Yoel* 110,140. Rabbi Eliezer Waldenberg, 9 *Tzitz Eliezer* 51:4; also 3 *Tzitz Eliezer* 27:1, where Rabbi Waldenberg vigor opposes the ruling of Rabbi Peretz, quoting a number of early rabbis who disagree with him on the unqualified legitimacy of a child born without sexual union.

[80] On Lucitanus, see essays in Harry Friedenwald, *The Jews and Medicine* (Baltimore, 1944), vol. 1, pages.332-390. Preuss (op. cit., 464) also quotes Lusitanus in discussing the *Gemara Hagiga*

[81] Friedenwald, op. cit., page 363, n. 98.

Rabbi Isaac Lampronti was another famous Jewish physician who makes mention of artificial insemination in his work[82] but this particular work is *halakhic*, not medical in nature. Lampronti (1679-1756),[83] in his magnum opus, *Pahad Yitzhak,* poses the following riddle: A child is the son of a woman who was impregnated by her father, yet he is not a *mamzer* How is this possible?[84] He answers, "This is Ben Sira" and recounts the incident in the bathhouse, "as is written in *ketubot."* This reference is clearly not to the Talmudic tractate, as the story derives from the *Alphabet of Ben Sira.* The term *"ketubot"* is likely to be translated as "the writings," in which case it may refer to the apocrypha. [85]

Returning to the story of Ben Sira, it should be noted that not everyone accepted the story of Ben Sira's birth. Solomon Ibn Verga (15th-16th century) states in his historical narrative, *Shevet Yehuda,* that Ben Sira was the grandson of Yehoshua ben Yehotzadak and makes no mention of relation to Jeremiah.[86] Rabbi David Ganz,

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[82] Another famous Jewish physician, Tobias Cohn (1652-1729), who mentions artificial insemination in his *Maase Tuvia* (Cracow, 1908), section 3, 118b.

[83] Although known for his *halakhic* expertise, Lampronti was a prominent Italian physician and a graduate of the University of Padua. See Abdelkader Modena and Edgardo Morpugo, *Medici E Chirurghi Ebrei Dottorati E Licenziati Nell'Universita Di Padova dal* 1617 al 1816 (Bologna, 1967), pages. 55-57. These authors mention that Lampronti consulted the famous physician Morgagni for assistance with his difficult medical cases.

[84] *Pahad Yitzhak* (Bnei Brak, 1980), s.v. *Ben Bito.* David Margalit does not mention this passage in his essay, "*Erkhim Refui'im she-bi-Encyclopedia haHilkhatit Pahad Yitzhak LeR.* Y Lampronti," *Koroth* 2:1-2 (April, 1958), pages 38-61.

[85] Although the *Wisdom of Ben Sira* is included in the works of the apocrypha, the *Alphabet of Ben Sira* is not. In Yehoshua Boymel, Emek *Halakha,* no. 68, regarding the citation Rabbi Lampronti...Even though he did not cite his source for this, still his words are believed, and this *tzaddik* is free from iniquity. Rabbi Boymel apparently thought the word "*ketuvim*" to be a generic not a reference to a specific work or body of works.

[86] (Pietrikov, 1904), introduction

the seventeenth century chronicler, claims that this story is mere exaggeration: "I have not found it anywhere in the Talmud, and I have not heard from my teachers that it is found in any *aggada* or *midrash*. "[87]

If *halakhic* tradition assumes that the passage in the *Alphabet of Ben Sira* is true, we can understand why subsequent *Rishonim* and *Aharonim* quoted it extensively and list the important *halakhic* points we learn from it:

- Ben Sira is clearly assumed to be the product of Jeremiah and his daughter.
- In either case, despite the fact that Ben Sira is the product of an *halakhically* illicit relationship, nowhere does one find aspersions cast on his lineage, and never is he referred to as a *mamzer.* The implication is that only the marital act can create the prohibition of *arayot* and label the resultant child a *mamzer.* The relevance of this case to artificial insemination with donor sperm should be obvious.
- Ben Sira was known as the son of Jeremiah. This fact implies that a child born from artificial insemination may be considered *halakhically* related to the sperm donor.

Rabbi Peretz ben Eliyahu of Corbeil (c. 1295) in his glosses on *Sefer Mitzvoth Katan* (also referred to as *Amudei Gola*) is the one of the earliest authorities who cited this

[87] Tzemah David, section 1, *eleph revii,* 448. Also in *Tzitz Eliezer*, vol.9, no. 51, gate 4, chap. 1, letter *tet*

case.[88] He states that a woman need not refrain from sleeping on her husband's sheets while she is a *nidda* for fear that that she might bear a child from remnant seed on the sheet and the child would be a *ben nidda*. However, Rabbi Peretz does warn that a married woman should not sleep on the sheets slept on by a man other than her husband. Why Rabbi Peretz differentiates between these two cases is a matter of *halakhic* import, but implicit in these statements is that Rabbi Peretz acknowledged that a woman could become pregnant in this manner. He brings proof from the case of Ben Sira. As I said before, Jacob Moellin (1360-1427?) also mentions the case of Ben Sira in *Likutei Maharil*, where it appears as a statement without particular *halakhic* context.[89]

Rabbi Shimon ben Tzemah Duran (Spain 1361-1444)[90], also treats this subject. A question was posed to him about a woman who claimed to have had a virginal conception. Rabbi Duran, who was also a physician, was asked to determine whether this was in fact possible, and, if so, what would be the *halakhic* ramifications. Whether this so-called bathhouse impregnation was actually feasible or simply contrived for the sake of *halakhic* analysis was a matter of intense debate

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[88] This reference is mentioned by the *Bayit Hadash* (R.Y. Sirkes 1561-1640) in *Yoreh Deah*. 195 (s.v. *ve-lo)* as appearing in the *"Hagahat Semak Yashan"'* of R. Peretz. The glosses of R. Peretz first appeared in the printed text of *Sefer Mitzvoth Katan* in the mid 1500's and all subsequent editions invariably contained these glosses. The 1556 Cremona edition does not have this particular gloss. It seems that this gloss remained in manuscript form and was never printed; hence the term *"yashan"* of the Bah likely refers to an old manuscript edition. This fact is further evidenced by the comment of R. Chaim Y.D. Azulai (Birkei *Yoseph* E.H. 1:14) that after much effort he was finally able to locate this particular gloss of R. Peretz in an old manuscript. A passage similar to that of R. Peretz appears in the *Shiltei hagiboryim* on *Rif* (T.B. *Shavuot* 2a) attributed to an author referred to by his acronym, HR "M. Rav Eliezer Waldenberg *(Tzitz Eliezer* vol. 9, no. 51, gate 4, chap. 1, letter *het)* has postulated that this may be a misprint, and the text should actually read HR"P, an acronym for HaRav Rabbenu Peretz.

[89] Spitzer, Sh.1989.
[90] Vol, 3, no. 263.

amongst the *Aharonim.* From the *Rishonim* who addressed this issue, I can cite Rabbi Shimon Ben Tzadok (called Tashbetz, Germany 1285). He concluded that it is feasible, marshalling evidence from the passage in *Gemara Hagiga*14b-15a, as well as from the case of Ben Sira. With respect to the latter, he prefaces with the disclaimer that "if we believe the apocrypha," then we have proof from Ben Sira. What is particularly interesting is Tashbetz's reference in a gloss to two of his contemporaries, one an unnamed non-Jew and the other named Rabbi Abraham Israel, both of whom claimed to have been familiar with cases of virginal women who had conceived.

As a medical doctor, it is hard for me to believe the concept of "bathhouse impregnation" from a scientific point of view. But as long as, our sages accepted it, they drew halakhic conclusions that serve us today. Also, implicit from all the above sources is that they accepted the possibility of this unique form of artificial insemination. Tashbetz and Lusitanus both accepted the possibility. As I wrote when I cited the first source, one of the first to expressly deny the possibility of such an event was R. Judah Rosanes (d. 1727), who articulates his position in his glosses to the Rambam's *Mishne Torah,* entitled *Mishne lemelekh.* [91] Rabbi Rosanes maintains that a woman can only become pregnant through the completion of the natural marital act (i.e. *gemar bia).* He brings support for this notion from Talmudic sources, and also discusses the Talmudic teaching that woman cannot become

[91] *Hilchot Ishut,* 15:4. Also in *Mishne lemelekh on HiL Issurei Bia17: 15* where R. Rosanes discusses these matters in great detail and states that the passage of Ben Zoma in *Hagiga* is not considered halakhic.

pregnant from the first intercourse (*bia rishona*). Rabbi Rosanes concludes that bathhouse impregnation is impossible.

Rabbi Rosanes's passage from the *Mishne lemelekh* is cited widely by different authorities, some with approbation others with criticism.[92] Although a number of *Aharonim* mention the *Mishne lemelekh* approvingly, including Rabbi Moses Schick, perhaps his most enthusiastic advocate was Rabbi Solomon Schick. In a responsum to Rabbi Yoseph Edinger, coincidentally a student of Rabbi Moses Schick, Rabbi Solomon Schick states assuredly and with no ambiguity that bathhouse impregnation could never happen. In addition to quoting Rabbi Rosanes and Rabbi Moses Schick as his support, he interprets the passage in *Gemara Hagiga* (14b-15a) in a novel fashion. As the aforementioned passage follows the story of four rabbis who entered *"pardes"* (however it is to be defined), and one of those rabbis is the same Ben Zoma of our passage, and this Ben Zoma was harmed by his journey into *"pardes."* Rabbi Schick maintains that the Gemara is possibly scornful of him. It is clear that according to Solomon Schick, the story of bathhouse insemination never could occur.[93]

Other rabbis questioned the possibility of bathhouse impregnation. Rabbi Yosef Hayyim (1893-1909), author of the *Ben Ish Hai,* espouses a novel position in his

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[92] In Malakhi ben Yakov HaKohen (d. 1785-1790),*Yad Malakhi* (Berlin, 1857), *kelalei Ha-dinim* no. 247; Rabbi Moshe Schick, known as Maharam Schick, *Taryag Mitzvot* no. 1

[93] *Teshuvot Rashban,* E. H. no. 8.

work *Torah Lishma*.[94] Rabbi Hayyim was asked whether he would allow sperm procurement from an ill man to facilitate proper medical diagnosis. The questioner maintained that since the sperm could subsequently be used to impregnate a woman, this should alleviate the prohibition of *hashhatat zera*. Rabbi Hayyim's contention is that "nature has changed" *(nishtane ha-teva)* with respect to artificial insemination.[95]Whereas insemination through an intermediary medium (e.g. bath house impregnation) was possible in the times of the *Tannaim*, owing to their greater bodily strength and potency of their seed, such was not the case from the time of the *Ammoraim* and forward. If it really had been possible, it would be an extremely rare occurrence, as, he maintains, was the case mentioned by Tashbetz. Even though the likelihood of impregnating a woman with the remaining seed was so remote, sperm procurement would not be allowed.[96] It was around the time this responsum was written, that John Hunter performed the first successful artificial impregnation of a human being. As often occurs with a medical success, it was not extensively publicized.[97]

Aharonim, also thought that bathhouse impregnation was not possible in their time due to the changed nature. However, it was the changed nature of the bath, they

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[94] (Jerusalem, 1976), no. 481. R. Hayyim wrote these responsa under a pseudonym.

[95] The concept of *" nishtane hateva"* has been invoked many times in mature. In *Tosafot* in T.B. *Avoda* Zara 24b, s.v. *Para; Tosafot in* T.B. *Hullin* 47a, s.v. kol; E.H. 156:4 in the *Rema.* Also, in N.M. Gutal, *Sefer Hishtanut Ha T'vaim B'halakha* (Jerusalem, 1995). Two areas where authorities also discuss this principle are *Hil. Terefot and metzitza in mila.*

[96] Rabbi Hayyim cites other reasons for forbidding sperm procurement in this case, such as that some seed might spill in the process of collection, even if they collect all the seed, it might not all be used for the purpose of insemination. These concerns have been voiced by current *poskim* in discussions on artificial insemination

[97] In Roheeder, op. cit.

maintained, not that of the seed, that explained why insemination was no longer possible.[98] They say that because the baths in Talmudic times were heated from below,[99]so it was theoretically possible for insemination to occur, either because a man was more likely to emit seed in this kind of bath, or because this particular heat source was more conducive to the survival of the seed.[100]

The difference between those rabbis and Rabbi Rosanes was that Rabbi Rosanes never questioned; he was against always to this notion. The other *Aharonim* are performing the traditional task of resolving contradictions between sources, trying to uphold the *hagahot hasmak* while being true to their own conviction that bathtub conception is impossible. The resolution is that bathtub conception used to be possible, but not any more. As I wrote before, three different approaches were invoked in response to Rabbi Rosanes. One was Rabbi Yehonatan Eybeschutz (1690-1764), who argued against Rabbi Rosanes based on a re-analysis of the Talmudic passages that Rabbi Rosanes cites, concluding that the latter's interpretations were incorrect, and that artificial insemination is possible.[101] Another,

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[98] Rabbi Yaakov Reischer, *Iyyun Yaakov* (WilhelmsDorff, 1725), on *Gemara Hagiga* also R. Pinchas Horowitz, *Pitha Zuta al HiL Nidda uTe*villa (London, 1958), 195:7, who explains the position of R. Reischer. Both of these sources question why Rambam omits the case of Ben Zoma from his code.

[99] Also in *Mishna Berura,* loc. Cit.

[100] Rabbi. Yekutiel Greenwald, in his *Kol Bo Al Avelut* (New York, 1947), pp. 305-6, n. 8, states that the majority of *poskim* hold that bathhouse insemination could never happen. However, if it was ascertainable that such an event had occurred, the parents and children would be obligated to mourn for each other. Another halakhic question unique to a child born from bathhouse insemination is whether such a child could have his *mila* performed on Shabbat. See R. Moshe Bunim Pirutinsky, *Sefer haberit* (New York, 1973), 9, who states, based on the interpretation of R. Hananel to the *Gemara Hagiga,* that since such a birth is considered miraculous, and not by natural methods of conception, the *mila* could not be performed on Shabbat.

[101] *Benei Ahuva* (Jerusalem, 1965), on Rambam, *Hil. Ishut* chap. 15.

was Rabbi Chaim Yoseph David Azulai (1724-1806) who mentions in three separate places in his writings that bathhouse impregnation is possible because it was accepted as fact by the *Gemara,* as well as by a number of prominent *Rishonim.*[102] The third approach of refutation is scientific in nature and was taken by Rabbi Baruch Mordechai ben Yaakov Libschiftz (1810-1885). Rabbi Rosanes had stated that conception could only be accomplished with *gemar bia* (traditional sexual intercourse). Rabbi Libschutz responded that with respect to bathhouse impregnation, the waters of the bath could transport the seed to the internal organs of the woman, thereby effectively accomplishing the same result as *gemar bia.*[103]

After analyzing all the sources I will explain what the issues and main problems of that artificial insemination and how some of these issues are very similar to cloning. I will answer these questions from a traditional point of view.

These questions are: How should one obtain the sperm, from husband or donor? If artificial insemination is permitted, may it be performed during the woman's unclean period (menstruation ritual cleansing period thereafter)? Is the woman prohibited to her husband following an artificial insemination? Is it considered an act of adultery? What is the status of the child--is the child a *mamzer* (illegitimate)? Is artificial

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[102] *Birkei Yosef,* E. H. 1: 14; *Yair Ozen, maarekhet* 1 no. 93; *Ptakh Enayim* on *Gemara Hagiga* 14b. Also R. Y.S. Nathanson, *Shai JaMore,* Glosses on E.H. 1;6; ibid., *Responsum Shoel umeshiv,* Vol. 3, section 3, nos. 34 and 132 (end); R. Eliezer Fleckles, *Teshuva me Ahava,* Y.D. no. 195.

[103] *Berit Yaakov* (Warsaw, 1876), E.H. no. 4. The author employs the same logic with respect to R. Peretz's pronouncement about a woman becoming pregnant from seed remaining on the sheets. Here, too, he maintains that a woman may use the sheets for internally cleaning herself, thereby bringing the seed into close proximity with the uterus.

insemination permitted at all? Is it permissible to use the sperm of the husband, or a donor, or a gentile? Does the donor fulfill the commandment of procreation? Is the offspring considered the child of the donor? Is the woman considered to be the wife of another and prohibited to marry again if her husband should die or divorce her? Is the husband permitted to provide his sperm for analysis and subsequent insemination if it is found suitable?

Another possible question is how does one obtain the semen for insemination without transgressing the prohibition of improper emission of seed? Before answering this question, it is important to make it clear prevalent rabbinic opinion sanctions AIH under circumstances where pregnancy can be achieved in no other way. The improper emission of semen was the sin of Er and Onan (Genesis 38:7-10), and AIH is performed under different circumstances, for the purpose of reproduction. Therefore, prevalent rabbinic opinions sanctions AIH.

Most orthodox rabbis (Frank, Feinstein, Waldenberg, Schwadron, Wolkin, Shapiro, Auerbach, Mintzberg, Baumohl) state that procurement of semen by acceptable means from the husband for insemination of his wife is permissible, since the semen will be used to fulfill commandment of procreation. There is a minority of Rabbis (Tannenbaum, Uziel, Hedaya, and Breisch) who disagree. Two methods of obtaining the sperm are mentioned in the Talmud, where it teaches about the discussion concerning a priest who is wounded in testicles (*petzuah dakkah*) or whose membrum is cut off (*kerut shafchah*):

> Rabbi Judah stated in the name of Samuel: If it [the membrum] bad, a small perforation which was closed up, the man is deemed to be unfit if the wound reopens when semen is emitted, but if it does not reopen the man is regarded as fit.... Raba, the son of Rabbah, sent to Rabbi Joseph: Will our Master instruct us how to proceed [to test whether the semen will reopen the closed perforation]. The other replied: Warm barley bread is procured and placed upon the man's anus. Thereby the flow of semen sets in, and the effect can be observed . . .. Said Abaye, colored [women's] garments are dangled before him [exciting his passions thus causing semen emission].[104]

According to Rabbi Feinstein, these methods are perfectly acceptable.[105] Also in order to excite the emotions and to cause semen emission for the purpose of artificial insemination into one's wife, it is permissible to think of a woman. The method, wins greater approval among orthodox authorities is the collection of sperm from coitus interruptus, as well as a condom applied prior to coitus. Because these procedures involve sexual relations, they are the most acceptable to Jewish law. Different is masturbation, strongly condemned by Rabbi Feinstein, based upon the following Talmudic passage: "Rabbi Eleazer stated: Who are referred to in the scriptural text your hands are full *of blood?*[106] Also, it was taught at the school of Rabbi Ishmael: Thou shall not commit adultery."[107] Implies that thou shall not practice masturbation either with hand or with foot."[108]

Rabbi Feinstein and Rabbi Waldenberg disagree in several points. Rabbi Feinstein considered improper to have sexual intercourse in the physician's office and for the

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[104] *Talmud Babli,Yevamot* 76a.
[105] Feinstein, Responsa *Iggrot Moshe, Even Haezer*, no. 70.
[106] Isaiah 1: 15
[107] Exodus 20:13
[108] *Talmud Babli,Niddah 13b.*

physician to retrieve the sperm from the vagina of the woman to combine several ejaculates for subsequent insemination, and Rabbi Waldenberg allows it.[109] Another difference is that Rabbi Waldenberg accepts masturbation to obtain semen if all the other methods cannot be used. He states that, if possible, the physician should perform the masturbation, but if that is not feasible, the husband can do it. Also, Rabbi Waldenberg said that one is permitted to extract semen directly from the testicle.

Another question that artificial insemination may arise is if the woman is prohibited to her husband following AID? This issue applies to receiving donor sperm because of the problem of possible adultery. The case in the Talmud of the high priest marrying a previously married woman who claims to be a virgin concludes that the possibility suggested by Samuel, that a unmarried woman could be impregnated will impregnate without producing bleeding or loss of her virginity, it is rare. Thus, the maiden is permitted to marry the high priest, as she is honest when she claims to be a virgin despite having been impregnated in a bath into which a man had previously discharged. This Talmudic passage teaches that only the act of sexual intercourse makes an unmarried woman ineligible to marry a high priest.

The case of a high priest requires only that the girl's virginity be preserved to comply with the biblical commandment but a virgin (*betulah)* of his own people shall he take

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[109] Waldenberg, Responsa *Tzitz Eliezer,* vol. 3, no. 27 and vol. 9, no. 5 1.

to wife.[110]To prohibit a woman to her husband requires only a sexual union between the woman and another (*be'ulat ba'al*), as it is written in Deuteronomy 22:22. Therefore, even without the loss of virginity, she is considered an adulteress.

From the case above, many authorities seek to determine if AID is permissible. Rabbi Judah Rosanes states that even without loss of virginity a sexual act makes an unmarried woman prohibited to marry a high priest.[111]A different opinion is considered by Rabbi Chananel ben Chusiel (11th century), in his commentary on Talmud. He thinks that the discussion of the unmarried woman and the high priest revolves around the requirement of the pregnant unmarried woman to bring a sacrifice to purify her from the ritual impurity of birth. Does the biblical phrase: *If a woman conceive seed and bear a man child, then she shall be unclean for seven days*[112] apply only to a woman who has become pregnant as a result of sexual intercourse, or is it also applicable for conception *sine concubito*? For Rabbi Chananel, this is the most important problem, and the other whether she is prohibited from marrying the high priest is less important.

It seems difficult for the orthodox authorities to resolve the issue of adultery from this source. Another source that I mentioned before is the statement of Rabbi Peretz ben Elijah of Corbeil, who doubts the viability of conception *sine concubito* and thinks

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[110] Leviticus 21:14.

[111] Rosanes, Commentary *Mishneh Lemelech* on Maimonides' Mishneh Torah, *Hilchot Issurei* Biyah 17:13.

[112] Leviticus 12:2

that a married woman who becomes impregnated in a bathhouse is not forbidden to her husband because there has been no prohibited intercourse.

Some present day rabbis agrees with Rabbi Corbeil's beliefs. For example, Rabbi Ben Zion Uziel thinks that no adultery or incest can occur unless there is a physical union of man and woman.[113] Also, Rabbi Moses Feinstein agrees with that assessment. For him, without an act of sexual intercourse, the woman is not prohibited to her husband even if she has been inseminated with the semen of another without the husband's consent. For Rabbi Feinstein, the law of an adulteress applies only for the sexual act and is involved even if there is no emission of sperm or even if the act is performed in an unnatural manner.[114] Rabbi Feinstein's beliefs are by shared Rabbi Sholom Mordecai Schwadron, Rabbi Yehoshua Baumol, and Rabbi Aaron Wolkin, who also allows the woman to her husband if no sexual contact has occurred between her and the donor of the semen.[115]

As we find disagreements between Hillel and Shamai and rabbis in all generations, here in this topic, we meet them, too. Rabbis who think that AID is adultery are: Rabbi Judah Leib Zirelson,[116] Rabbi Abraham Lurie of South Africa, Rabbi Ovadya Hedaya,[117] and Rabbi Eliezer Yehuda Waldenberg of Jerusalem. Waldenberg cites

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[113] Uziel, Responsa *Mishpatei Uziel. Even Haezer,* no. 19.

[114] Feinstein, Responsa *Iggrot Moshe, Even Haezer,* no. 10.

[115] Schwadron, Responsa Maharsham, p. 3, no. 268; Baumol, Responsa *Emek Halachah,* no. 68; Wolkin, Responsa Zekan Aharon, point 2, no. 97.

[116] Zirelsohn. Responsa *Marchei Lev,* no. 73.

[117] Lurie, in *Haposek* (Tel Aviv). Cheshvan-Kislev (5710) 1949; Hedaya, in Noam (1948/5718): 130-137.

numerous rabbinic responsa to support his position.[118] He rejects the inference that others draw from the Talmudic passage and the statement of Rabbi Peretz ben Elijah, saying that in both instances, impregnation of the woman occurred passively and is an accident. Also, he thinks that AID consists of the active participation of medicine, a donor and a woman, which makes it a forbidden procedure. Also, for Rabbi Waldenberg, the husband could divorce his wife on these grounds, and she loses the monetary settlement written into the marriage contract (*ketubah*).

Another issue to consider is the status of the child. Is it considered a *mamzer*? There are rabbis who do not consider the child a *mamzer (*illegitimable), there are some who doubt and call him/her a possible *mamzer* (it is a worse status than that of *mamzer,* since the *safek mamzer* is not allowed to marry anybody, not even a *mamzer,* les he or she in fact be legitimate), and there are rabbis who consider him/her a *mamzer.* In the first group are Rabbis Uziel, Weinberg, Feinstein, Baumohl, Wolkin, Joseph Saul Nathanson, Manachem Kirshbaum, Raphael Pladi, Abraham Neemrok, and Shlomo Liman Auerbach.[119] In the second group are Rabbi Waldenberg and others who consider the child a possible *mamzer (lit. safek mamzer).* And in the third group are: Rabbis Zirelsohn, Lurie, Hedaya, and Mordecai Jacob Breisch.[120]

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[118] Waldenberg, Responsa Tzitz Eliezer, vol. 9, no. 51:4.

[119] Nathanson. Responsa *Shoel Umeshiv,* 2d ed., p. 3, no. 133; Kirshbaum. Responsa *Menachem Meshiv,* p. 2, no. 26: Pladi, Responsa Yad Ramah. Quoted by D. B. Kranzer, in Noam 1 (1958): 111-123; Neemrok. in Noam (1958/5718): 143-144; Auerbach, in ibid.. pages 145166.

[120] Breisch, Responsa *Chelkot Yakov,* no. 24

The next question that has to be addressed is what happens in a situation where the husband could not be a donor; is it acceptable for orthodox authorities to receive the sperm from an external donor?

I did not find a definitive (i.e. one universally accepted "right" answer) answer from orthodox rabbis. Rabbi Waldenberg, as I wrote before, is against this form of sperm donation. For him, it is an abomination. Also, he cites Rashi's comment on a Talmudic passage. Rashi interprets the biblical phrase *to* be a God unto thee and to thy seed after thee[121] to mean that God favors only those whose genealogy (i.e., paternity) is known.[122] The phrase in the Talmud itself reads: "To distinguish between the seed of the first [husband] and the seed the second." The reasons that he gives are:

- The genealogy of the child is unknown.
- This could lead to "lest he marry his sister," as mentioned in the Talmud.

Therefore, avoidance of possible incest would interdict AID.

- After the "proxy" father's death, his other children may "steal" the portion of inheritance belonging to the child produced by AID. Alternatively, the child may wrongly receive inheritance from his mother's husband upon the latter's death.

Therefore, the question of stealing an inheritance makes AID forbidden.

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[121] Genesis 17-7.

[122] Rashi's commentary on Yevamot 42a.

Rabbi Waldenberg prohibits AID even if the donor's identity is known. He interprets the verse "*And thou shall not lie carnally with thy neighbor's wife to defile thyself with her*"[123]-as a prohibition of having one's semen enter another's wife even without the sexual act. Jacobovits also prohibits AID. For him, AID should be condemned as "an act of hideousness" or "an abomination" or "human stud farming." AID is only permitted by Rabbi Schwadron and Rabbi Baumol under extreme need.

Also, Lord Immanuel Jakobovits is against AID. He thinks the generation of children born would become arbitrary and mechanical, robbed of those mystic and intimately human qualities which make man a partner with God in the creative propagation of the race.[124]

Other question arising from this topic are whether or not if the donor is fulfilling the *mitzvah* of procreation and who is the father of the child. The answers vary..
For example, Rabbi Moshe of Brisk asks the specific question in his commentary on Karo's code as follows:

> ... One may raise the question, in the case of a woman who became pregnant in a bathhouse, whether the father has fulfilled [the precept] of *be fruitful and multiply* [Gen. 1:28, 9:1, and 9:7] and if the child is considered his son in all respects. And in the *Likutei Maharil* we find that Ben Sira was the son of Jeremiah, who washed in the bathhouse, because Sira numerically equals Jeremiah"[i.e.. the arithmetical sum of the Hebrew letters of the name Sira is identical with that of Jeremiah.] [125]

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[123] Leviticus 18:20

[124] In Talmudic view, man enters into a partnership with God by perpetuing His creation through the propagation of the race (*Kidushin* 30b and *Yevamoth* 63b). Significantly, in Jewish law the obligation to marry derives specifically from the duty of procreation.

[125] Commentary *Chelkat Mechokek* on Joseph Karo's Shulchan Aruch, *Even Haezer* 1:6.

Rabbi Samuel ben Uri, by commenting the *Shulchan Aruch,* answers that the child is considered the man's son in respects.[126] Rabbi Samuel bases his answer on the teaching of Rabbi Peretz ben Elijah (*Hagahot Smak*). Rabbis that agree with both of them are Rabbi Rosanes, Rabbis Jacob be Samuel, Yisroel Zev Mintzberg, Simon ben Zemach Duran, a Jacob Ettlinger.[127] Other rabbis believe the child is considered the son of the donor but because there was no sexual act the donor does not fulfill the *mitzvah* of procreation. They are Rabbi Jacob Emden[128]and Moshe Schick. And Rabbi Hedaya and Moshe Ayreh Leb Shapiro disagree with all of them in all the issues.[129]

If the all the orthodox would accept AID, another question could be asked. Could the woman be considered to be the pregnant nursing wife of another? Should the woman's husband die or divorce her following AID, is she allowed to remarry while she is still pregnant or, following delivery, while she is still nursing? The answers to these questions are found in a Talmudic passage. In *Yebamot*[130] it is written that a man should not marry the pregnant wife of another or the nursing wife of another

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[126] Commentary *Beth Shmuel* on Karo's Shulchan Aruch, *Even* Haezer 1:6.

[127] Ben Samuel, Responsa *Beit Yakov,* no. 122; Mintzberg, in Noam 1 (1958/5718): 129; Duran, Responsa *Tashbatz,* page 3, no. 263; Ettlinger, Commentary *Aruch Lenair* on Yevamot 10a.

[128] Emden, Responsa *She'elat Yavetz,* page 2, no. 96

[129] Shapiro, in Noam 1 (1958/5718): 138-142.

[130] *Talmud Babli, Yevamot* 36b and 42a.

even though she has been divorced or widowed, until after the child is born or until she stops nursing, respectively. The reason that are given are:

- It will be impossible to identify which part of the child is the offspring of the first husband and which is the offspring of the second
- There may be danger to the fetus from abdominal pressure from sexual relations with the new husband, who might not be as careful to avoid harming the unborn fetus, as would the true father.
- The nursing baby might die of starvation if the woman conceives during the nursing period because her milk would become turbid.

Maimonides has written about this rule:

> And the sages also ordained that a man not marry the pregnant wife of another or the nursing wife of another, even though [in the former case] the owner of the seed which made her pregnant is known-lest the fetus be harmed during intercourse because he is not careful with the child of another. And [in the case of] a nursing woman lest her milk become turbid and - he does not pay attention to heal the milk with things which improve turbid milk.[131]

After Maimonides, Rabbi Jacob ben Asher and Rabbi Joseph Karo in their codes also state:

> The sages decreed that a person should not marry nor betroth the pregnant wife of another or the nursing wife of another.[132]

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[131] Maimonides, *Mishneh Torah, Hilchot Gerushin* 11:25.

[132] Ben Asher, *Tur Shulchan Aruch*, Even Haezer 13:11; Karo. *Shulchan Aruch, Even* Haezer 13:1 1.

Rabbi Waldenberg after studied the sources concludes that the new husband must abstain from cohabitation with his wife until after she stops nursing. Again, some rabbis with Waldenberg, such as Malchiel Zvi Halevy Tanenbaum,[133] Zirelsohn, and Uziel. Others are in doubt, like is Chayim Joseph David Azulay.[134]

I have written about the opinions regarding AID. But what about to use the husband's sperm for the medical procedure? Would it be possible? One thing is clear: Most of the objections made to AID, would not apply to AIH. Some of the objections to AID are:

- Possible adultery
- The offspring possibly marrying a sibling
- "Stealing" of an inheritance and licentiousness

And the issues for AIH include:

- Whether or not the husband has a paternal relationship to the child
- Whether or not a child conceived through AIH is a fulfillment of the Torah commandment of *peru u-revu,* or at least the prophetic edict of *lashevet*
- Whether the methods employed for the procurement of semen violated the edicts against *hashhatat zera* and what alternatives could minimize the prohibition

[133] Tanenbaum, Responsa *Divrei Malkiel*, page 4, nos. 107-108
[134] Azulay, Commentary *Birkei Yoseph, Even Haezer* 1 and 13.

- A fear concerning substitution or mixing with donor semen

As always, we have differences of opinion. For Rabbis Feinstein, Schwadron, Wolkin, and Zvi Pesach Frank, AIH is permissible.[135] Rabbi Waldenberg and Rabbi Tannenbaum permit AIH only in extreme situations. An important conclusion is that, in general, rabbis who normally forbid AIH argue that Rabbi Elijah ben Peretz's statement allowing a woman to become pregnant from sheets upon which her husband has lain (and possibly emitted sperm) is rare.

If AIH is accepted, could the procedure be done when the woman is ritually unclean *(niddah)?* Rabbis Feinstein, Wolkin, Auerbach, and others permit AIH even this period if there are not other choices. But Rabbis Waldenberg, Tannenbaum, Hedaya, Schwadron and others permit AIH, but not while the woman is ritually unclean.

For Rabbis who allow AIH there are different opinions about how much time the couple should wait to start this treatment. According to Rabbi Karelitz, two years, for Rabbi Feinstein[136] five years, for Rabbi Ya'acov Yitzchak Weiss,[137] the couple must wait ten years and Rabbi Waldenberg says the couple should keep trying to conceive indefinitely.

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[135] Feinstein, Responsa *Iggrot Moshe, Even Haezer*. p. 2. no. 18: Wolkin, A. Responsa *Zekan Aharon, Even Haezer*, p. 2, no. 97; Frank, Commentary *Har Zvi,* Tur Even Haezer, no. 1; Yosef, Responsa *Yabeeya Omer*, page 2, no. 1.

[136] Feinstein, Responsa *Iggrot Moshe, Even Haezer.* Page 2, no. 16.

[137] Weiss, Responsa *Minchat Yitzchak,* page. 1. no. 50 and p. 3, no. 47.

Dr. Avraham Steinberg is one of the medical bioethics experts from the *Shaarei Tzedek* Hospital in Israel who thinks that artificial insemination with husband's sperm (AIH) may be a helpful procedure for men who have low sperm counts, since it allows the combination of several ejaculates and may also be indicated when a woman's fertile period around ovulation precedes the date she can go to the *mikva*.

What is In Vitro Fertilization?

In vitro fertilization (IVF) is the technique that enables conception to occur outside the Fallopian tubes. This usually happens when the Fallopian tubes are blocked or missing, so it is impossible for the sperm and ovum to make contact. A great percentage of infertility problems are the result of a disorder of the Fallopian tubes.[138]

When IVF is practiced, a woman will receive hormones to stimulate her ovaries to produce several eggs, rather than the usual one. Shortly before ovulation would normally occur, the doctor uses ultrasound to guide a needle through the cervix to the ovaries to gather or "retrieve" developed ova. After inspecting the ova to make sure that they are not defective and after appropriate preparation, the ova are combined with the prepared sperm. The resulting embryos are allowed to develop in

[138] Bleich, J. D., 2000.

the petri dish for a few days, reaching the stage of two to eight cells; they, or a portion of them, are then transferred on the third or fourth day to the woman's uterus through a catheter inserted through the cervix. If more than enough embryos are produced through this process, they may be frozen ("cryopreserved") for use in further, future attempts. After this procedure, the pregnancy continues the normal way. The fetus continues to develop in the uterus in an apparently normal manner. In cases of moderate male infertility when the male has low count of sperm, the same technique may also be used. Conception results from the meeting of the ovum and a single sperm, and because vast numbers of sperm are destroyed or rendered impotent in the process of traversing the female genital tract, this treatment could give the couple the possibility to have children through other means.

Two other procedures that use similar techniques are GIFT and ZIFT. In GIFT (gamete intrafallopian transfer), ova and sperm are mixed and placed directly into the fallopian tube, thus imitating the natural process of fertilization more closely and therefore, hopefully, increasing the odds of leading to a live birth. With ZIFT (zygote intrafallopian transfer), the embryo produced in vitro is transferred to the fallopian tube rather than to the uterus, again in an attempt to imitate natural fertilization more closely. Both of these procedures require laparoscopy, a somewhat more invasive procedure than the transcervical procedures used in IVF. The success rate with GIFT and ZIFT has been less than with IVF and certainly not as promising as originally theorized and projected. IVF therefore remains "the gold standard" of

these technologies, and GIFT and ZIFT are generally used only as a last resort, after IVF has been tried several times unsuccessfully.[139]

In vitro fertilization was studied by Drs. Patrick C. Steptoe and Robert G. Edwards in England. On July 25, 1978 the birth of Louise Brown showed that this technique was possible. They reimplantated a human embryo into the mother's womb.[140] Then they reported the birth of a girl by using this technique.[141] After that many children were born through this medical procedure. Also, fertilized ovum removal from the womb of one woman and its implantation into a recipient "surrogate" mother has resulted the birth of healthy infants.[142]

Orthodox's Position on Reproductive Techniques

Before I examine what orthodox rabbis, think about IVF it is important to say that since Judaism does not posit a doctrine of natural law, all the genetic techniques must be examined solely in light of possible infraction of Biblical and rabbinic proscriptions. In the absence of a specific prohibition, man is free to utilize scientific knowledge in order to overcome impediments to procreation.

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[139] *American Fertility Society* , 1994 pages 38-40.
[140] Steptoe, P.C. and Edwards, R.G. 1978.
[141] Steptoe. P. and Edwards, R., 1980.
[142] Rosner, Fred. Biomedical Ethics and Jewish Law, page143

As I wrote when I examined artificial insemination, much of the controversy concerns whether husband or donor sperm is inserted vaginally or into the uterus.[143] Many of the *halakhic* concerns with AIH (artificial Insemination with husband's sperm), particularly those involving the methods by which sperm is procured, apply equally to in vitro fertilization.[144]As well as artificial insemination, in vitro fertilization raised many of the same religious, moral, theological and *halakhic* questions. These include:

Are we tampering with life itself when we perform in vitro fertilization? Are we interfering with the Divine plan for humanity? If God's will is for a man and/or a woman to be infertile, who are we to undertake test-tube fertilization and embryo reimplantation into the natural or genetic mother, or into a host or surrogate mother, to overcome the infertility problem?

Judaism teaches that only God gives and takes life. Also, God created nature for man to use to his advantage and benefit. Nachmanides taught that the man strength and government on the earth to do what they want with the animals.[145] Therefore animal experimentation is certainly permissible provided one minimizes the pain or discomfort to the animal. Also it is permissible to use hormone production such as

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[143] Artificial insemination with husband's sperm (AIH) may be a helpful procedure for men who have low sperm counts, since it allows the combination of several ejaculates and may also be indicated when a woman's fertile period around ovulation precedes the date she can go to the *mikva.* See generally Dr. A. Steinberg, "Artificial Insemination in the light of *Halackha*," *Sefer Assia* 128-141 (1982) and Rabbi A. Cohen, "Artificial Insemination," 13 *journal of Halakha and Contemporary Society* 43 (Spring 1987).

[144] The issues raised by AIH included: a) whether or not the husband has a paternal relationship to the child; b) whether or not a child conceived through AIH is a fulfillment of the Torah commandment of *peru u-revu* or at least the prophetic edict of *lashevet*; c) whether or not the methods that were employed for the procurement of semen violated the edicts against *hashhatat zera* and what alternatives could minimize the prohibition; and d) fear concerning substitution or mixing with donor semen.

[145] Ramban's commentary to Genesis 1:28, (*vechibshuha*)

insulin from bacteria or in tissue culture or in animals by recombinant DNA technology for man's benefit. Gene therapy, such as the replacement of the missing or defective gene in Tay Sachs disease or hemophilia, if and when it becomes medically possible, may also be sanctioned by Jewish law. But is man permitted to alter human hood and/or humanity by in vitro fertilization, by transfer of the embryo from a woman inseminated with her husband (or other) sperm into another woman's womb, or by artificial gestation in a test tube or glass womb, or by sex organ or gene transplants, or by genetic screening and/or counseling, and the like? Some of these questions directly impact the issue of cloning, because they would presumably be raised with respect to cloning as well.

Fertilization techniques require supervision of the physician, waiting periods, and exploration of alternatives. As I explained, AIH is generally regarded as a *halakhically* permissible procedure through which paternity can be established and the *mitzvah* of *peru u-revu* or at least *lashevet* can be fulfilled.[146]

In the Annual Torah *She-be' al Peh* Convocation in Israel in 1978, the Sephardic Chief Rabbi, Rabbi Ovadiah Yosef, gave his qualified approval, of 'in vitro

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[146] Example are, *Teshuvot Maharsham* 111, no. 268; *Minhat Yitzak*1, no. 51; Rabbi Shlomo Zalman Auerbach, I *Noam* at 157 (5718); *Seridei Eish* III, no. 5; *Tzitz Eliezer* IX, no. 51; *Yabia Omer* II, *E.H.* no. 1. Also in *Nishmat Avraham E. H. 1:5. [Lashevet* is the shorthand expression for the prophetic exhortation, *"Lo tohu bera'a lashevet yetsara"* ("He did not create the world to be desolate, but rather inhabited"-Isaiah 45:18), an exhortation that may be binding even on those not obligated in *peyu u revu,* e.g., women, and that may be fulfilled even in ways that *peru u revu* cannot be. Also, *Tosafot, Hagiga* 2a and *Baba Batra* 13a, s.v. kofin; *Minhat Hinukh*, end of *Mitzvah* One.

fertilization".[147] He approved of this procedure in a situation in which the husband produces far too few sperm with each ejaculate to impregnate his wife or where a woman is unable to move the egg from the ovary into the uterus because of blocked Fallopian tubes. Rabbi Ovadiah Yosef gave his qualified approval to the in vitro fertilization of the woman's egg with the husband's sperm and the reimplantation of the fertilized zygote or tiny embryo into the same woman's womb The Ashkenazic Chief Rabbi, Rabbi Shlomo Goren, asserted that conception in this manner Is morally repugnant but legally unobjectionable. This situation represents a type of barrenness akin to physical illness and, therefore, justifies acts which entail a small amount of risk, such as the procurement of eggs from the mother's ovary by laparoscopy, a minor surgical procedure.

Today, by and large, most *posekim* have correlated IVF with AIH and have permitted its utilization subject to the same limitations.[148] Rabbi Waldenberg is one of the exceptions. He thinks that IVF is an impermissible procedure and that even *ex Post facto,* one does not fulfill the mitzvah of *peru u-revu.*[149] Rabbi Waldenberg makes some dramatic claims about the horrific social implications of IVF and even mentions the possibility that scientist might one day clone human beings. I will consider him later. He said that IVF is more problematic than AIH in a number of distinct respects:

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[147] J.T.A. Dally News Bulletin, Aug, 1978

[148] Rabbi " Ovadia Yosef, I *Tehumin* at 287; Rabbi Avigdor Nebenzal, 34 *Assia* (Tishrei 5743); Rabbi Shmuel Wozner, *Shevet halevi* V, no. 47 (although one may not desecrate Shabbat to save the preembryo because of the low probability of its ever coming to term).

[149] *Tzitz Eliezer* XV, no. 45

1. In contrast to AIH, IVF transfers only the fertilized ova, with the rest of the sperm discarded. In AIH all sperm is deposited into the vagina or uterus. Therefore, IVF violates the edict against *hashhatat zera* (unprovoked destruction of male seed). [150]
2. If fertilization occurs outside of the womb, the male does not fulfill the mitzvah of procreation. This issue creates a violation of *hashhatat zera*.[151]
3. With an IVF offspring, there could be problems with the paternal or maternal[152] relationship. These beliefs are support by Rabbi Moshe Sternbuch[153] who also denies paternal identity in cases of IVF, and consequently, prohibits the practice as a violation of *hashhatat zera*. Another rabbi who shares this opinion is Rabbi Yehuda Gershuni.[154] He thinks that there is no paternal union between a sperm donor and an externalized embryo even if later brought to term, but he nonetheless permits the procedure; since IVF does in fact result in the creation of a physical human being, albeit one that is not *halakhically* related to the genetic parents, it is a fulfillment of the prophetic statement, "He did not create the world to be void, but He formed it so that it would be settled" *(lashevet yetsara)*.[155] A second level requirement:

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[150] The prohibition against the wanton destruction of male "seed" is based on *Nidda* 13a and is codified in *Shulhan Arukh, Even HaEzer* 23:1. Also *Genesis* 38:7 and Rashi's comments.

[151] There is a variation of IVF termed Gamete Inter-Fallopian Transfer (GIFT), where the egg and sperm are mixed together in the petri dish but are then placed in the fallopian tube, where fertilization takes place. It would be interesting to know what Rabbi Waldenberg would rule concerning GIFR, since fertilization does indeed take place *kederekh kol ha-aretz.*

[152] Even where the egg donor carries the baby to term and is thus both the genetic and birth mother.

[153] *BiShviLei haRefu'a,* no. 8 *(Kislev* 5747), page 33.

[154] *Kol Tzofayikh,* pages 361-367.

[155] Isaiah 45:18.

that is, although IVF does not fulfill *peru u revu* there's another *mitzvah* that is relevant here which is the obligation to populate the earth. Rabbi Gershuni argues that even the mere fulfillment of *lashevet is* enough to prevent the emission of the seed from being *levatala.*

We learn from the Talmud, that the majority resolves cases of IVF. Rabbis Waldenberg, Sternbuch, and Gershuni are, in this issue, the minority. In general, the majority of the *posekim* have concluded regarding in vitro fertilization that:

- The egg and sperm providers do have parental relationship with an IVF-generated offspring;
- The procedure, if undertaken for procreation by an otherwise fertile couple, does not violate the prohibitions against *hashhatat zera;* [156]
- One may fulfill, through any resulting offspring, either the mitzvah of *peyu u-revu,* or, at the very least, the "lesser" *mitzvah* of *lashevet.* [157]

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[156] Whether a couple that may undertake AIH or IVF already have the minimum son and daughter but desire to have more is a matter of dispute. Compare the views of Rabbi Auerbach (even where he has a son and daughter, a man may be permitted to obtain sperm in order to fulfill the imperative of *lashevet* or where his wife is in significant psychological distress in not having more children) cited in *Nishmat Avraham E.H.* 23:1 (however with the qualifying term *"yitakhen"-it* may be possible) with the contrary view of Rabbi Eliyahu Bakshi-Doron, the present Sephardic Chief Rabbi of Israel (then Rav of Haifa), who ruled that the ban on *hashhatat* zera can be lifted only for the Torah commandment of *peru u-revu* and not for the lesser *mitzvah* of *lashevet.* Letter to Dr. Joel B. Wolowelsky, Dec. 15, 1991. Rabbi Moshe Feinstein also seemingly subscribes to this restrictive view. In *Iggrot Moshe E.H.* IV, no. 73. Note, however, that both Rabbi Feinstein and Rabbi Bakshi-Doron are addressing the use of sperm procurement for *testing,* not actual *procreative* use. The latter may be considerably more lenient. Note, too, that any *halakhic* distinction between *peru u-revu* or *lashevet* must assume that one fulfills *peru u-reou* through AIH or IVF. This too is a matter of controversy.

[157] It appears to be unresolved whether one can fulfill the Torah command of *peru u-revu* through either AIH or IVF. Rabbi Auerbach in his Noam article states that the matter is not clear. The *Arukh leNer* to *Yevamot* 10a explicitly rules that one does not fulfill *peru u- revu* in the absence of a sexual act. On the other hand, Rabbi Bakshi-Doron apparently assumes that *peru u-revu* is fulfilled, since he permits the procedure only to achieve

Still some questions are important to resolve, questions similar to the subject of human cloning. For example, if one obtains several eggs from the mother's ovary at one time and fertilizes all of them so as to select the best embryo for reimplantation, is one permitted to destroy the other fertilized eggs? Do they not constitute human seed and, therefore, should not be "cast away for naught"? Is one permitted to perform medical research on the unused fertilized eggs? What is the status of other fertilized ova in the test tube? Is the destruction of such fertilized ova tantamount to abortion? Is such a fertilized ovum regarded as "mere water" during the first forty days of its development?

One solution may to implant excess fertilized eggs into non-ovulating women. Then, another question is what should be the approach if no woman available for an additional implant and there has been more than one successful fertilization? If a fertilized ovum were "more than nothing," would Jewish law mandate in vitro procedures with only one ovum at a time? There may well be a Jewish legal and ethical distinction between a fertilized egg in a test tube and a fertilized egg uterus. The question of the possible independent existence of a zygote has legal import. Jewish law requires the desecration of the Sabbath to preserve the existence of an

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this purpose. Also in *Minhat Hinukh, Mitzvah* One, who notes that the mitzvah of *peru u-revu* is not marital intercourse *per se* but the actual having of children; the act which generates those children is nothing more than a *hekhsher mitzvah* (a necessary preliminary). Under this analysis, it should be a matter of indifference whether children are created through intercourse, AIH, or IVF; *peru u-revu* should be fulfilled irrespective of the method employed. The foregoing assumes a paternal bond. If one adopts the views of Rabbis Waldenberg, Sternbuch, and Gershuni, that sperm contributors do not have paternity in IVF cases, it is clear that there is no mitzvah of *peru u-revu,* though, as noted, Rabbi Gershuni even here would concede the *mitzvah* of *lashevet.*

embryo in the mother's womb even less than forty days old. If there is no human fetal life outside the uterus, a superfluous fertilized ovum could be disposed of by any means, such as flushing down the drain. An alternative of action would be to refrain from supplying nutrients, thereby allowing it to perish. One can redefine the question as to whether or not an unfertilized egg may be deemed to be potential life. Since the vast majority of unfertilized sperm and eggs are never fertilized and do not constitute new life, only a fertilized ovum might be considered as potential life. Fertilized ova could be equated with human life.

Another important question regarding IVF and human cloning is how a couple should treat the excess fertilized ova. The couple has different options:

- Implanting all or some of the preembryos
- Destroying and not implanting them
- Experimentation
- Donating them to an infertile couple, or possibly to an unmarried who wants to be a mother

(1) Using a gestational surrogate who agrees to carry the embryo/fetus to term and then return the baby to the couple whose egg and sperm have been united.

The majority of modern *posekim* have allowed the destruction, or at least the passive removal, of "unwanted" preembryos, ruling that the strictures against abortion apply only to embryos or fetuses within a woman's womb and not to

preembryos existing outside of it.[158] They allow experimentation on preembryos not destined for implantation, too. Different is the opinion regarding embryo donation to infertile couples. No matter if the couple are Jewish or no Jewish or if the donation is to a single woman, there are *halakhic,* and ethical questions and they have not received answers[159] Even though it is not sanctioned, embryo donation to a married Jewish couple could be considered adultery and the product of that *mamzerim.*[160] Regarding last point above, it is important to mention that the Chief Rabbinate of Israel gave the approval in 1995 to the use of a gestational surrogate who meets certain conditions.[161] It would be interesting to know if this sanction would be supported by other orthodox rabbis.[162]

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[158] Rabbi Mordechai Eliyahu (the former *Rishon Letziyyon),* 1991; Rabbi Chaim David HaLevi (Ashkenazic Chief Rabbi of Tel Aviv), 1990; Rabbi Moshe Sternbuch, *BiShvilei haRefu'a,* no. 8 (Kislev 5747), p. 29. This also appears to be the implicit assumption of Rabbi Shaul Yisraeli in an essay published as an Appendix to *Encyclopedia Hilkhatit Refuit,* vol. 4.

[159] Some of these complexities-which may also apply to sperm and egg donations as well as the use of a surrogate-are spelled out in Rabbi J. David Bleich, "In Vitro Fertilization: Questions of Maternal Identity and Conversion," Tradition 25 (4), Summer 199 1, p. 82; Rabbi Ezra Bick, "Ovum Donations: A Rabbinic Conceptual Model of Maternity," Tradition 28(l), Fall 1993, p. 28; and Rabbi Bleich's rejoinder at "Maternal Identity Revisited," Tradition 28(2), Winter 1994, p. 52. See also Volume 5 of Tehumin (5744), which contains major discussions of this issue by Rabbis Zalman Nechemiah Goldberg, Avraham Kilav, and Zerach Warhaftig and *Nishmat* Avraham (App. Vol.) E. H. 22:2 at page 186

[160] Whether or not children born to married women from third party sperm donors were *mamzerim* was the subject of a long-standing debate. Compare, *e.g., Iggrot Moshe E. H.* 1, no. 71 (child is not a *mamzer*) with the well-known contrary position of the Satmar Rav in *HaMaor* 15(9): 3-13 (1954). A number of *posekim* have stated that a child born from Jewish donor semen is a *safek* mamzer See Rabbi Auerbach in I *Noam; Tzitz Eliezer* IX no. 51.The point here is that whatever problems exist with the use of third party sperm should apply equally to the use of third party embryos.

[161] As reported in *Haaretz* (February 14, 1995). Among the necessary conditions: (1) the surrogate be single and not bear a relationship to the sperm contributor that would be *halakhically* incestuous, e.g., a sister or even a sister-in-law; and (2) records be kept detailing the identities of both the surrogate and the egg donor (the mother who will raise the child) so that the child will not marry relatives of either.

[162] *Nishmat* Avraham (App.Vol.) *EH.* 5 (2) who records a number of negative views concerning the use of surrogates.

Regarding the issue of surrogate motherhood, Lord Immanuel Jakobovits thinks that to abort a mother's naturally fertilized egg and to reimplant it in a host mother for reasons of "convenience for women who seek the gift of a child with out the encumbrance and disfigurement of pregnancy is offensive to moral susceptibilities." Furthermore, says Jakobovits, "to use another person as an "incubator" and then take from her the child she carried and delivered for a fee is a revolting degradation of maternity and an affront to human dignity. " [163]

Hershler says that the mother who nurtures and gives birth to the baby determines the maternity of the child, not necessarily the biological mother based on the biblical story of the birth of Dinah to Leah and the Talmudic discussion.[164] Bleich said about this story that the Talmud declares that Dinah was born a female as a result of Leah's prayers during her pregnancy.[165] Leah prayed that her already conceived fetus would be born a female. She knew that Jacob would become the father of a total of twelve sons, and she did not wish her sister Rachel to give their husband fewer sons than the maidservants Bilhah and Zilpah. For Bleich, it is clear from the parallel narrative in the Talmud *Yerushalmi*,[166] that the phenomenon described by the sages involved an in utero sex change. However, one biblical commentator states that what transpired was not a sex change in Leah's fetus but a physical exchange of the fetus from the womb of Leah to the womb of Rachel, and vice

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[163] Jakobovits, I. "Artificial Insemination," page 261-266.
[164] Genesis 30:21; *Talmud Babli, Berakhot* 60a
[165] Bleich, J.D. " Maternal Identity," Tradition 19 (1981): 359-360
[166] *Talmud Babli, Berakhot* 9:3

versa, i.e., an embryo transfer.[167] This means that Dinah was conceived by Rachel but transferred to the womb of Leah, while Joseph was conceived by Leah and transferred to the womb of Rachel. Also, Bleich wrote that a Talmudic commentary declares this double embryo transfer is also the correct interpretation of *Berakhot* 60a.[168] Finally, Bleich cites an alternative rabbinic opinion, which concludes that maternal relationship is established by conception rather than birth. Again, regarding surrogate motherhood, there are different opinions.

As I said before, one of the big objections some orthodox rabbis have is the issue of who are the father and the mother of the baby born by in vitro fertilization. Regarding this issue, a Talmudic passage in *Yevamot* is often cited to demonstrate that although paternity arises upon conception, maternal unions are not generated until birth.[169] This passage might lead to a false conclusion that the female egg contributor should have no say in the disposition of the preembryo simply because, in the eyes of *Halakha*, she is not yet a mother. An examination of other passages indicates, however, that such a dichotomy is not convincing.[170] Proof of that, could

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[167] *Targum Yonatan* on Genesis 60a

[168] Commentary of Rabbi Samuel Edels, known as *Maharsha*, on *Niddah* 31a

[169] *Talmud Babli*, *Yevamot* 97b. The Gemara states that if a non-Jewish woman converted while pregnant, the children that are born after she became Jewish *(horatam she-lo bi-kdusha ve-leidatam bi-kdusha)* are regarded as half siblings from the same mother but are not regarded as sharing a common father. As Rashi explains, since the paternal bond is generated at the moment of conception, the conversion of the mother, which constitutes a valid conversion of the children, erases all prior familial relationships based on the principle of *ger she-nit-gayer ke-katan she-nolad* dami, "a convert is a newly-born entity." Once the conversion is effective, however, a new maternal bond is forged by virtue of birth. Also *Meguila* 13a, *Rashi s.v. be-sha'a.*

[170] The most that the Gemara establishes is that even if a preexisting union can be erased by conversion, a new maternal union can be established by birth. The fact that viable birth is a sufficient condition for maternity does not prove it is a *necessary* one. It is entirely possible that in the absence of conversion, a full maternal union can exist even during pregnancy and even with respect to preembryos.

be what it is writing in *Sanhedrin* 69a that no paternal union can exist until the conclusion of first trimester.[171] Rabbi Akiva Eiger seems to apply the same standard to the maternal union as well.[172] We can conclude from that neither party has parental rights in a preembryo, a stage well below first trimester development.

On the other hand, one could look at the law of *demei veladot.*[173] A Biblical source suggests paternal "ownership" of children prior to birth regardless of the fact that once born, they are no longer property. This is the *Halakha* of *demei veladot,* which awards financial compensation for the criminal death of the fetuses to the father, not mother.[174] The Jerusalem Talmud ads the qualification that the relationship be one

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[171] *Talmud Babli, Sanhedrin* 69a states that a child cannot become a *ben sorer u-more* after the age of 13 years and three months. Since the child is described as a *ben*, this excludes someone who already has the capacity to be an *av*. A boy is generally incapable of impregnating a woman until he reaches the age of majority at 13. If he would impregnate a woman, the fetus would not be discernable until the end of the first trimester. The Talmud therefore concludes that the earliest moment at which a child acquires the capacity to be an *av* is not at the age of 13, when impregnation and conception could take place, but only three months later, when the pregnancy would be physically recognizable. Thus, contrary to the implication of the *sugya in Yevamot,* that paternity arises upon conception, *Sanhedrin* 69a delays paternity to a much later stage.

[172] In *Yore De'a* 87. According to the Mishna in *Hullin,* milk that is obtained from an animal after its death is not subject to the prohibition of being consumed with meat. This is based on the fact that the Torah prohibits only the milk of an animal that has the capacity be an *aim* ("mother"). What about milk that is obtained from a live animal that is a *tereifa*? Rabbi Akiva Eiger tentatively suggests that although a *tereifa* is incapable of giving birth, it is capable of carrying pregnancy at least through the first trimester, and at that point would indeed be considered an *aim* just as, according to *Sanhedrin* 69a, the father would be deemed an *av*. Thus, R. Akiva Eiger equates "maternity" and "paternity." Rabbi Akiva Eiger's use of *Sanhedrin* 69a to establish an identical definition of maternity again departs from the implication of the Gemara in *Yevamot,* but in the opposite direction. While *Yevamot* seems to say that the maternal union arises no earlier than birth, R. Akiva Eiger understands that it too arises no later (and no earlier) than the end of the first trimester.

[173] Exodus 21:22

[174] Exodus 21:22. This *halakha* could be cited in relation to establish the existence of paternal and maternal bonds and to establish a hierarchical priority in decision making. While the Torah speaks of the husband, the Talmud in *Baba Kama* 43a makes clear that such compensation is payable even where impregnation occurred out of matrimony

in which marriage is at least possible *ex post facto*, excluding, for example, pregnancies arising from incest or adultery.[175] If we posit that the husband's entitlement to *demei veladot* rests on some sort of prenatal property right in the embryo or fetus, then perhaps the husband (or at least father) should have the final say.

There is a *makhloket* (different opinion) between Rambam and Ra'avad about *demei veladot*.[176] The *Halakha* is clear that if a pregnant woman was injured, as a result the fetus was killed, and the father dies subsequent to the death of the fetus, the right to collect *demei veladot* passes to his heirs just as any other debt would. The *makhloket* is in situation where the father dies first and then the fetus is killed. For Rambam, the *demei veladot* are not payable to the husband and instead belong to the mother. According to Ra'avad the *demei veladot* belongs to the heirs of the father even if he dies before the fetus. This *makhloket* could be used to understand different ways *demei veladot*.

Rambam understands *demei veladot* as a freestanding personal right of the father, bearing no relationship to a property interest in the fetus. This means, if the father dies before the fetus, there is nothing for his heirs to inherit.[177] Ra'avad understands *demei veladot* as a preexisting limited ownership or property right in the body of the fetus itself. The father is compensated because "his property" was damaged.

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[175] The *Tosafot* quoted the *Talmud Yerushalmi*, s.v. *Afilu*, *B.K.*43a

[176] *Hilkhot Hovel u Mazik* 4:1-4 and comment of Ra'avad to *Halakha* 2

[177] *Levush Mordekhai B.K.* n26 and *Marheshet* II, n38

Therefore, when he dies, that property interest" passes to the heirs, who will similarly be entitled to compensation if "their" property gets destroyed.

An alternative explanation for Rambam's view was offered by Rabbi Shaul Yisraeli.[178] He points out that Rambam omits the rule that even an unmarried father collects *demei veladot.* Rabbi Yisraeli believes that according to Rambam, if the man was unmarried to the mother or was divorced before the *havala,* the *demei veladot* would go to the woman. Therefore, in one of his *pesak,* he denied the existence of any parental union until there is embryo transfer and uterine implantation.[179] Rather than maternity arising from birth and paternity from conception (as implied from Rashi's comments in *Yevamot),* and instead of a unified "first trimester" test (as suggested by *Sanhedrin* 69a and R. Akiva Eiger), a single standard based on implantation would define the moment at which both maternity and paternity arise.[180] This would lead to the conclusion that no one "parent" would have greater presumptive authority than the other, for in respect of the preembryo which is not yet *in utero,* neither has halakhic parental status. His view is not shared by other authorities.

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[178] In Appendix to *Encyclopedia Hilkhatit Refuit,* vol. 4 pages 29-35.

[179] In an article written in 5752, R. Yisraeli concluded that a child conceived from sperm after the death of the sperm donor bore no relationship to the donor and would not be entitled to share in the donor's estate, since conception did not take place in the donor's lifetime. Also in *Torah sheBa'al Pe,* vol. 33, pages 41-46 (5752

[180] Therefore, the implication of the law of *demei veladot,* that both father and mother have parental rights prior to birth-at least according to Rambam, who awards mother *demei veladot* if father died-applies only to an embryo or fetus that is carried in utero and not to an externalized preembryo.

To sum up, there are various opinions regarding the question of paternity and maternity. Similar questions could arise for cloning. The understanding of the sources that the authorities studied will give me skills to justify my opinion.

Orthodox Jewish Conclusions

Infertility is a disease like many others. Thanks the development of the sciences, there are new choices today: From an orthodox point of view, artificial insemination and in vitro fertilization techniques, using the semen of a donor other than the husband is considered to be an abomination (using Rabbi Waldenberg's words) and strictly prohibited for a variety of reasons, including the possibility of incest, lack of genealogy, and the problems of inheritance. For other authorities, the procedure of AID is considered to be adultery, which means that also the physician and the donor are guilty, too. Of course, they oblige the husband to divorce his wife. Some rabbinic opinions, however, state that without a sexual act involved, the woman is not guilty of adultery and is not prohibited to cohabit with her husband.

The situation is different, for orthodox rabbis, regarding AIH. It is permissible the use of semen from the husband if no other method is possible for the wife to become pregnant. The discrepancy between the rabbis is how long to wait before trying artificial; means, and many authorities said that the procedure must occur after the woman finishes the period of ritual impurity.

Speaking about the status of the child, the rabbinic authorities are divided. The majority believes that the offspring is legitimate, as was Ben Sira, the product of conception *sine concubito;* a small minority of rabbis consider the child illegitimate; and some rabbis believe that the child is a *safek mamzer.* Some rabbis state that although the child is considered the donor's son in all respects, the donor has not fulfilled the commandment of procreation. A minority of rabbinic authorities asserts that the child is not considered the donor's son at all.

For several rabbis, the woman treated by AID (D.I.) or AIH is considered to be the nursing or pregnant wife of another and, if her husband dies or divorces her, she cannot remarry another until after she has finished nursing the child.

Regarding the method of obtaining the semen from a husband, coitus interruptus or condoms are preferred. But most rabbis allow obtaining sperm for analysis and for insemination.

Regarding in vitro fertilization, in general, the majority of the *posekim* have concluded that the egg and sperm providers do have parental relationship with an IVF-generated offspring. The procedure, if undertaken for procreation by an otherwise fertile couple, does not violate the prohibitions against *hashhatat zera* and that a man may fulfill the *mitzvah,* through any resulting offspring either the mitzvah of *peru u-revu,* or, at the very least, the "lesser" *mitzvah* of *lashevet.* But some

orthodox authorities believe that these techniques are abominations and never they should be used.

Conservative Movement's Position on Reproductive Techniques

As general policy, conservative rabbis maintain that they should use the precedents within Jewish tradition to guide them in their own rulings as much as possible, even when such sources are scant in number and considerably different in context from the questions we are asking, as long as they keep in mind the ways in which these sources differ in a relevant way from the case at hand as we weigh such precedents and draw conclusions from them.[181] The Conservative movement after studying all the sources that I have cited before, gives a responsa as follows:

The conservative responsa[182] regarding artificial insemination and egg donation says that both are Jewishly permissible procedures if the semen used is from the woman's husband, but not if it is from another man.[183]

Even in those cases where the commandment to procreate is not fulfilled, these techniques enable the social parents to experience the joys and challenges of

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[181] Dorff, E., 1998,Page 50

[182] Dorff, E. Responsa 1991-2000 of The Committee on Jewish Law and Standards of the Conservative Movement, page 509

[183] Decisions of the Rabbinical Assembly, Biomedical Issues, January 1992 (042649,061949, 012052,121057B, 022378)

parenthood, thereby growing themselves, and they add to the numbers of the Jewish people at a time when that is nothing short of critical. Because of the way the commandment to procreate has been interpreted in Jewish sources, because of the physical dangers sometimes incurred, and because of the psychological problems involved in the asymmetry that these methods of having children sometimes create, infertile couples are not required to engage in these procedures to have children. For those who do use them, though, our endorsement of their choice to have children by these methods is not grudging but enthusiastic.

Rabbi Isaac Klein wrote[184] that the consensus on this subject is:

1. In no instance may artificial insemination be considered adultery since there is no adultery without physical intercourse. This ruling removes the stigma of adultery from those who submit to artificial insemination, and the stigma of illegitimacy from children born from adultery and illegitimacy apply only in cases where there is broken faith and physical intercourse.[185]

2. When the donor is a stranger (AID, artificial insemination from donor), there are other considerations both legal and moral, e.g. the question of the child's paternity, and the possibility of mating brother and sister in the future.[186]

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[184] Klein, Rabbi Isaac, 1992

[185] Feinstein, Rabbi M. *Igrot Mosheh, E.H.* I, resp. 10.

[186] Fletcher, *Morals and Medicine,* page. 129.

3.When the husband is the donor (AIH, artificial insemination from husband), the problem concerns to onanism.[187] The consensus of opinion is that this discharge, though not the result of natural intercourse, cannot be called onanism since it is used for purposes of conception.[188]

Regarding in vitro fertilization techniques, Rabbi Elliot Dorff wrote that they can be used with donor sperm, donor eggs, or both, but most often it is the husband's and wife's gametes that are used. [189] Rabbi Aaron Mackler in a responsum approved by the conservative movement's Committee on Jewish Law and Standards have generally permitted them, for after all, they hold out the promise of enabling an otherwise infertile couple to have children.[190]

One of the problems related to these conception techniques is abortion. Rabbi Dorff said that some orthodox rabbis have permitted selective abortions on the grounds of the mother's mental and/or physical health when more than three embryos implant in the uterus, and he adds that Conservative rabbis would undoubtedly do so as well.

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[187] Genesis 38:9-10

[188] *Otsar Ha posqim,* 1: 12; Feinstein, *Igrot Mosheh, E.H.* 1, resp. 10; Klein, "Science and Some Ethical Issues," pages 166-69.

[189] Dorff, Rabbi E., 1998 page 55

[190] Rabbi Aaron Mackler (1997). Rabbi Ovadiah Yosef past Sephardic chief Rabbi of Israel, has also ruled permissively on IVF; see Drori (1980), pages 287-288 Similarly, Rabbi David M. Feldman, the Conservative rabbi who has written the most authoritative book on birth control and abortion (Feldman 1968), has permitted use of IVF for otherwise infertile couples; see Feldman (1986), pages 71-72.The major exceptions to this line of permissive rulings for using IVF are Rabbi Eliezer Waldenberg *(Tzitz Eliezer, vol.* 15, no- 455 pages 115-120; reprinted in *Assia* 33 (1982), pages 5-I3 and Rabbi J. David Bleich (in Rosner and Bleich (1979), pages 80-85). Also, the response to Rabbi Waldenberg by Rabbi Avigdor Nebenzal ("In Vitro Fertilization-Comments," *Assia* 35 (1983), page 5, where he points out that prohibiting IVF to those couples who need it would preclude the husband from fulfilling the commandment to procreate and, by increasing the couple's anguish, might even be a prime factor leading to divorce. .

He suggests to avoid the need for selective abortions as much as possible, Jews in the first place should have only two, or at most three, zygotes implanted for IVF or ZIFT and should use only two, or at most three, eggs for GIFT.

Reform Movement's Position on Reproductive Techniques

The rabbis of the reform movement have studied artificial insemination and in vitro fertilization, too. Rabbi Solomon Freehof, in 1952, was one of the earliest rabbis to study artificial reproduction.[191] He was asked if Jewish Law permits artificial insemination. In his answer, he touched many legal problems, like does the donor fulfill the duty of begetting children *(periya ureviya)* if a child is born (but the donor has no other children)? Does he commit the sin of wasting seed *(zera levatala)*? Is the woman henceforth forbidden to live with her husband on the ground that a man who is not her husband has fertilized her? Is the child a *mamzer,* since he is born of a married woman *(eshet ish)* and a man not her husband? Is there not a danger that the child, when he grows up, may marry his own blood sister or the wife of his own blood brother (contrary to the Levirate laws)? These questions are the same as those posed by the other movements, but the answer differs in reform interpretation.

In his answer, Rabbi Freehof explained that although these topics are new, the *halakha* have already been discussed those question with regard to certain special

[191] Freehof, Rabbi S., 1952.

situation which are similar to artificial insemination, namely, if, for example a woman is impregnated in a bath from seed that had been emitted there[192] Regarding if the child is a *mazer,* Rabbi Freehof cited Joel Sirkes (1561-1640),[193] who said that since there had been no actual forbidden intercourse the child is kasher *("Ein kan bi-at isur").* Because there has been no illicit intercourse to demonstrate that the woman is not immoral and is therefore not forbidden to live with her husband. Rabbi Freehof cited in his responsa, Judah Rosanes who died in Constantinople in 1727.[194] To demonstrate who the child is son of, Rabbi Freehof brings the commentary of Samuel b. Uri Phoebus (17th century)[195], who said that it is the son of the donor; otherwise we would not be concerned lest the child later marry his own blood sister. If he were not, the donor's daughter would not be his sister.

Also, Rabbi Freehof wrote that Chayim Fischel Epstein and Ben Zion Uziel[196] have discussed these issues. Epstein opposes the use of seed from a stranger, but allows the use of the husband's own seed if that is the only way that the wife will get pregnant. He believes this because of the danger that the child may some day, without knowing, marry one of the forbidden degrees of relationship. Ben Zion Uziel shares the same beliefs as earlier authorities do. For him, the woman is not immoral

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192 *"Ibera be-ambatei"* cf. *B., Chagiga* 15a.

193 Sirkes, Joel. In *Bach to Tur, Yoreh De-a* 195 (quoting Semak)

194 Rosanes, Judah.In his *Mishneh Lamelech* to Maimonides, *Hilchot Ishut* XV.4,

195 Phoebus, Samuel B. Uri. In his commentary *Beit Shemu-elto Shulchan Aruch, Even Ha-ezer* 1, note 10.

196 Epstein, Chayim Fischel in his *Teshuva Shelema* (*Even Haezer,* #4), and by Ben Zion Uziel of Tel Aviv, the chief Sephardic rabbi of Palestine, in his *Mishpetei Uziel,* part II, *Even Ha-ezer*, section 19.

because of this act and the child is *kosher.* Rabbi Freehof added that Uziel disagreed with *Beit Shemu-el,* who said that the child is not the child of the donor as to inheritance and *Chalitsa.* For Uziel, the woman thus impregnated (if not married) may not marry until the time of suckling the child is over and the child is not the donor's child, because the donor has sinned in wasting seed. For Rabbi Freehof, Uziel allows the procedure at the recommendation of the physician although he hesitates to say so.

Rabbi Freehof believes that the process of artificial insemination should be permitted.

The possibility of the child marrying one of his own close blood kin is unlikely and according to Jewish law, the wife did not commit a sin and the child is *kosher.*

Another rabbi, Alexander Guttmann, was asked the same question as Rabbi Freehof. In his responsa, Guttmann said even though, these issues were not discussed in our sources, rabbis of our time studied the topic in order to find a Jewish solution. He cited the same sources as Rabbi Freehof: *Chagiga 14b-15a, Chelkat Mechokek, Beit Shmu-el,* and *Mishneh Lamelech.*[197]

[197] Guttmann, Rabbi A, 1952, pages 125-128.

He cited the source in Talmud *Bavli* to bring the question that appear there whether a virgin who became pregnant is allowed to be married by the High Priest.[198] Then the Talmud discussed that the reason for her being pregnant is that she was impregnated in a bath from seed deposited there by a man. Rabbi Guttmann made clear in his responsa that this incident was an accident, not artificial, in purpose as is the technique.

With the second source,[199] Rabbi Guttman wants to bring the question of *mamzerut* whether the father fulfilled the commandment of *periya ureviya* (procreation) if his wife was impregnated in the bath, and whether the resulting child is his child in every respect. Rabbi Guttmann said that the source instead of giving a clear answer to the issue of *mamzerut,* cites the incident that Ben Sira was the result of a bath insemination.[200]

Rabbi Guttmann brings the next source[201] to show how Phoebus answered the issue of *mamzerut* by referring to a note[202] by Perez ben Elijah. This note tells that a menstruous woman could lie on the sheet of her husband but not on a stranger's sheet, because she could become pregnant. Rabbi Guttmann wants to show that they were afraid that the woman would become pregnant while she is menstruating and therefore produce a *Ben Hanida* (child of a menstruous woman). Then Rabbi

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198 Leviticus 21:13-14, *"Isha bivtuleiha"*

199 Lima, Moses ben Isaac Jehuda. *Chelkat Mechokek* on *Shulchan Aruch, Even Ha-ezer* 1, note 8

200 *Likutei Maharil*

201 Phoebus *Samuel* ben Uri. *Beit Shemu-el ibid,* note 10, *cites Chelkat Mechokek's* question

202 A note by Perez ben Elijah on Semak in *Hagahot Semak,* written by Isaac ben Joseph of Corbeil.

Guttmann answer since there is no prohibited intercourse, the child is entirely *kasher*, even if she became pregnant (in the same way) by a stranger, since Ben Sira was *kasher*. The problem of being pregnant, in that way, by a stranger rises of the possibility that the resulting child might marry his own sister by his father (whose identity is unknown). Rabbi Guttmann said that *beit shemu-el* concludes from this note that the child resulting from such an insemination is that of the emitter of the seed in every respect. For Guttmann this conclusion is irreconcilable with the fundamental rule of artificial insemination, requiring that the child belong to the mother's husband, not to the donor of the seed.

Rabbi Guttmann brings the next source, because says *eln safek- dela ne-esra leva-alah mlshum de-ein kan bi-at-isur"* ("There is no doubt that she does not become prohibited to her husband because no prohibited intercourse took place").[203] This very important because clarifies that accidental insemination in a bath or on a sheet (i.e., without direct contact with a man) cannot be considered as adultery, which would make her prohibited to her husband. Rabbi Guttman, in his responsa, tries to resolve one of the problems, which is whether or not the emitting of seed for artificial insemination would be *hotsa-at zera levatala* (wasting of seed), which is prohibited. Then he cited a responsa by Ben Zion Uzie,l [204] cited by Rabbi Freehof, too. Rabbi Guttmann said that Uziel equates artificial insemination with accidental insemination. Then Rabbi Guttmann brings another rabbi, Haim F. Epstein,[205] who share's the

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[203] Rosanes, J.

[204] Uziel, Rabbi B. Z., 1938.

[205] Epstein, Rabbi H. F. In his *Teshuva Shelema* (St. Louis, 1941), vol. II, Even Ha-ezer, Responsum 4, pages 8-10

same thoughts of Rabbi Uziel. The difference, however, is that Rabbi Epstein said that regarding the use of the husband's seed for artificial insemination, he states *"Efshar dezeh rnutar,"* "i.e., "It is possible that this is allowed," if the physician finds that this is the only possible way for his begetting a child. The arguments of Epstein as to the necessity of limiting of the concept *hotsa-at zera levatala* (wasting of seed), based primarily on *Yevamot 76a*, provides for Rabbi Guttmann some justification for Rabbi Epstein's conclusion.

Rabbi Alexander Guttmann tried to make it clear in his responsa that the artificial insemination was not mentioned at all in our sources. What is mentioned is an accidental way, which is not the same as premeditated artificial insemination. Also, there is no incident involving bath insemination; all the discussion was theoretical. Also, for Rabbi Guttman, Ben Sira was *agada*. Rabbi Guttmann final's words in his responsa are that even though he did not see sufficient evidence for recommending the issuance of a prohibition against artificial insemination, he would like to caution against a hasty *heter* (permit) for which he did not find backing in Jewish sources.

The reform movement posed other questions, related by Rabbi S. Ezring, in March 1986.[206] Should a parent tell a child that he or she was conceived through artificial insemination means? Also, is the husband the actual father if the semen used for the procedure was a mixture of his sperm and donor sperm? Finally, is it permissible to use donor sperm for artificial insemination?

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[206] CCAR Responsa, Contemporary American Reform Responsa. 197-Child Born Through Artificial Insemination

The CCAR Responsa Committee answered first about the status of the father. The committee said that in accordance with Jewish law, the husband is presumed to be the father unless there is proof that this is not so.[207] The committee answered that In this case, as there was no other intercourse, and a mixture of semen was used, the husband is definitely considered to be the father. The husband would be presumed to be the father even if there was some suspicion that the woman had intercourse with someone else, or if the child was the result of rape.

Then the answer said that the only reason for not using a Jewish donor for artificial insemination lies in the possibility that the child may marry incestuously without realizing it,[208] and for that reason both Jewish and non-Jewish donors may be used.

Finally, the committee resolved that there is no reason to tell the child that he is the result of artificial insemination, arguing that such knowledge cannot benefit the child or his or her relationship with the parents. Therefore, the committee advised to not tell the child about his or her conception through artificial insemination.

Rabbi Mark Washofsky, head of the CCAR Responsa Committee, summarizing the *halakhic* traditional and reform responsa, wrote that reform responsa accepts both forms of artificial insemination (AIH and AID or DI) for several reasons.[209] He wrote

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[207] *Talmud Babli*: *Hulin.* 11b; *Sotah* 27a; *Shulchan Arukh Even Haezer* 4.13 ff and commentaries

[208] Epstein, *Teshuvah Shelemah, Even Haezer* #4

[209] Washofsky, Rabbi M. page 235, 2001.

that the reform movement vigorously dissents from the attitude displayed by many orthodox rabbinic scholars. He wrote that the reform movement is aware of the moral seriousness of this technological intervention into human procreation, but on the other hand, it is a *mitzvah* to enable Jewish couples to bear children. He added that the new reproductive technologies present wonderful opportunities to help bring Jewish children into the world. Regarding the techniques, he added that they are not to be viewed as threats to morality but as gifts of God through the medium of human intelligence. The mere possibility of scientific abuse must not deter us from considering the immense good that they can do. Finally, he said that to refer to modern reproductive technologies, as "abominations" is to perpetuate a tragic injustice upon childless couples and distort the message of a tradition, which commands us to choose life. Regarding the *halakhic* concerns raised by traditional responsa, he said the possibility that the child might grow up to marry a blood relative, is too statistically far-fetched to take seriously.

In his answer, he said that the emotions of the women involved were not considered by the traditional authorities in their analysis of artificial insemination. They considered the legal paternity, to make sure that the male will fulfill the obligation" To be fruitful and multiply," because this *mitzvah,* according to Jewish tradition, is incumbent upon males only, and not upon women. A woman is not commanded to have children, and her emotions are irrelevant for Jewish law. Rabbi Washofsky added–that is why every orthodox *halakhic* authority forbids AID, which enables a woman but not her husband--to bring a child into the world. In contrast, Rabbi

Washofsky said, reform opinion views all religious obligations through the lens of gender equality. This means that a Jewish woman, no less than a Jewish man, fulfills a *mitzvah* by having children. Finally, he concluded that the reform movement is much more likely to look favorably upon the use of a donor's semen, even though the child is not the biologic offspring of a woman's husband.

Rabbi David Ellenson, the president of the Hebrew Union College, has written about this subject, too.[210] In his paper, he deals with two responsa about artificial fertilization *(hafrayyah melakhutit)* written by two different Israeli orthodox rabbinical leaders. The first responsa was written in 1981 by Rabbi Eliezer Waldenberg of Jerusalem, the *Tzitz Eliezer,* well-known as the world's leading Orthodox *halakhic* authority on issues of medical ethics, while the second responsa was written in 1988 by Rabbi Hayyim David Halevi, the chief rabbi of Tel Aviv-Jaffo, one of the most prolific authors of responsa on the modem Israeli scene.[211]

Rabbi Ellenson wrote that in 1981, Dr. David M. Meier, director of Shaarei Tzedek Hospital in Jerusalem, asked R. Waldenberg to provide a *halakhic* response to this "new medical technique--artificial fertilization in a petri dish," whereby children could be conceived non-coitally. Rabbi Waldenberg responded to Dr. Meier in a responsum dated 8 Elul, 5741 (September 7, 1981), that there were, in his opinion, both implicit and explicit *"halakhic* stumbling blocks" to the procedure. Artificial

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[210] Ellenson, Rabbi D., 1995.

[211] Waldenberg's responsum can be found in *Tzitz Eliezer* 15:45. Halevi's responsum is located in his *Mayyim Hayyim,* no. 6 1.

insemination *(hazraah melakhutit),* he noted, had already been the subject of a great deal of *halakhic* literature.[212] He himself countenanced artificial insemination, but only when every effort to conceive "naturally – *k'derekh kol haaretz"* had been exhausted. If, after ten years had passed, the woman was not pregnant, or if an orthodox doctor indicated prior to the passage of this ten-year period that the woman could not become pregnant "in a natural manner," artificial insemination could be permitted if the donor was the husband of the woman. R. Waldenberg, in his responsum on artificial insemination, also voiced total opposition to this procedure when the donor of the semen was a male other than the husband. Indeed, in such an event the woman "was obligated to receive a divorce from her husband." [213] In other words, he restricted his *heter* for artificial insemination only to instances of AIH (artificial insemination when the husband is the sperm donor). It did not extend to AID (artificial insemination when the sperm donor is not the husband).

Rabbi Ellenson commented that Rabbi Waldenberg sent away the assurances of the medical community as to their reliability in this matter as "a total lie-- *shav va'sheker havtahatam zot"* designed to assuage public outcry against this medical innovation. R. Waldenberg's opposition was based upon his fear that family lineage would be confused and that the traditional understanding of the family could be blurred by a technology that so easily allowed for a separation between genetic, gestational, and rearing parents. "Heaven forfend," he exclaimed, "against anarchy *(hefkeirut)* such

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[212] Waldenberg's review of this literature is found in *Tzitz Eliezer 9:5* 1, chapter 4, sections 17-18 and 20-21.

[213] *Ibid,* 13:93.

as this which is likely to erupt into serious breaches against the wall [that protects] the purity *(bhomat hataharah)* and lineage of the family *(v'hayihus hamishpahti)."* With this, Rabbi Waldenberg condemn's artificial fertilization as a Jewishly sanctioned solution to the problem of infertility--even for a married couple.

Rabbi Ellenson wrote that eight years later, on 15 *Kislev,* 5749 (November 24, 1989), an anonymous doctor wrote to Rabbi Hayyim David Halevi of Tel Aviv-Jaffo questions related to artificial fertilization in a petri dish. Rabbi Halevi started his answer by explaining all the differences in the authorities and he ruled to dispose of those ova, which were not selected for transplantation since the law forbidding abortion applied only to a fetus in the womb of a woman. Rabbi Halevi, believed that it was *halakhically* permitted to authorize in vitro fertilization or the use of fertility drugs to stimulate ovulation, for assisting married couples in their attempts to "be fruitful and multiply" and "inhabit the world." As rabbi Ellenson wrote, it is clear that Rabbi Halevi's answer was completely different from Waldenberg's.

Also, Rabbi Ellenson cited Rabbi Herschel Schachter of Yeshiva University, who observed that when *halakhic* decisions confront a particular issue, they do what *posekim* have done for centuries. They juxtapose "the particulars of [their] own case and various *halakhic* precedents and principles, thereby deciding into which category [their] own case falls. Then [they] must apply these precedents and principles to the situation at hand." The problem Rabbi Schachter asserts is that situations presented to rabbis by advances in medical technology are "unique to our

generation." There simply may be no precedent to offer guidance.[214] This is very important in my research because sometimes rabbis have to write new responsa to answer new questions, because new issues may be discovered that need rabbinic interpretations.

Rabbi Ellenson asked a very important question: What does a person, a rabbi, do in an instance such as this when no Biblical or Talmudic source speaks directly to the issues under consideration? How do we, as liberal Jews, have to evaluate responsa when "halakhic authorities" are far away from the feelings and problems that so many liberal Jews have? Rabbi Ellenson wrote that no female voice neither the voice of gay or lesbian couples was heard in the orthodox responsa.

Rabbi Ellenson made an interesting comment about the Jewish approach that any liberal responsa must have. He said that a liberal Jewish approach to artificial fertilization must consider all the persons, as well as the individual voices of men and women. A liberal *halakhah* must orient itself in a manner that is more inclusive than is reflected in the orthodox responsa. This is a very important statement that impacts my research of cloning, because my response to this issue is liberal and must be inclusive.

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[214] Schachter, Rabbi H. page 32,1989.

Rabbi Ellenson said that the traditional responsa could teach liberal Jews how complex these issues are. For liberal Jews, and, for most *halakhic* authorities as well, as Rabbi Halevi said, advances in noncoital reproductive technologies are to be applauded and welcomed. They important thing is that the fertilization techniques, allow infertile couples to have the blessing of conception. Rabbi Ellenson quoted Rabbi Moshe Zemer: "Sages throughout the generations ... were lenient [in these matters] and encouraged infertile couples to be helped by such medical treatment and by other new medical discoveries so that the first commandment in the Torah,' Be fruitful and multiply, and fill the earth,' could be established."[215]

Rabbi Ellenson disagrees completely with Rabbi Waldenberg, saying that Judaism always support's medicine in order to get the cure for all diseases. Ellenson quoting Rabbi Gold said, "Using the techniques of in vitro fertilization, an egg can be fertilized outside the womb and then can be genetically manipulated before it is implanted in a woman's uterus. There are obvious advantages to genetic engineering. Someday it may be possible to cure such genetically based diseases as hemophilia, diabetes, sickle cell anemia, and Tay Sachs."[216] For Rabbi Ellenson, R. Waldenberg's view that techniques such as IVF represent an unjustified tampering with the "natural processes" of creation is unacceptable. He continue that accepting Waldenberg's argument on this point would be to condemn all technological intrusions into the natural order. Rabbi Ellenson agrees with Rabbi

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[215] Zemer, Rabbi M., page 288, 1993

[216] Gold, *And Hannah Wept,* page 147

Halevi because he shows more sensitivity to this issue. He has the same sources Rabbi Waldenberg, but his answer is completely different.

Also, Rabbi Ellenson mentions that non-orthodox *posekim* on questions of artificial conception have already implicitly recognized these problems. Rabbi David Golinkin, head of the Rabbinical Assembly's Israeli Law Committee, has treated the question of AID in the context of Jewish family concerns.[217]

Ellenson cited Rabbi Walter Jacob, who in a case dealing with IVF with ova donated by the wife's first cousin wrote, "We would give reluctant permission to use IVF in the manner you have described. The potential problems are numerous and should lead to great caution." [218] Finally rabbi Ellenson recommended to liberal *halakhists* to continue the moral and ethical discussion and to make their voices be heard by liberal Jews.

Rabbi Solomon Freehof was one the earliest rabbis who addressed this issue of in vitro fertilization.[219]. Afterward, the CCAR Responsa 5757.2 and 5738.3 addressed the same issue. The questions that they addressed were:

1. Is in vitro fertilization permitted in Jewish Law?

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[217] Responsa of the *Va'ad Halakha* of the Rabbinical Assembly of Israel Vol.3, 5748-5749, pages 83-92.
[218] Jacob, Rabbi W., page 32, 1987.

[219] Freehof, Rabbi S., pages 123c, 1952

2. If IVF is permissible, is it ethical to reduce the number of embryos after they have been implanted successfully in the womb?

3. If IVF is permissible, is it ethical for a woman to bring to term multiple births by deliberate artificial means (e.g. more than four babies)?

1.The CCAR Responsa Committee ruled "In vitro fertilization is a legitimate medical therapy, offering a realistic hope to many who seek to build families... Human infertility is a disease and "the procedures designed to correct it (is) medicine."[220] Consequently, IVF, which does not pose an unacceptable risk to either the mother or fetus, is an acceptable medical procedure. IVF fulfills the *mitzvah* of *periyah ur'viyah,* reproduction. The CCAR Responsa 5752.2 also notes that IVF is not a required procedure for infertile Jewish women. And, of course the responsa constantly holds forth the option of adoption.

2. IVF is an acceptable medical procedure. In vitro fertilization, as I have explained before, involves the harvesting eggs from a woman and then inseminating them with sperm donated either from her partner or anonymous donor in a glass dish. If fertilization takes place, the egg or eggs are then implanted into the uterus. Then, if all goes well, implantation in the uterine wall will be detected in about two weeks.

The main question is how many eggs can be implanted and is it permissible under *halakhah* and Jewish ethics to selectively reduce (abort) fetuses in order to make room the womb for the surviving fetuses?

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[220] CCAR Responsa 3752.2 and 5758.3

Not all zygotes implanted in the womb will survive. Hopefully, if eight zygotes are implanted, perhaps one or two or even three will survive those first two weeks and be implanted into the uterine wall. The ethical dilemma presents itself when more than two embryos survive. In that event, the question of abortion could appear. In the late Solomon Freehof's collection, Contemporary American Reform Responsa, he answers a question of when is abortion permitted. While he cites various orthodox authorities that are more or less lenient to abortion, he clearly states that it is permissible:

> It is clear from all of this that traditional authorities would be most lenient with abortions within the first forty days. After that time, there is a difference of opinion. Those who are within the broadest range of permissibility permit abortion at any time before birth, if there is a serious danger to the health of the mother or the child. We would be in agreement with that liberal stance. *We do not encourage abortion, nor favor it for trivial reasons, or sanction it "on demand"* [221]

A human embryo at less than 40 days is considered *maim be alma*, "mere water," and not a fetus *(ubar)*.[222] Consequently, terminating the gestation of such young embryo is not even considered abortion. The implication of this concept, in ethical and *halakhic* terms is that Reform Judaism, permits the discarding of unused embryos before they are implanted.[223] Therefore, if we do not implant more than two or three zygotes within a woman's womb, medicine can discard, freeze or experiment upon unused embryos without fear of *halakhic* retribution. Furthermore, medicine would not be faced with the unethical options of selective reduction and

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[221] Freehof, Rabbi S.1985.

[222] *Talmud Babli*,*Yebamot* 69b, *Niddah* 3.7, 30b, NL Ker. 1.1.

[223] Discussion in the CCAR Responsa " In Vitro Fertilization and the Status of the Embryo," 5757.2.

carrying multiples fetuses to term. In other words, if doctors don't implant them, they will not have to abort them.

Liberal and progressive Judaism also asks if IVF is permissible, is it ethical for a woman to bring to term multiple births by deliberate artificial means (more than three)? And if selective reduction is unethical and a violation of *halakha* is it then ethical for a woman to carry multiple fetuses to term? The answer is no. If a woman brings six, seven or even eight fetuses to term, there is a tremendous risk of both birth defects to the children and a real risk of death or permanent injury to the mother. Because of the dangers involved, a woman should not attempt to bring such a large number of fetuses to term.

Also, Rabbi Mark Washovsky addressed the issue of in vitro fertilization.[224] The Reform responsa take a more affirmative view of this technological advance in human reproduction that orthodox responsa. The reform movement, he said, considers IVF a medical procedure, a legitimate measure undertaken in response to the disease of infertility. He continues that because IVF does not entail unacceptable physical risks to the woman involved, there is no reason to advise against it. An important statement he made is that the reform movement would not deny the couple the hope this procedure holds out to them. Also, the reform movement cannot condemn in vitro fertilization as "morally repugnant." He

[224] Washofsky, Rabbi M., page 236, 2001.

concluded his responsa by saying that IVF is a great blessing for childless couples, a blessing for which people should be deeply grateful.

Reform Conclusions

Reform Judaism believes that the man and the woman have the same privileges and both have to fulfill *mitzvoth*. Both have to fulfill the *mitzvah* of *pria ve revia*. That is why we allow artificial insemination in both its techniques (AIH and AID or DI). Reform Judaism takes the emotions and feeling of the couple very seriously. Both male and female must have the support by doctors and rabbis in this difficult process. Also, Reform Judaism allows in vitro fertilization (IVF). It encourages that the treatment be under taken ethically taken from all sides. This means, for example, to not install more zygotes in the woman's womb than she could carry. Also, destroying an embryo before forty days is permissible without any ethical, moral and *halakhic* implications. Reform Judaism takes in consideration that these techniques make it possible to bring children into a world that needs them. For that reason, these fertilization techniques are blessing from God, raising hope in those couple affected by infertility.

Having studying the sources of artificial insemination and in vitro fertilization from an orthodox, conservative and reform viewpoints my next step is to study cloning,

keeping in mind the sources, questions and dilemmas pertinent to fertilization techniques currently in widespread use.

Orthodox's Position on Cloning

I will start bringing all the Jewish literature about human cloning that has been written. I will bring in viewpoints of orthodox, conservatives and reform rabbis and medical doctors. I will see how they used the religious texts and how they related the texts to the reproductive techniques that I have analyzed earlier.

In 1998 Dr Avraham Steinberg wrote with John D. Loike an interesting article about human cloning.[225] Dr. Steinberg wrote about the positive arguments supporting human cloning. He said that human cloning might be considered permissible for several reasons. To begin, he said, cloning is not discussed directly in the Torah. *Tiferet Yisrael on Yadayim*[226] states **that when the Torah does not specifically prohibit an activity, it is permissible to do it.** This is very crucial. Another reason he gave in favor of cloning is that cloning is based on established biological principles that do not seem to involve any defined *halakhic* prohibition (assuming

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[225] Steinberg, M.D, A. and Loike, Ph.D. J.D, pages 32-46,1998. Dr. Steinberg is the Director of the Center for Medical Ethics at the Hebrew University, Hadassah Medical School, and Senior Attending Physician, Pediatric Neurologist, Department of Pediatrics, at the Shaare Zedek Medical Center in Jerusalem. He was awarded the Israel Prize in 1999 in recognition of his extensive contributions to the field of Jewish medical ethics. Dr. Loike is a research scientist in the Department of Physiology at Columbia University.

[226] *Tiferet Yisrael* on *Yedayim* 4:3

that there are no serious medical or harmful effects of cloning). Furthermore, he said, that according to Ramban,[227] as I wrote before, God gave man the right to master all powers embedded in the physical, chemical and biological sciences in order to "rule the world." This means that human cloning represents a powerful biological force that man could explore and control. The last reason Dr. Steinberg gives, is that cloning technology appears to have great medical potential, and a basic opinion of the Torah (Exodus 21:19),[228] as expressed in the phrase *ve-rappo ye-rappe,* is that Jews are permitted and obligated to utilize all available technology to heal the sick.[229] The practice of medicine it is not only permitted, a *devar reshut*, but on the consensus account constitutes the fulfillment of a positive divine command; it is a *devar mitzvah*.[230] I will come back later to his ideas in my conclusions.

Dr. Steinberg also said that, regarding the reproductive techniques that cloning technology might provide a *halakhic* advantage over artificial insemination or *in vitro* fertilization for the infertile couple. As I have explained before, from an orthodox point of view both artificial insemination and *in vitro* fertilization, the non-coital

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[227] Ramban on *Bereshit* 1:26 and 1:28 *(s.v. Kivshuha)*

[228] Also in *Talmud Babli, Baba Kamah* 85a

[229] Exodus 21:9 and *Talmud Babli, Bava Kama* 85a. The *halakhic* tradition interprets this verse as a permit and even a duty to practice medicine.

[230] Also, in *Talmud Babli, Bava Kamma* 81b, Maimonides' *Perush ha-Mishnayot, Nedarim* 4:4 where healing is considered fulfillment of *hashavat avedah* (returning a lost object), and Ramban's *Torat ha-Adam: Sha'ar ha-Sakkanah, in Kitvei Ramban* ed. C.B. Chavel (Jerusalem, 5724), II, 41-43 where healing is considered part and parcel of *ve-ahavta le-reakha kamokha,* or where the command is considered implicit in the granting of license. Also, *Shulhan Arukh, Yoreh Deah* 336: 1.

procurement of sperm by the male is *halakhically* problematic.[231] In the case of doing human cloning procedures, the male would only have to donate mammary cells or some other non-sperm cell. This has to be done to avoid any problem *of hotsaat zera le-vatala,* as I have explained before. This means that reproductive human cloning techniques would be considered in the future, instead of artificial insemination or in vitro fertilization, as a way to avoid any potential *isurim.*

Regarding the negative aspects of reproductive human cloning, Dr. Steinberg said a Jew should follow *derekh ha-teva* (a Jewish version of natural law). This concept is used by Ramban[232] and Rabbi Aron Halevi from Barcelona in *Sefer ha-Hinukh*[233] as one reason why *kishuf* (magic) and *kil'ayim* (forbidden mixtures) are prohibited practices. Dr. Steinberg also said that the creation of human life via replication (i.e., the absence of natural sexual reproduction in *Nidda* 31a and 1,*Kidushin* 30b) may go against a general dogma that God directed human life to be formed through natural sexual processes. Probably, this application of *derekh ha-teva* might include the principle that each human being possesses an inalienable right to be a product of two sexually different parents, and that each parent must contribute *zera* (seed) to the formation of a child.

By explaining *derekh ha-teva,* Dr. Steinberg refers to two factors related to our topic. One is that the male has not given his *zera* to create the child, and second, and in

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[231] Steinberg, M.D, A. (Ed.) *Encyclopedia Hilkhati-Refuit* vol. 2, pages 407-426; S. J. Zelvin, *Talmudic Encyclopedia* vol. 11, pages 129-141

[232] In Leviticus 19:19. Ramban, there, appears to declare that one grafts different species violates the command " You shall keep *chukotai* (my statues)," and mixes up the work or order of creation.

[233] *Sefer Ha Chinukh* #62, #244 and #245

some way, the most important point is that no male or male-derived tissue is needed to create a human life. Here is a big difference with the current-day reproductive methods that I have described before (AIH and IVF). As I have said before, AIH and IVF need a male to donate sperm. The Talmud implies that the preferred method of human procreation requires both a man and a woman. [234] The *Gemara* said that three partners (God, man, and woman) are necessary for the creation of a human being, and that *zera* of both man and woman contribute to the development of the child. Therefore, Dr. Steinberg said human cloning using current technology might present a *halakhic* problem with respect to *derekh ha-teva.* However, since there are no primary sources that specifically prohibit other ways of procreation (such as asexual reproduction), perhaps the *Gemara* simply describes the preferred method of procreation while not forbidding other methods. In other words, we use positive law (the *mitzvot* and the *halakhot*) to interpret and to define natural law.

Also, he said that cloning a human from male and female tissue might not go against the *hashkafa* of procreation, while using only female tissue to clone a female may create a problem. Related to this, it is important to keep in mind the passage in *Midrash Rabba*,[235] which said that Hava (Eve) named her first born son Kayin (Cain) because *kaniti ish et Hasbem,* which Rashi translates as, "I have acquired a man with God." The *Midrash* further said that Adam was created from *adama*, Hava from Adam and from then on–*be-tsalmenu ki-dmutenu*--no man without woman, no woman without man and not both of them without the *Shekhina*. It seems that this

[234] *Talmud Babli Masechtot Niddah* 31 a and *1,Kidushin* 30b
[235] *Bereshit Rabba* 22:2 and 1:26

Midrash and the *Gemara* that I have cited suggest cloning a child using an egg and a mammary cell from two women or from one woman might be prohibited; on the other hand, cloning a child using an egg from a woman and a donor cell from a male might be acceptable.

Dr Steinberg also gives other possible reasons that may forbid the procedure, such as medical risks. Of course, any practice that endangers or risks the health of the mother will not be permitted. Until today, 2003, there is no clear scientific evidence to show that there is no risk, so this argument could be valid and may prohibit cloning. Probably a future *halakhic* dilemma would involve cases deciding whether the cloned child will suffer greater birth defects or psychological stress from being a clone. However, it is not expected that "cloned" children will suffer any greater personality dysfunctions or adjustments than twins created naturally or via *in vitro* fertilization. But as Dr Steinberg said, issues of identity and individualism must be assessed to determine whether there are any psychological risks involved in cloning.

Another important point brought by Dr Steinberg is called eugenics, the selective breeding of the human race. These types of technology, as many movies and science fiction stories have "predicted," could be used to create clones from a *gadol ha-dor,* the best of the generation, or from monsters. As I will address in my conclusions, techniques of human cloning can be used for good and for bad. If we interpret our sources with this topic in mind, we could learn that they relate to the

issue of cloning from *gadol ha dor.*[236] It is written that families of *talmidei hakhamim* (wise students) do not necessarily have children who are *talmidei hakhamim,* because according to Rav Yosef, the development of a *talmid hakham* is not "genetically" (the language of the *gemara is yerusha)* determined. Clearly Rav Yosef understood the differential impact of "nature" (genetics) verses "nurture" (social environment) on human psychological and moral development. This means that cloning, per se does not determine how that person will turn out.

Another interesting point that Dr. Steinberg brings is *kishuf* (sorcery or magic). *Kishuf* is defined by Maimonides and Rabbenu Hananel, as a form of idol worship involving practices or processes that simply do not work. [237] If cloning is included in this category, it would be is prohibited. On the other hand, in another source we find that *kishuf* and *kilayim* are *halakhot* that are important in the preservation of distinct life species *(le-mineihu)* created by God. [238] The sages that believed this are Ramban,[239] Rashba,[240]and the Gaon of Vilna.[241] What these sages believed is that by creating new life forms via genetic manipulations (in the case of *kilayim,* by planting two different crops in the same field or cross breeding different animal species) one is transgressing the prohibitions against *kilayim* and *kishuf.*

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[236] *Gemara* in *Nedarim* 81a
[237] In *Talmud Babli, Sanhedrin* 67b
[238] *Sefer Ha-Hinukh, mitzvah #62*
[239] *Deuteronomy 18:9*
[240] In his Responsa #413
[241] In *Talmud Babli, Yore De'a* #179 and 113

Rambam and Rabbenu Hananel think that *kishuf* relates to processes that are not real and do not work, which means that cloning **would not** be included in this prohibition. Ramban understands *kishuf as* preserving *le-mineihu*. This means also that human cloning **would not** be prohibited, as Dr Steinberg said, because:

- Human cloning would contribute to preserve the human species, not to create different human life forms.
- For Ramban, *kishuf* is only prohibited if utilized for *malakhei habala* (evil purposes), which does **not necessarily** apply to human cloning.
- These technologies (human cloning technology) are biological processes and not "magical or supernatural" processes.

In summary, the concept of *kishuf* can teach an important *halakhic* lesson. Even though the *gemara*[242] said that *kishuf* was one of the causes of destruction of the world in the times of Noah, in another place of our religious texts it is written that for medical purposes, for saving another life, it is permissible to grow different crops in one field.[243] This teaches us that if there are medical benefits to any technology (including human cloning) the use of technology may take priority over *halakhic* problems associated with the technology.

Regarding if reproductive human cloning is considered *kil'ayim* (type of forbidden mixtures), Dr. Steinberg says, that the use of genetic engineering on plants and

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242 *Talmud Babli, Sanhedrin* 105b

243 *Kitzur Shulchan Aruch*, laws *of Kilayim* 295:1-2

animals to improve their quality is allowed by R. Shlomo Zalman Auerbach zz"l even when genes are transferred from one species to another.[244] Also, Dr Steinberg expresses that the prohibition of *kilayim* applies only when the part of the plant that is transferred has the potential to give rise to a complete new plant. Also, cloning animals with human genetic material in order to produce parts that humans can use for transplantation does not constitute *kilayim;* and in fact such research should be encouraged to save human life. "In contrast, to crossbreed a human with an animal definitely contradicts the will of the King and is unequivocally forbidden."

When I was studying reproductive techniques, it raised a lot of questions for which I have tried to find *halakhic* answers. The same happens here. Some of those questions have answers and some do not. Are clones from humans *halakhically* human? What is the difference between a clone and a *golem*? Does the family who participates in the process of human cloning fulfill the commandment *peru urevu*? Who are the *halakhic* parents of a cloned child? Can any male DNA be used, other than the husband of the woman, for cloning, and would the resulting baby be classified as a *mamzer?* What would be the social implications of families with clones? And, of course, the similar questions that have been raised regarding reproductive techniques could be asked again here.

To answer whether or nor the clones would be considered human beings, we have to assume, as I think it is proper, that human clones will eventually be created

[244] Stern, Rabbi Y. M., pages 181-182, 1992.

whether or not cloning is deemed permissible by governments or Jewish law. As I have described before, in the topic of reproductive cloning, something important to resolve for Jewish law is if a clone is created in the absence of sperm (or *"zera"),* sexual relations or even without utilizing any cells from a man (i.e., when the host egg and donor DNA are obtained from the same woman) is this considered to be a human being? In the eventual case, if the clone would be not considered human through *halakha*, probably it could be defined as a *golem*. I will explain this in a separate question below. But here, I would like to mention that if a human clone were defined as a *golem,* many *halakhic* issues would have to be resolved. Issues like could a Jew marry a *golem?* And what would be the *halakhic* status of the offspring?

To determine the difference between a human being and a *golem,* it is important to remember the two things that differentiate a *golem* from humans, as it is written in the Talmud[245] from a human clone. From a scientific point of view, a *golem* is created by means of chanting "mystic combinations of the Divine Name" (obtained from *Sefer Yetsira)* over selected dust of the earth.[246] Human clones are created using biological technology and human cells. Also, unlike a cloned human, a *golem* is not born from a mother's womb. Thus, as Dr. Steinberg said, if a human clone does not fit the definition of a *golem,* it appears to be *halakhically* human. It is important to keep in mind, however, that if technology develops to allow babies to be formed and gestated ex-utero (outside a woman's womb) or in the uterus of another

[245] In *Gemara* on *Sanhedrin* 65b

[246] Also in *Mishnah Berurah*, chapter 55 n.4, cites a *halakhic* discussion of whether "*Adam she notzar al iedei Sefer Ietzirah*," can be counted in a *minyan.*

animal such as a cow, then the *halakhic* status of such life-forms might have to be re-evaluated.[247]

I would like to explain a little more about the concept of the *golem*, as seen in our tradition. As I have said before, *golems* are artificial people created by mystical means. Stories tell of figures made from dirt, brought to life by reciting one of the names of the Divine or by placing a piece of parchment with God's name [or the word *emet* ("truth")] on the *golem's* forehead. I have cited before *Sanhedrin* 65b, which said:

> Rava created a man and sent him to Rav Zera. The rabbi spoke to him, but he did not answer; Rav Zera exclaimed "you are artificial: return to dust"... Rav Hanina and Rav Ohaya would sit every Sabbath eve and study the book of creation and create a calf one-third the size of a full calf, and eat it.

Rabbi David J. Bleich referred to this passage to say Jewish teaching would not scowl upon cloning of either animals or humans simply because it is a form of asexual and "unnatural" reproduction.[248] For him, the text teaches two things. First, asexual husbandry with animals is morally permissible. Second, "harnessing metaphysical forces practiced by kabbalist teachers is acceptable." This means, the Talmudic text accepts the legitimacy of asexual reproduction and therefore homologous reproduction of animals. For Rabbi Bleich, the *golem* is a being that only **resembles** a human ("anthropoid") replication of already existing human

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247 *Talmud Babli*, *Haggiga* 14b

248 Bleich, Rabbi D. J, pages 47-86 1998.

genetic material is completely missing. For him, the creation of the *golem* is the only form of asexual reproduction that was cited in the *halakhic* sources.

As Rabbi Michael J. Broyde wrote, in the last 600 years there have been a number of accounts of *golems* created to assist the Jewish community in its various times of need.[249] As Rabbi Chaim Steinmetz notes, "Whether or not these legends are fictional is irrelevant; what we are interested in is how man's ability to artificially create life is viewed by Jewish thinkers."[250]

Rabbi Broyde also said that the responsa literature contains discussions about what a *golem* can do, religiously speaking, e.g. may a *golem* be counted in a *minyan*? He adds that humanness -- being created in the image of God *(betzelem elokim)* -- is not dependent on intelligence.[251] Rather, as Rabbi Broyde cites the *Encyclopedia Talmudit states*:[252]

> A person who is born from another person -- in the womb of a woman -- is prohibited to be killed.

It adds:

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[249] Broyde, Rabbi M., pages 23-65,1997. Rabbi Broyde is Associate Professor of Law at Emory University and rabbi of the Young Israel of Toco Hills in Atlanta, Georgia. He is a widely published writer, Senior Lecturer in Law at Emory University School of Law, and Associate Director of the Law and Religion Program at Emory University.

[250] Steinmetz, Rabbi Ch. " Creating New Species," Unpublished ms. This Article was shared to Rabbi Broyde, in the article that I cited before.

[251] An explanation of this is given by Eleazar Fleckeles, *Teshtivot Me'Ahava* 53, who discusses whether a significantly deformed child is human, and concludes that obviously it is.

[252] Broyde, Rabbi M, pages 23-65,1997.

> One who is created through a mystical process or through a mixing of divine letters [if that person is killed] the one who kills him does not violate the prohibition to murder *(lo tirtzach).*[253]

There have always been people who have different views about the *golem*, such as thinking its origins are non-human, or that they are specifically divinely created, or that a *golem is* both specifically divinely created and a deaf-mute.[254] Rabbi Samuel Adels (Maharsha) said that a *golem* can speak and appears human is, in fact, human.[255] As Rabbi Broyde said, support for the proposition of "humanness" is determined by human function. In cases where apparent definition of humanness -- birth from a human mother -- does not apply, can be found in an explicit discussion of humanness in the Jerusalem Talmud:

> Rabbi Yasa states in the name of Rabbi Yochanan: "If [a creature] has a human body but its face is of an animal it is not human; if [a creature] has an animal body, but its face is human, it is human. Yet suppose it is entirely human, but its face is animal like, and it is learning Torah? Can one say to it "come and be slaughtered?" [Rather one cannot]. Or consider if it is entirely animal like, but its face human, and it is plowing the field [acting like an animal] do we come and say to it, "Come and perform levirate marriage *[yibum]* and divorce *[chalitza]?"* [Rather, one cannot.] [256]

The beginning of the section seems to say that when the definition does not apply, one examines the creature for "human" features. But the conclusion seems to say that when dealing with a "creature" that does not conform to the simple definition of

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[253] *Encyclopedia Talmudit,* "Adam" 1:165. Also *Chacham Tzvi* 94. *She'elat Yavetz* 2:82 quotes others who compare such a creature to an animal - it is alive, but not human.

[254] In *Darchei Teshuva* on *Yore De'a* 6:11, *Marasha, Sanhedrin* 65a, *Sidrai Taharot, Ohalot* page 5a, *Tzafnat Paneach* 2:7

[255] Rosenfeld, A. " Human Identity: Halakhic Issues," (*Tradition 16:3*) 1997 at page 58.

[256] *Talmud Yerushalmi, Niddah 3:2*

humanness --born from a human mother--one examines the context to determine if it is human. Rabbi Broyde asked: Does the *golem* study Torah or is it pulling the end of a plow? This means that a human clone, even one brought to term trough artificial incubation, would be human, as it would have human intellectual ability and human attributes that a *golem* would not have.[257]

Rabbi Broyde thinks stories about fully artificial people are of no relevance in cases of AIH/D, IVF or cloning, since the fertilized egg is implanted in the uterus of a woman, who gives birth to a child and is the legal mother. Therefore, a human clone, is no less than any other "born" child, he or she passes the test for humanness and is human.

I must say that I agree with Rabbi Broyde, who believes that the fact that the *golems* were destroyed in the tales without any thought, when their function was finished, is a clear proof that *golems* were not considered human. They were not governed by Jewish law and could be treated as dead objects. Since there are a lot of discussions about the concept of a *golem* in our sources, specifically in the seventeenth and eighteenth centuries, I will return later to this subject, with the view of Rabbi David J. Bleich.

When I was discussing the reproductive techniques earlier, I mentioned one of the big concerns for orthodox authorities was the *mitzvah* of *pirya ve-revya*. Again, here

[257] As Rabbi Broyde wrote in his article, might indicate that a fully incapacitated clone might not be human. Also in, Hershler, Rabbi Moshe, 1985.

the lack of male *zera* or male tissue and the absence of sexual relations will determine this issue. It is important to ask whether this *mitzvah* can be fulfilled only when a child is born out of natural sexual intercourse or if this *mitzvah* is fulfilled when a child is born irrespective of how or where fertilization takes place. Is possible to use the same *halakhic* precedent[258] that authorities used for artificial insemination? Of course, there is not another precedent in the *Gemara* that supports the propagation of humans in the absence of male seed like there is in the case of human cloning. As Dr. Steinberg says, if there is no male sperm and no sexual relations, this could be a case where this *mitzvah* will not be fulfilled; but the *mitzvah* of *la-shevet*, to populate will be fulfilled.[259]

There is another question I have addressed before regarding the *halakhic* parenthood of the child-clone. From a *halakhic* point of view, this issue concerns whom the child is forbidden to marry. Also, this deals with whether the child is a *Cohen, Levi, or Israel.* Another issues is if a child is a *bat Cohen,* having special privileges and obligations. Following strictly *halakhic* rules, clone children must know which parents to respect. It is important to know if the child is a Jew or Gentile. How do the laws of *yibbum* (levitate marriage), and the laws of inheritance apply to a clone person?

Dr. Steinberg tried to resolve some of these issues, giving a situation where both the host egg and the donor mammary cell are obtained from the same mother. The

[258] *Talmud Babli, Hagigah* 14b

[259] Steinberg, M.D, A. and Loike, PhD J.D, pages 32-46. 1998.

fetus is carried by the woman nine months, and the mother will deliver a girl who will be a perfect clone because both the nuclear and mitochondrial DNA were obtained from the mother. In this example, no male cell or sperm directly contributed any DNA to the creation of this cloned girl. As the mother was Jewish, the baby would be Jewish. The question to resolve, as we have to do in infertilization in vitro and artificial insemination, is to know who is the *halakhic* "father" of this cloned child? As Dr. Steinberg clearly said, there are three possible situations:

1) The father of the mother, or the grandfather, of the cloned girl would be the father because about half of his genetic information is transmitted to the child through the host mother;

2) The donor of the mammary cell, who in this case is the biological mother, would be the *halakhic* father. Therefore, the biological mother would then serve as both the *halakhic* father and *halakhic* mother of this cloned baby; or

3) The cloned girl will have no *halakhic* father.

We do not have in our sources cases where either a grandfather or a mother can serve as the *halakhic* father. As Dr. Steinberg said, there are no direct *halakhic* precedents in the *Gemara* supporting the first and second possibilities. In contrast, there are two situations in our sources where the child does not have a father. These

situations are known as *shetuki* and *gerut.* A *shetuki*[260] is defined as a child whose mother's identity is known but whose father's identity is not[261]; this could be because the child is not told who he is or because the mother did not know herself. The conclusions for this situation is that a *shetuki*, is considered as a possible *mamzer* and to prevent his/her marriage to a relative, he/she would not marry another Jewish person.[262] Of course, a *shetuki* has a father who is unknown, yet in the clone child, the father does not exist because was no sperm. By knowing her genome, she would be forbidden to marry her relatives, but could still wed a Jewish non-relative.

The other case that appears in our sources is the case of the *gerut.* A convert to Judaism is treated as being an orphan. This status could be homologated for the clone child.

Another problem arises in a situation where an egg of a woman and the DNA from the cell of her daughter, mother, or sister are used to clone a child. Of course, there is no situation in our sources that not allow the union of a mother with a daughter to form a child. Probably, nobody thought about that before.

Still unclear issue is knowing the *yihus* of a male clone child: is he is *Cohen, Levi or Israel*? The *halakha* must deal with his status if he is *Cohen or Levi.* This has to be determined by how the child was created. This means from the *"zera"* of a *Cohen-*

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[260] In *Talmud Babli, Kidushin* 73a.
[261] Steinsaltz, Rabbi A, page 270, 1996.
[262] In *Talmud Babli, Kidushin* 73a, *Rambam Hilkhot Issurei Bi'a* 15:21. Also, in Responsa *Seridei Eish helek* 3#5

father or *Levi*-father via sexual relations. Probably, from an *halakhic* perspective if the father is a *Cohen*, the child will be considered a *Cohen*. The same will happened with the son from a *Levi*.

Another obscure point, as it is with IVF and AIH/D, is knowing if a cloned child is or is not considered a *mamzer*. Can DNA be used from any kind of male other than the husband of the woman for cloning? To answer this question, it is important to understand the *halakhic* idea of *mamzerut*.[263] *Mamzerut* is defined as the product of a non-correct sexual union (such as father-daughter, son-mother), and the father transmits the hereditary status through *zera*. Since in cloning there is no *zera* transmitted, this situation would never happen.

If human cloning would be accepted as a method of reproduction, a male would not be needed for a female to have children. This could be a social consequence that has to be considered seriously. Tissue banks, similar to today's sperm banks, would be where people would donate cells to clone children like themselves. This could have terrible repercussions without supervision. As Dr. Steinberg said, there would be no *halakhic* prohibition of donating non-sperm cells, unlike artificial insemination or *in vitro* fertilization, where a male must donate sperm. Today, it is not clear whether such tissue banks will be developed, but thirty years ago, science did not predict sperms banks for AIH/D and IVF, as well.

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[263] *Shulchan Aruch, Even ha Ezer*, 4:18, 22:24 and 8:5.

As I have written about IVF and AIH/D, Rabbi Waldenberg[264] has a negative view of any kind of these techniques. His beliefs are share by Rabbi Eliashiv, who also thinks all those techniques would go against *haskhafat ha Torah.* Rav Auerbach shares also this position.[265] And of course some orthodox authorities think that cloning may be a *Hilul Hashem,* a direct affront to God.[266] But others orthodox authorities, as I have discussed before, do not agree with that concept, that is why they permit AVF and AIH/D.

When Rabbi Broyde gives his ideas about whether or not cloning is good and permissible in Judaism, he uses five categories to sort out the reproductive methods: obligatory; commendable, but not obligatory; permissible; discouraged but not prohibited and prohibited. [267]

In the first category, he mentions a man is required to procreate by having a minimum of two children according to Jewish Law. He considers this category as a *mitzvah chiuvi.*[268]

The second category activities, that are commendable, but not obligatory (*mitzvah kiyumit*)-he said different authorities decree procreation beyond the obligation to have one boy and one girl as an optional activity. According to this

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[264] Responsa *Tsits Eliezer,* vol. 15 #45-4

[265] *Nishmat Avraham* , vol. 4 *Even Haezer*, 1:3

[266] *Teshuva by Helkat Ya'akov*, vol. 3 #45.

[267] Broyde, Rabbi M., pages 23-65,1997.

[268] *Shulchan Aruch Even Hezer* 1:3.

approach, such conduct is a *mitzvah*, but not legally obligated. Following this idea, a person who has already fulfilled the obligation to be fruitful and multiply and is not married is under no obligation to remarry, although authorities suggest to marriage when it is possible.

In the third category, activities which are permissible (*mutar*), Rabbi Broyde brings the case where Rabbi Moshe Feinstein allowed a woman, with the consent of her husband, to engage in artificial insemination using a gentile's sperm.[269]

In the fourth category he spoke about couraged but not prohibited *(bitul mitzvah)* activities. He said different authorities decree that in cases where there are many children in the family, it was convenient to stop having children. Following this idea, one who avoids fulfilling this commandment has forsaken the opportunity to do a good deed (*mitzvah)*. As always, there are authorities opposed to this.

In the last category, he spoke about prohibited *(assur)* activities, such as abortion without a good reason.[270] Also, Rabbi Broyde said the discussion of cloning focuses on whether the obligation to be fruitful and multiply or its rabbinic analog has been fulfilled. Rabbi Broyde brings forth two possible arguments. First, a man fulfills the *mitzvah* to be fruitful and multiple solely by giving genetic material to produce a child who lives. In this case there is at least one mother (gestational mother) and in most circumstances there will be a father/second parent. In the second argument, the

[269] *Iggerot Moshe Even Haezer 1:10, 71; Even Haezer 2:11; Even Haezer* 3:11.
[270] Bleich, Rabbi J. D, 1991.

intrinsic definition of the obligation to be fruitful and multiply or its rabbinic equivalent involves the combination of the genetic materials of a man and a woman—by intercourse or by in vitro—and if the combination of genetic material from a man and a woman are missing, there is no fulfillment of the obligation to be fruitful and multiply. Rabbi Broyde thinks the first argument is superior. To justify this argument he gives the example that when the fertilized egg is implanted in a woman, and a child is produced, it resembles the natural birth process.

Rabbi Broyde concludes that, cloning as a form of reproduction, in all likelihood, is sufficient to exempt a person from the obligation to procreate again. He gives the example that a *ger* with children after conversion does not need to have more children.[271] Rabbi Broyde cites *Biur Heitev* 1:11 to justify his point. There, it is written that the converted Gentile is exempt from the *mitzvah* of *peru urevu* because he has children who are "called after his name," even though the converted Gentile has not according to the *halakha,* had children. A clone could be considered similar to this situation. Making a clone would be a way of fulfillment *peru urevu*. As I have said before, from an *halakhic* prospective, this obligation, is only for the man but recognizes that the woman is a necessary participant.[272]

Because human cloning does not present *halakhic* issues that have been raised in terms of the fertilization of the egg by the sperm, and does not involve any reproductive technology other than implantation, and is not an activity that violates

[271] *Shulchan Aruch Even Haezer*, 1:7.
[272] *Shulchan Aruch Even Haezer,* 1:13

the *halakha*, Rabbi Broyde concluded that there are no *halakhic* reasons to forbid cloning. [273] Also, he said when the woman is the donor of the genetic material, this activity is a permissible activity (mutar), even though no *mitzvah* is fulfilled.[274] If the woman is married, she might not wish do this, because the child could be a *mamzer*—illegitimate.

Rabbi Broyde also said that in human cloning, the egg/ovum is removed from the egg donor prior to fertilization. This means that there is no possible way to think that the nuclear material in the unfertilized egg is killed, which means an abortion.

The last point that Rabbi Broyde made is that when a donor is a man, cloning would be a good deed if he cannot otherwise fulfill *peru urevu*. But when the donor is a woman, cloning could be religiously neutral, neither prohibited nor a *mitzvah*, simply permissible.

Another interesting issue to consider is whether the clone would have a human soul.

Rabbi Bleich, who seems very reluctant to the idea of human cloning as a reproductive technique, said that if even the man could have the power to create a clone endowed with a human soul, there may well be reasons to question whether

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[273] Broyde, Rabbi M., page 55, 1997.

[274] *Halakhic* authorities prohibit a married woman from functioning as a gestational mother for any child other than one whose father is her husband. In Rabbi Yaakov Breish, *Chelkat Yaakov*, 3:45-48. Also in Rabbi Yechiel Yaakov Weinberg, *Sridai Eish, 3:5.*

that power should be used.[275] For him, artificial creation of human beings represents a way of *imitatio Dei* (which is usually a good thing), a way to deny the divine creation of the universe, and a denial of the existence of God. That is why Rabbi Bleich is against reproductive human cloning.

Back to the concept of the *golem,* Rabbi Bleich comments that the kabbalist teachers were concerned about it, similar to his concerns about reproductive human cloning. For him, the *golem* literature serves to demonstrate the unassailability of the status of a human clone as a human being. As proofs of his thoughts, Rabbi Bleich brings a passage of *Sefer ha-Gematriot,* written in the thirteen century, authored by disciples of Rabbi Judah the Pious, where it is said:

> Ben Sira wanted to study *Sefer Yezirah.* A voice *[bat kol]* came out and said, "You cannot do it alone." He went to Jeremiah his father. Ben Sira is [numerically equivalent to] Ben Yermiyahu, [the son of Jeremiah] and they studied it and after three years, a man was created to them, upon whose forehead it was written *'Emet,* as on the forehead of Adam. And the created one said to them: If the Unique One, tile Holy One, Blessed be He, created Adam, when lie wanted to kill *[Ie-hamit]* Adam, He erased a letter from *'emet* and what remained is *MeT* [dead], even more so I would like to do it and you shall no longer create a man, so that people shall not err concerning him, as it happened in the generation of Enosh.[276] This is why Jeremiah said: Cursed is the man who relies on Adam. The created man said to them: Reverse the combination of the letter backwards. And they erased the *'aleph* from his forehead and he immediately turned into ashes. [277]

Rabbi Bleich said, as seen in this text, that the *golem* might be sacred, as it had happened before, in the time of Enosh. People vow before Adam, thinking that he

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[275] Bleich, Rabbi D. J., pages 47-86 1998.

[276] Rambam, *Hilkhot Avodah Zara* 1:1 and Sholem, Gershon. "On the *Kabbalah* "page 1181

[277] Idel, M. *Golem* page 64 and G. Sholem, "On the *Kabbalah*" page 179

was God. Rabbi Bleich brings another text with the same story, taken from an anonymous author of a manuscript called *The Secret of the Name of 42 Letters:*

> We found in *Sefer ha-Bitahon* written by R. Yehudah (ben Bateirah) that Jeremiah, of blessed memory, was studying *Sefer Yezirah* alone: A voice came out and said to him: Take a companion. He went to Sira his son and they studied [together] for three years in order to accomplish what was written. Then they that feared the Lord spoke one with the other. At the end of three years, when they wanted to combine the alphabets, according to the *Zeruf,* [combination] the *Mikhlol* and the *Ma'amar,* a man was created, and on his forehead it was written, YHVH *'Elohim 'Emet.* In the hand of that man there was a knife, and he was erasing the *'aleph* of the word *'emet* and there remained met. Jeremiah rent his garment and said to him, "Why did you erase the *'aleph of 'emet?"* He answered him, "I will tell you a parable.... Thus is God, when He created you in the image, likeness and form. Now, when you created a man like Him, the people will say that there is no God in the world but you." Jeremiah told him, "If so, how can we repair it" *[mai takanteh]?* He answered them, "Write the letters backwards over the dust that was thrown, by the intention of your heart and do not think about the way of [its] honor or of its order *[tikkuno]* but do all this backwards." And they also did so and that man became before their eyes dust and ashes. Then, Jeremiah said, "Indeed it is worthwhile to study these matters for the sake of knowing the power and dynamis of the creator of the world, but not in order to do [them]. You shall study them in order to comprehend and teach."

Rabbi Bleich brings this text, not reflected in the *halakhic* sources, to say that in the time of Jeremiah or in the thirteenth century with the image of a *golem*, and in our days with possibility of the creation of a human clone, the idea that God is the creator of the universe and creator of all beings would never be destroyed.

For Rabbi Bleich, there are four views regarding to the status of a *golem*: Rabbi Avraham Azulai (1660),[278] Rabbi Chaim Joseph David Azulai (Hida, seventeen

[278] *Hesed le Avraham, Ein Ya'akov, Ma'ayan Revi'i, nahar,* 30

century),[279] Rabbi Zevi Askhenazi (*Hakham Zevi*)[280] and his son, Rabbi Jacob Emden (1769).[281] Rabbi Emden believed that its status is identical to that of a brute animal, that is why is disqualifying it from being counted in a *minyan*. Rabbi Zadok ha-Kohen of Lublin[282] believes that it is human in every sense and he accepts Rabbi Zevi Askhenazi comments that the anthropoid is not only a human but also is a Jew. Rabbi Zadok adds that the golem is not endowed with a soul and therefore is neither rewarded nor punished in the afterlife. Maharsha and Rabbi Gershon Leiner beliefs that only an anthropoid capable of speech is human. For *Zofnat Pa'aneah,* the *golem* does not have the status of a living creature.

At this point, it would be proper to clarify the difference between a *golem* and a human clone. Rabbi Bleich explains the former is created *ex-nihilo,* from the dust, and clearly does not have a human progenitor. The human clone, however, has a human progenitor and it is the product of asexual reproduction. For him, a human cloned acquires human status by virtue of the fact that it is a *yozei* of a human being, i.e. by virtue of its generation from human tissue. Rabbi Bleich explains that the concept of *yozei* is generally associated with the status of food products. Rabbi Bleich, by quoting Rabbi Elchanan, said that, in this case, anything that is emitted by, or proceeds from, a particular entity has the status of the entity that produced it. Therefore, the concept of *yozei* serves as the standard by which one determines

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[279] *Mahazik Berakha, Orah Hayyim* 55:1 *also in Mar'it he-Ayin;* Talmud Babli, *Sanhedrin* 65b and in *Birkei Yosef, Orah Hayyim* 55:4

[280] *Teshuvot Hakham* Zevi, no 93

[281] *Sheila'ilat Ya'avez,* II, no. 82

[282] *Kuntres Divrei Holamot,* sec 6 (translation is provided by Moshe Idel, *"Golem,"* pages 220-223)

identity as a member of a species, with such determination of identity impacting the determination of issues of religious law.[283]

Speaking about the ethical implication from a Jewish standpoint, Rabbi Bleich brings the comments made by Professor Paul Ramsey in the 1970's regarding fertilization in vitro. Ramsey asserted that no researcher can exclude the possibility that he/she may do irreparable damage to the child-to-be. For Rabbi Bleich, the same can be applied to human cloning.[284] He believes there is strong reason to suppose that our sages would have decried fetal experimentation and reproductive human cloning because of the inherent danger of producing congenital defects. Also he added, clones could have physiological problems, by being born in an unusual manner. Rabbi Bleich is against human cloning because it does not cure a disease, it does not restore a dysfunctional organ to its intended purpose and it does not serve as a fulfillment of the *mitzvah peria urevia*. In all, cloning, for him, serves no purpose other than the selfish aim of having a child genetically identical to his or her biological parent(s).

For Rabbi Bleich, the treatment of the *halakha* toward reproductive human cloning is the same as in adoption. Both issues do not fulfill the *mitzvah* of *peria urevia*. Neither device "cures" infertility. And if reproductive human cloning is regarded by the *halakha* as immoral, it cannot reduce the pain of infertility. Although Rabbi Bleich, as it is clear, does not agree with reproductive human cloning, he is in favor of

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[283] In *Kovez Inyanim, Hullin* 17a, in *Kovez Sh'iurim*, 1, *Pesahim* sec 120; in *Kovez He'arot*, no 33, sec. 8

[284] Ramsey, P., pages 1480-1485, 1972.

therapeutic human cloning. Cases of leukemia, when the bone marrow of family is incompatible, may need this medical procedure. Also, he agrees to use human cloning as a procedure in cell and tissue therapy. As he said, embryonic stem cells have the ability to differentiate into cell type, in theory, and could produce human blastocysts. In a case where rejection of transplants occurs because the body's immune system recognizes the transplanted tissue as foreign, human cloning probably will help. Stem cells could be taken from the developing blastocyst and be induced to differentiate. This means that those cells would be genetically identical to those from which the nucleus was taken and hopefully the new tissue will not be rejected. I will come back to this later when I will discuss the Reform responsum about this issue.

Another situation where cloning would be beneficial is in the category of a *choleh le-faneinu*.[285] This means, "For whom the danger and potential benefit is regarded as actual rather than merely hypothetical," like some cases where the transplant is rejected.

Rabbi Bleich concludes his thought with what our sages learned from the *golem* literature: the absence of prohibition against it created the *golem*, but this does not mean that the rabbis encouraged it. Rabbi Bleich thinks "the modern-day *golem*" (human clone) must not come to pass as a means of reproduction.

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[285] On this basis, Rabbi Ezekiel Landau (Prague, 1719-1793), permits autopsies, normally forbidden as a desecration of the corpse (*nivul ha-met*). Autopsy is permitted if the information it reveals can heal a *choleh le-faneinu*, in Responsa *Noda Bi'hudah, Yoreh De'ah* 2:210.

Reproductive human cloning is a subject that has and will have different opinions. Dr. Steinberg, in a more recently article, addresses some questions that I did not discuss before.[286] Does the development of cloning of human beings include an attack on the very belief in the Creator of the world? In contrast to Rabbi Bleich, for Dr. Steinberg the answer to this question is no. Dr. Steinberg defended his answer by saying that reproductive human cloning, as another reproductive treatment, exemplifies creation *"yesh mi-yesh"* (something from something). For him, the utilization of knowledge of nature does not constitute a new creation. For him, God is the only one who can create a world *ex nihilo*. He believes that by studying these procedures, Judaism supports Rambam, who believed that acquiring new knowledge is the way to fulfill the *mitzvah* of love of God.[287]

Another important question that Dr. Steinberg touches on is if the technology of cloning humans should be viewed as a fundamental *halakhic-hashkafic* transgression of interfering with Creation? As I have expressed before, Dr. Steinberg said that Judaism obligated human beings to build and develop a better place in this world. Dr. Steinberg said all activities of developing and advancing the world must justified by fulfill three conditions:

1) The first is that there are no *halakhic* prohibitions against technological advancement.

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[286] Steinberg, M.D. A., pages 199-206, Sept. 2000.
[287] Rambam. *Hilchot Yesodei ha-Torah*, 2:2

2) The process of improvement of Creation does not have a prohibited result, so this process cannot be prevented or corrected.

3) The benefits for humans surpass the possible harms. This notion can be found worded in many ways by the great *halakhic* masters. For Dr. Steinberg, cloning humans through technology is a natural act, and it does not introduce a totally unfamiliar species into nature; it "is no different from the using of antibiotics to decimate injurious bacteria."

Another basic question Dr. Steinberg addresses is if the actual technology for cloning humans presents substantial *halakhic* prohibitions. Again, he answered, "No." Also, he disagrees with the sages who believed that cloning comes under the *halakhic* rubric of witchcraft. They base their opinion in *Tanakh and Hazal.* Witchcraft is related to the unnatural creation of humans and animals.[288] Dr. Steinberg agrees with Rambam, who said, "Anything for which the association of cause and effect is established by accepted scientific rules and is dictated by natural logic does not constitute witchcraft; likewise, anything proven by experience, even if not prescribed by logic, is permissible."[289] For Dr. Steinberg, reproductive human cloning is not included inside the prohibition of witchcraft by *rishonim.*[290] The Torah's prohibition of witchcraft, according to this approach, refers to the use of evil spirits or powers with

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[288] Exodus 7:11-12 and *Sanhedrin* 67b

[289] Rambam. Guide of the Perplexed III: 37

[290] Ramban to Deuteronomy 18:9; Rashba, Responsa, I:#413; R. Bahya, Ex. 22:17; *Sefer ha-Hinukh, mizvot* 62 and 511; Gra, *Yoreh De'ah 179:13.*

destructive intent. [291] Dr. Steinberg interprets the text by understanding that the prohibition of witchcraft does not include acts done with constructive intentions:

> ...In this vein, our sages of blessed memory said as a general rule: Whatever contains a purpose of healing, is not considered of 'the ways of the Emorites' (*Shabbat* 67b). In other words, it is not to be forbidden because of an aspect of sorcery [in it]-since there is a useful benefit in it, truly found by experience, this is not one of the forbidden ways. For they were forbidden only on account of the harm in them. [292]

Also, for supporting his position, Dr. Steinberg cites Meiri, who wrote:

> Anything done as a natural activity is not included in the prohibition of witchcraft. Even if one knew how to create creatures without natural procreation, as is known in the books of nature, he may engage in this activity, since anything natural does not fall under the rubric of witchcraft. [293]

For all these reasons that I have presented above, Dr. Steinberg believes the scientific technology of cloning should not be likened to witchcraft.[294]

Different from Dr. Steinberg's view is the view of Rabbi Kenneth Waxman, who believes that cloning only is permissible in animals or plants, not humans. In his article about cloning, he believes medicine should always be permitted in order to

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[291] Ramban to Exodus 7: 11

[292] *Sefer ha-Hinukh, mitzvah* 62 and *Encyclopedia Talmudit* vol. 7, S.V. *Darkhel ha-Emori*

[293] Meiri, in his *Bet haBehirah* commentary to *Sanhedrin 67b.*

[294] This touches upon a central problem in halakhic reasoning: How do we evaluate modern phenomena on the basis of analogies to texts that simply do not speak to modern conditions? (I.e. Does *kishuf* really tell us anything about cloning?)

save a life.[295] For him the verse in Exodus 21:19 shall be interpreted as the *Tosafot* and others commentators did.[296] They taught that from this verse. We learn:

a) One might have thought that the practice of medicine violates the *gezerat ha-melekh,"*[297] the decree of the king, i.e., the divine will, and is hence prohibited.

b) *Ka mashma lan,* the verse teaches that no prohibition exists.

There could be two ways of understanding this. One could be that diseases are not the "will of the king." Therefore, medicine is permitted.[298] The other way of understanding would be man is permitted to interfere and obligated to intervene, despite the decree of the king. Rabbi Waxman commented that Rabbi Moshe Feinstein said, "The practice of medicine might be compared to the numerous biblical examples of praying against a divine decree or plague."[299] Rabbi Waxman said man is sometimes permitted and even obligated to act in a way that seems against the natural order and contradicts the divine will.

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[295] Waxman, Rabbi K., pages 188-194, Sept. 2000. He is the former rabbi of the Albert Einstein Synagogue, Bronx, New York, and currently teaches at MaTaN in Jerusalem.

[296] In Ramban, *Torat ha-Adam,* loc. cit. and *Commentary on the Torah,* Lev. 26:11.In fact, in his commentary to Le. 26:11, Ramban takes a very negative view of medicine, which in some important ways conflicts with what he says in *Torat Ha'adam.* There he teaches that cure will not be thanks the doctor but thanks the prophet.

[297] This is the Tosafists' formulation. Ramban's formulation in *Torat ha-Adam is: Ha-Kadosh Barukh Hu mohez ve-hu merappe.* Also, in *Tur, Yoreh De'ah 336.*

[298] Also, Ramban's comments to Lev. 26:11, *Turei Zahav (Taz) to Shulhan Arukh, Yoreh Deah 336.* This approach maintains that inasmuch as not everyone is worthy to receive constant Divine providence, one may seek and provide medical help on the assumption that one operates within the parameters of a natural world framework and one of reward, punishment and divine decree.

[299] *Iggerot Mosheh, Orah Hayyim* 3: # 90

Rabbi Waxman also expressed an idea that I really share: "When human creative capacities, ingenuity and technology are utilized to alleviate human suffering or to improve the human condition even in the broadest sense, our actions are permitted, perhaps mandated, and constitute a full-fledged accomplishment of the religious ideal of *imitatio Dei*. However, in the absence of these or other clear and ethically appropriate benefits we must consider sounding the clarion call of retreat lest we contradict the divine will and usurp the divine prerogative."[300] I believe with this thought because it shows how Judaism does care for the health of the human being, while emphasizing that any scientific advancements have to be made under the provisions of bioethics.[301]

Finally, Rabbi Waxman concludes he agrees with any cloning technique in animals and plants, to improve the health of human beings. However, for him, reproductive human cloning "seems to meet no valid and ethically appropriate human need."[302]

While Rabbi Waxman has a negative view regarding human cloning, Dr. Julian (Yoel) Jakobovits presents a different approach in his article. [303]

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[300] Waxman, Rabbi K., pages 188-194, Sept 2000.

[301] This could be compare with the situations brought in *Teshuvot For The Nineties*, no.5754.14, at page 343 ff— when medical technology loses its therapeutic value, it no longer is to be defined as "medicine." If a respirator, for example, is not helping the patient, it is not medicine.

[302] Ibid.

[303] Jakobovits, M.D. J. (Yoel), pages 195-198, Sept 2000. Dr. Jakobovits is Assistant Professor of Medicine at the Johns Hopkins University Hospital and Medical School and the Sinai Hospital of Baltimore. He has published numerous articles on Jewish medical ethics.

Dr. Jakobovits says cloning is not evident in our sources which means that cloning is an exception of the *mishnaic* axiom that declares *hafokh bah ve-hafokh bah de kulah bah* (Study it and review it: you will find everything in it).[304]

Dr. Jakobovits reviews of the process that involves human cloning and although, I discussed this in another chapter, I think it is important to repeat it here. Cytology teaches that every cell, except from the germ cells of the testes and ovaries, has the entire complement of genetic material essential to control the development and operation of the entire organism. In the process of differentiation, the undifferentiated genetic material within each cell is latent. The process of cloning re-activates the latent cells, giving the cell the potential to re-create the entire being. There are up to three people involved in the process. One person gives the entire genetic contents of a non-germinal, or somatic, cell's nucleus. The resultant clone will be an identical replica of this individual. Another person gives a cell from which the native genetic material has been removed. The gene-containing nucleus from the first person will be put into the gene-depleted cell of the second individual. "This refilled cell is stimulated by an ill-understood electrochemical process and then inserted into a womb of the first person, the second, or even a third—from which it derives nutrients and in which it is carried to term and eventual birth."[305] This is, in summary, the human cloning process.

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[304] *Avot* 5:24

[305] Jakobovits, M.D. J. (Yoel), page 196,Sept. 2000.

Dr. Jakobovits mentions, similar to the rest of the authorities, that the problem with cloning is the consequences of such technology rather than to the technology itself. He analyzed the same questions others did, and he also raised the important issue of what would be the status of a cloned being? Should this clone be considered alive? He thinks, there is no reason to believe that the cells used to clone could not be harvested from the donor even after death.

One of Dr. Jakobovits interesting comments is that scientists will need to understand the mechanisms and circumstances that turn on and off the activity of specific portions of the genetic code. Knowing that will be a first step to envision the cloning of a specific organ.

Another important contribution to genetic engineering and human cloning is made by Dr. Fred Rosner in his article.[306] He started his comments with many of the same questions. Does the genome project intrude upon the Divine plan for this world by interfering with nature as God created it? Is genetic engineering equal to changing the Divine arrangement of Creation? He says that even though some rabbinical authorities answer these questions in the affirmative way, they are in the minority.[307] Dr. Rosner says that the majority of opinion believes having knowledge for curing human beings is divinely sanctioned and mandated. Dr. Rosner supported this

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[306] Rosner, M.D F., pages 211-215, Sept. 2000. He is Director of the Department of Medicine at Mount Sinai Services at the Queens Hospital Center in Jamaica, New York and Professor of Medicine at the Mount Sinai School of Medicine. He has published many books and articles on Jewish medical ethics.

[307] Hershler, Rabbi M., pages 350-353, 1981.

comment by the *midrash* on Genesis 1:28, given by Rabbi Samson Raphael Hirsch. For Rabbi Hirsch, "to subdue the earth," is to master, appropriate, and transform the earth and its products for human purposes. To have "dominion over the fish and over the birds and over every living thing on earth"[308] Dr. Rosner says this passage "means to use them for human benefit." Dr. Rosner says that learning more and having scientific advancement does not mean, "to eat from the prohibited tree of knowledge"[309] If it is good for the humanity, it is permissible.

Dr. Rosner agrees with the other doctors I have discussed previously—that therapeutic genetic engineering does not violate the Torah by undermining God's creation of the world. Crossbreeding, on the other hand, would be a form of genetic engineering that *would* violate the Torah.

For Dr. Rosner, science must continue to be studied to work toward the development of new knowledge. By doing so, it would be a real proof that God created the world.

Dr. Rosner agrees and cites the traditional basis upon which the tradition defines medicine as a *mitzvah*. Also, Dr. Rosner says that Maimonides' interpretation of the biblical obligation to restore a lost object[310] may include the restoration of one's lost

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[308] Genesis 1:28
[309] Genesis 2:17
[310] *Deuteronomy*, 22:2.

health.[311] For Dr. Rosner, gene therapy cure's diseases, and any treatment that brings cure would also be sanctioned by Jewish law. Examples are insulin (for diabetic patients) and antibiotics.

Since "neither the sperm nor the ovum nor even the fertilized zygote are persons, they can be manipulated," says Dr. Rosner.[312] In contrast, Rabbi Moshe Hershler believes that gene therapy and genetic engineering may be prohibited because "he who changes the [Divine] arrangement of creation is lacking faith [in the Creator]" and he cites as support for his view the prohibition against mating diverse kinds of animals (i.e. cross-breeding involves mating, not genetic engineering), sowing together diverse kinds of seeds, and wearing garments made of wool and linen.[313] Rabbis Shlomo Zalman Auerbach and Yehoshua J. Neuwirth disagree with Rabbi Hershler by rejecting his proof.[314]

One of the conclusions Dr. Rosner mentions is that "there is no specific *halakhic* prohibition against attempting to clone a human being."[315] Dr. Rosner raises the same questions I have discussed before. Another conclusion he mentions is that "there are no clear *halakhic* precedents in biblical or Talmudic literature."[316] He mentioned the article written by Dr. Steinberg and Dr. Loike showing their

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[311] Maimonides, Commentary to the *Mishnah, Nedarim* 4:4.

[312] Rosner, M.D. F.,page 214, Sept. 2000.

[313] Leviticus, 19:19.

[314] Abraham S. A., pages. 215-218, 1993.

[315] Rosner, M.D. F., page 214, Sept. 2000.

[316] *Ibid.*

conclusions, as I have discussed before, "that human cloning technology is permissible **if used as a form of medical intervention for infertility or to correct genetic defects in children.**"[317] Dr. Rosner believes when the world sees that reproductive human cloning, as a treatment, is something serious, the *halakha* will approve it.

Another doctor who wrote about human cloning from a Jewish prospective is Dr. Richard V. Grazi.[318] In his analysis he mentions Rabbi Broyde, as I mentioned earlier who concludes "at worst, cloning a person would be *halakhically* neutral and that, under certain circumstances, it may be even be a *mitzvah.*"[319] Dr. Grazi mentions other authorities opposed to cloning, such as Dr. Abraham S. Abraham, who says "that because human cloning falls outside *darkhei ha-teva*," it is prohibited.[320] Dr. Grazi believes these two positions are so opposed that the opinion of the majority of *posekin* will be the one we will follow in the future.[321]

Dr. Grazi describes different medical diseases that do not have treatments today even with the new techniques that I have described such as IVF or AIH/D. Examples

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[317] Steinberg, M.D. A. and Loike, Ph.D. J.D. "Human Cloning and Halakhic Perspectives," (*Tradition* 32, 3) pages 31-46,1998.

[318] Grazi, M.D. R, pages 216-219, Sept 2000. Also, he is editor of *Be Fruitful and Multiply: Fertility Therapy and the Jewish Tradition* as well as numerous articles in the field of reproductive medicine and ethics. Dr. Grazi maintains an active clinical practice as the founder and director of Genesis Fertility Reproductive Medicine.

[319] Broyde, M.D. M.J., pages 503-35, winter 1998.

[320] Personal communication from Dr Abraham S. Abraham to Dr. Grazi in May 1998. (As noted in the article)

[321] Indeed there is a huge gap between the two positions, which suggests that "*halakha*" as a process of thought could go either way, and end up answering this question in many different ways along a broad spectrum: 1) Cloning is permitted- no halakhic objection; 2) Cloning is forbidden as a violation of Divine decree; and 3) Moderate positions that take these extremes into account and balance their concerns.

of those are gonadal failures as a result of genetic diseases. As Dr. Grazi says, "In all of these cases, there exists no source of (haploid) germ cells with which to begin fertilization and embryonic development."[322] When this happened reproductive human cloning would be a possibility because would permit the use of (diploid) somatic cells for embryonic development, even though without true fertilization. This is Dr. Grazi's conclusion.

In cases of male infertility, the wife's egg will be able to host the husband's somatic cell DNA. Of course, as Dr. Grazi explains well, the resultant embryo and the (always) male child born of this procedure would be a genetic clone of the husband. In cases where the woman is infertile a host egg from which the nucleus has been extracted would need to be harvested from a donor, without needing the husband at all because the wife would provide the cell DNA. In this case, the resultant would be always a female. As Dr. Grazi clarifies, "The recipient would conceive after her own somatic cell was fused with the enucleated egg. Save for mitochondrial DNA, which would remain from the donor."

As Dr. Grazi says, from an *halakhic* standpoint, there will not be any discussion about paternity or maternity in cases where the husband is cloned. Cases involving cloning of the female would be more difficult. As I have discussed before, Dr. Grazi says that in IVF, using an egg donor, a prevalent view is that the woman who gives

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[322] Grazi, M.D. R., page 217, Sept 2000.

birth is the *halakhic* mother. Others authorities, as I have discussed, do not agree based on the basis of uncertain lineage.

Dr. Grazi and others mention human cloning will create organs (livers, kidneys, etc) that will help people to be cured. Also, an important issue he raises is monetary; there is no doubt this treatment will be expensive and probably will be done by wealthy people.

Another conclusion he draws is that *halakha* will be neutral in cases of using genetic manipulation to cure diseases. As an example, Dr. Grazi comments on the pronuclear transfer technique. This technique currently under investigation is used in premenopausal women who want to become pregnant. Donor eggs are used from the mother so that a woman is allowed to bear her own genetic child. This technique can be used only, if the woman has oocytes. As Dr. Grazi said, premenopausal women have normal nuclear DNA and their problems having babies lies in a defective capacity to fertilize and implant the product of cytoplasmic factors. That is why a young egg and the older egg are extracted simultaneously. After incubation, through the use of manipulation techniques, the older nucleus replaces the younger. Then, a single sperm is microinjected into the "grafted" egg and fertilization and implantation are hopefully successful. As Dr. Grazi describes, this technique was used in mice successfully but not yet achieved in humans. Finally, Dr. Grazi agrees with using reproductive human cloning in cases of infertility.

Dr. Eitan Fiorino takes a different approach.[323] Dr. Fiorino agrees with the position of Rabbi Tendler, and Dr. Fiorino is against human cloning for moral issues.[324] Although Dr. Fiorino recognizes Rabbi Broyde's point's as outlined previously, Dr. Fiorino's opinion is based on the moral aspect of the biology of reproduction.

Dr. Fiorino argues that because there is no *halakhic* answer to the subject, it falls into the category of *reshut,* which means the permission to inspect. As Dr. Fiorino says, cloning falls within the bounds of "supra-halakhic" concepts such as *naval bi-reshut ha-Torah (a* scoundrel within the bounds of Torah) and *lifnim mi-shurat ha-din* (beyond the technical legal requirements).[325]

Dr. Fiorino thinks, for cases like cloning where there are no *halakhic* answers, it is important to create an ethical opinion based upon differences between cloning and all other forms of assisted reproduction. For him, the process of human reproduction is sexual, occurring when male sex cell (gamete) are brought together with a female sex cell, and both provide genetic complement's to create a fertilized ovum. The final product of a child has a mixture of his/her parents' genetic material. As I have already explained, reproductive techniques change the place where the fertilization

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[323] Fiorino , M.D, PhD E., pages 220-223. Sept 2000. Also, he is a pharmaceutical industry analyst at J. P. Morgan. He has authored numerous papers and reports in the scientific, medical and financial literature and has a particular interest in medical ethics in *Halakhah.*

[324] Tendler, Rabbi Moshe D, 1997.

[325] Kirschenbaum, A., pages 109-136,1991.

occurs. So, the main and important difference with cloning arises because it is a process of asexual reproduction (in which the nucleus of a body cell (somatic cell) containing the full genetic complement is transferred to an ovum from which the genetic material has been removed. There is no union, no joining of two individuals (or of their genetic information) to create a new person. Cloning is not an act of creation but an act of duplication.

Dr. Fiorino opposes human cloning because, for him, cloning does not offer cure, or the fulfillment of the *mitzvah* of *peria u-revia,* as well as the other reproductive techniques. In fact, cloning could raise the risk after hormone stimulation of ovarian cancer. For him, cloning will change the structure of the family, developing a special parent-child relationship between genetically identical individuals. Dr. Fiorino argues this will create different types of new *halakhic* relations in the family. His other concerns are economic, where people could clone themselves for monetary gain. In summary, Dr. Fiorino is not in favor of cloning from a moral standpoint.

Another opinion I would like to bring is from Dr. Feige Kaplan.[326] In her article, Dr. Kaplan shows skepticism with human cloning. She recognizes some Jewish

[326] Kaplan, Ph.D. F, pages 225-235, Sept 2000. She is Associate Professor of Human Genetics and Pediatrics at McGill University. Dr. Kaplan is the Director of Population Screening Programs for Tay-Sachs Disease and 0-Thalassemia at the Montreal Children's Hospital and is responsible for Curriculum in Genetics at McGill University Medical School.

authorities are in favor of cloning.[327] To this end, she cites *Tiferet Yisrael* on the commentary on the Mishnah saying:

> Anything for which there is no reason to forbid is permissible with no need for Justification, for the Torah has not enumerated all permissible things, rather forbidden one.[328]

Dr. Kaplan also cites Rabbi Pinchas Lipner who states: "Jewish medical ethics is basically Jewish *Halakhah*. What is ethical in Judaism is legal, and what is legal is ethical. We don't divide the two. Anything which is legal (e.g., cloning) is ethical."[329] Her skepticism is founded on several points: Would human cloning violate a moral right to unique genetic identity? What would be the impact of human cloning on the structure family? How would cloning effect human diversity, and would we abuse of eugenics (how would the genetic parent is chosen)? One very important concern is about the safety of attempting to clone human beings. All theses concerns make Dr. Kaplan be skeptical: she realizes the benefits these techniques bring to humanity, but on the other hand, she realizes the danger these procedures carry.

To sum up, in Orthodox Judaism it is clear, in general, that all authorities, rabbis and doctors, agree that therapeutic cloning is *halakhically* acceptable it because helps to

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[327] Hirschberg, P.. "Be Fruitful and Multiply and Multiply and Multiply," *The Jerusalem Report,* pages 32-36 April 16, 1998.

[328] Lipschutz, Rabbi E.. *Tiferet Yisrael,* commentary to *Yadayim* 4:3. Also in Hirschberg, page 33.

[329] From taped lecture of Rabbi Pinchas Lipner, "Human Cloning—is it *Halachically* Permissible?" at the Ninth Annual Conference on Jewish Medical Ethics (San Francisco, February 13, 1998). Tapes of the Conference are made available through the Institute of Jewish Medical Ethics of the Hebrew Academy of San Francisco.

cure and to save lives. Regarding reproductive human cloning, the opinions are more diverse. Some authorities forbid the use of reproductive human cloning arguing religious and moral reasons. Others rabbis and doctors argue that because it is not forbidden by the *halakha* and will help the humanity, human cloning will be an acceptable technique that, of course, will be morally controlled.

Conservative Movement's Position on Cloning

In June 1997, President Bill Clinton asked a commission of people (scientist and clergy) serving on the National Bioethics Advisory Commission to study the subject of human cloning and prepare a report of recommendations. Representing Judaism was Rabbi Eliot Dorff, who belongs to the Conservative Movement. In this report, Rabbi Dorff is speaking to a **general audience** and not a specifically Jewish one.

The report in the section of religious traditions considers the religious positions regarding the topic and uses the metaphor of a traffic light to compare and to analyze all the traditions. Regarding Judaism, the light is amber, which indicates the need to proceed with caution and care, slowing the pace or stopping research as necessary. This policy reflects the need for regulation by relevant professionals. For human cloning, it is a flashing red light, which indicates the need to stop to evaluate

risks before proceeding. There is a temporary moratorium until important scientific and social questions are addressed.[330]

The report says that from a Jewish perspective, man is a partner with God in the mission to perfect the world. But regarding cloning, from a Jewish perspective the subject "is troubling because of the prospect that the mandate to master nature will be transformed into mastery over humans. The Jewish understanding of the self entails that persons are more than their genotypes." The report argues that thinking about cloning implies remembering what happened in Nazi Germany with the use of eugenics programs carried out on European Jewry.

Under "An Ethic of Responsibility," the report says that Judaism is committed to preserve human life, therefore it is possible to support cloning for a therapeutic reason, or for a genetic disease or condition, such as infertility, that besets an individual or couple. But as the report says, " Many proposals for human cloning do not meet these conditions of underlying disease, therapy, and individual benefit." [331]

The report also mentions another issue previously discussed, as Rabbi Dorff says, "human cloning raises a danger of self-idolization. Through sexual intercourse and the raising of children, human beings are confronted with the inescapable 'otherness' of persons. This otherness enables the development of humility and the

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[330] National Bioethics Advisory Commission. " Cloning Human Beings," (*Report and Recommendations),* Rockville, Maryland, June 1997, pages D-29, 30.
[331] *Ibid.*

authenticity of 'I-Thou' relationships. These characteristics curb human hubris and self-idolization."[332]

Another problem the report mentions is linked to parenthood and the responsibilities of lineage. Human cloning will cause changes in the family relationship, in its structure and roles; It would be unclear who has responsibilities to whom between and among the generations. And the report adds that according to Rabbi Tendler, "We do not live well with generational inversion" that might be induced by cloning.[333]

Regarding the status of a clone, the report refers, as I have also discussed, to the *golem*. It says that the *golem* it is not considered to have human status and it can be destroyed. But the report also says, "Were a human clone to be actually produced from biomedical research, there is rabbinic consensus that the clone would have human status, and the imperative to protect life would require protection and care for clone."[334] I think this statement is very important because it opens the possibility to human cloning and it is radically different from other traditions that did not think even about it.

Regarding cloning research, the report says Jewish scholars are cautious of a public policy prohibiting cloning research because such a ban could violate the command of mastery and interfere with valuable scientific research. The report says it is

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[332] *Ibid.*
[333] *Ibid*
[334] *Ibid*

important to continue because human cloning could bring potential benefits to humanity. Specially, the report shows that, in Judaism, the human embryo does not enjoy full moral status, which means research can be warranted. Still, in any case, the command to do not harm has to be fulfilled.

The report finishes by saying, "Jewish scholars support extensive consideration by the Jewish community of the ethical and social issues pertaining to human cloning. Rabbinic discussion does express fundamental concerns about the potential modification of human life through cloning. Insofar as cloning, coupled with capitalistic motivations, transforms the person into a product or fungible commodity, it would violate the sacred character of human life."[335]

This report is basically made by conservative and traditional rabbinical authorities, which made me think that their beliefs are expressed. On the other hand, the reform movement stands in a more permissible path regarding therepeutical and reproductive human cloning.

[335] *Ibid*

Reform Movement's Position on Cloning

Up until now there are no official Reform responsa to human cloning in general (therapeutic and reproductive), and the goal of this thesis is to present ideas toward such a response. But there is a reform responsum regarding stem cells.[336] A Reform responsum is a *halakhic* document, based upon *halakhic* sources. Stem cells, as I have discussed before, are cells that have the capacity of being undifferentiated and becoming any type of cell. Their specific function remains unspecific until they receive a signal to develop into a specialized cell.

Even though stem cells are not the same as human clones, some of the conclusions of the stem cell responsum can be applied to cloning:

"1. The practice of medicine is a *mitzvah*, partaking of the duty to save life. Because medicine is an experimental science, the *mitzvah* of medical practice includes medical research as well as the direct treatment of patients. For this reason, we are encouraged by the dramatic therapeutic prospects offered by research into human stem cells." [337]

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[336] **Http://www.ccarnet.org/cgi-bin/respdisp.pl?file=7&year=5761** CCAR Responsa. "Human Stem Cell Research," 5761.7

[337] *Talmud Babli, Pesachim* 25a-b; *Yad*, Yesodei Hatorah 5:6. Also, *Talmud Babli, Bava Kama* 85a, a *midrash* on the words *rapo yirapei*. Also, Maimonides (*Commentary to the Mishnah, Nedarim* 4:4), who learns that medicine is a *mitzvah* from Deuteronomy 22:2 (*vaha she voto lo*), which the Talmud (*BT* Sanhedrin 73a) reads as implying a duty to rescue. Medicine, again, becomes an obligatory and not merely a permitted practice. *Torat Ha'adam*, ed. H.D. Chavel (Jerusalem: Mosad Harav Kook, 1964), 41-42. Also, we have a positive duty to save

"2. All human life, including prenatal human life, possesses an inherent sanctity that requires our respect and honor and that conflicts with the demand that we destroy it for our own purposes, even medical purposes."

"3. The fetus is not a *nefesh*, a full legal person. Abortion is therefore permitted for reason of the life or health of the mother. It is *not* permitted in order to obtain fetal tissue for medical research. The tissue of fetuses that have been aborted for morally justifiable causes, however, may be utilized in that research."[338]

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the lives of those who are in danger is derived from Lev. 19:16 ("do not stand idly by the blood of your fellow"); Also, in Talmud Babli, *Sanhedrin* 73a; *Yad*, Rotzeach 1:14; *Shulchan Arukh Choshen Mishpat* 426. That this obligation outweighs virtually all other duties imposed by the Torah is derived in Talmud Babli, *Yoma* 85b, from a midrash on Lev. 18:5; see *Yad*, Yesodei Hatorah 5:1 and *Shulchan Arukh* Yore De`ah 157:1. Even if the Talmud does not explicitly identify medicine with *pikuach nefesh*, Ramban notes that the *halakhic* literature does require that the laws of Shabbat and Yom Kippur be set aside when, in the opinion of a physician, their observance would endanger life. Also, Talmud Babli,Yoma 8:5-6 and 83b; these rules are summarized in *Shulchan Arukh Orach Chayim* 328-329 and 618. Also, in *Tur* and *Shulchan Arukh*, *Yore De`ah* 336:1.

[338] *Yad*, Rotzeach 1:9. On the law of the *rodef*, which the Rabbis derive from Leviticus 19:16 ("do not stand idly by the blood of your fellow"), also, in *Talmud Babli*, *Sanhedrin* 8:7 and 73a. Also, *Sanhedrin* 72b, *s.v. yatza rosho*. Also, in *Teshuvot for the Nineties*, no. 5755.13, pp. 171-176. This conclusion is shared by the *Sefer Me'irat Einayim*, *Choshen Mishpat*, no. 8; *Tiferet Yisrael* to *M.* Ohalot 7:6; *Chidushey R. Akiva Eiger*, *M.* Ohalot 7:6; and *Arukh Hashulchan*, *Choshen Mishpat* 425, no. 7. Rashi's is the better interpretation because it fits with the Mishnah's use of the word *nefesh* to describe the infant upon its emergence from the womb and not prior to that point; clearly, the fetus *in utero* is not a *nefesh*. Rambam's *rodef* explanation is difficult: if it is permissible to destroy the fetus because its birth endangers the mother's life, why are we no longer permitted to destroy it when its head or major part has emerged from the womb? Does it not continue to endanger her life? Rather, the distinction must be based upon a difference in status between fetus and mother. So long as it is *in utero*, the fetus is not a full legal person; hence, in a conflict between fetus and mother, the latter, who *is* a *nefesh*, takes precedence ("her life comes before its life"). Once it has emerged, the fetus becomes a *nefesh-i.e.*, a day-old infant, a full legal person-and has a claim to life equal to that of the mother. Also, in A.S. Avraham, *Nishmat Avraham* 3, 220-222, for a summary of views. Most Orthodox *poskim* during the preceding century and more have taken the position that abortion is forbidden *de'oraita*, as a matter of Torah law. Among these is R. Issar Yehudah Unterman, *Resp. Sehevet Miyehudah* 1:29, who defines feticide as an "appurtenance" (*avizraiya*) of murder, that is, as murder in all but name. Others, however, see the prohibition as *derabanan*, based upon Rabbinic law; see, for example, R. Ben Zion Ouziel, *Resp. Mishpetei Ouziel*, *Choshen Mishpat* 46

"4. The legal status of the embryo that exists outside the womb is inferior to that of the fetus. There is no duty to save it from death; nor is there an explicit prohibition against its destruction. For this reason, it is permissible to discard the excess embryos created as part of the procedure of in vitro fertilization and, by extension, to use them for purposes of stem cell research. If we may destroy some embryos in order to derive stem cells for the sake of that research, it is certainly permissible for scientists to make use of the already existing lines of stem cells in possession of scientists." [339]

"5. It is not permissible to create embryonic human life for the purpose of destroying it in medical experimentation. It *might* be permissible, however, to create and destroy embryonic human life in order to derive stem cell material that would be used as medical therapy for actual patients. The development of such therapies, if it ever occurs, lies in the distant future. In the meantime, it is incumbent upon all of us to continue to study, consider, and debate the moral implications of this promising new avenue of medical research."

These conclusions say that medicine is a *mitzvah,* that all human life must be respected and honored, that the fetus it is not a *nefesh* and until forty days the fetus is considered *mayim be alma* (mere water) and can be destroyed if necessary.

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[339] *Talmud Babli, Yevamot* 69b. Also, in R. Waldenberg's quotation is from his *Resp. Tzitz Eliezer* 7:48, ch. 1 (pp. 190-191). Also R. Ya`akov Emden, *Resp. Chavat Ya'ir*, no. 31; R. Chaim Ozer Grodzinsky, *Resp. Achiezer* 3:65 (end); and R. Yechiel Ya`akov Weinberg, *Resp. Seridey Esh* 3:127 (p. 341). R. Moshe Feinstein, *Resp. Igerot Moshe*, Choshen Mishpat 2:69. Ramban (*Torat Ha`adam*, ed. H.D. Chavel, 29) makes this very point. CCAR Responsum 5757.2, section 4.

Finally embryonic human life can be destroyed if necessary, it is forbidden to destroy them without any reason. As I have said all these conclusions can apply to human cloning. This means that probably clone embryo would be destroyed if there would being implanted, but it would be forbidden to create them just for destruction.

One of the reform rabbis who wrote about human cloning is Rabbi Peter Knobel.[340] One of the points Rabbi Knobel made is that nowadays the *halakha* has to be progressive, which means *halakha* must be able to address any scientific advancements and the *halakha* must foresee what is obligatory *(hovah)*, permissible (*reshut*) and forbidden (*assur).*

Rabbi Knobel analyzed in his article the status of the *golem,* and he cites Dr. Walter Jacob's article.[341] He also emphasizes the positive contributions of genetic engineering, cloning artificial embryonisation, artificial insemination, and in vitro fertilization, while recognizing that darker purposes for science always remain.

Also, Rabbi Knobel recognizes Judaism's belief in scientific experimentation when it is morally neutral, and therefore demands the researcher to be responsible with the investigations.

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[340] Knobel, Rabbi P, 1998. He was born in Newark, New Jersey and educated at Hamilton College, HUC-JIR, and Yale. He is senior rabbi of Beth Emet, The Free Synagogue, Evanston, Illinois. He chairs the Liturgy Committee of the CCAR.

[341] Jacob, Rabbi W., pages 32-34 February 1978 (1987).

One of Rabbi Knobel's thought's with which I totally agree is that for Reform Judaism, *tikkun olam* means, "We will use our God-given talent as being created in the divine image to correct the flaws and repair the fissures in creation. Our creative ability is what we share with God." The ability to create, through cloning, may be a way to contribute to *tikkun olam*.

Rabbi Knobel discusses, how therapeutic cloning will be for humanity. He gives the example of a couple who conceived a baby for the purpose of providing a bone marrow transplant to an older child. This is an act of *pikuach nefesh*. They bring the child into the world to save a life, and cloning could also be perceived in this manner. Also, he mentioned that for people in need of transplants it would be wonderful, to clone a single organ that was a perfect match. Rabbi Knobel cites the London *Jewish Chronicle,* which quotes Orthodox authorities as stating cloning is not prohibited by the *halakha* and Lord Jakobovitz speaking positively of the possibility of cloning single organs. This tells us that even though some Orthodox authorities do not agree with therapeutic human cloning, others support it.

Following the idea of therapeutic cloning, as rabbi Knobel mentions, it would be controversial to clone an embryo, use it and then abort it. That is why Rabbi Knobel writes in the article's notes that the status of the fetus as potential rather than actual life as well as the time of the abortion would be factors. He says that having parameters for knowing good from bad results would be important.

Rabbi Knobel concludes by saying cloning most likely will not be the best answer to the problem of childlessness, but because *peru urevu,* procreation, is an important commandment, **cloning would be permitted**. Rabbi Knobel says clearly, however, that moral and ethical issues would have to be continuously addressed.

The opinions of Rabbi Knobel are shared by the majority of Reform rabbis and doctors. But there are some Reform authorities who disagree with reproductive human cloning. On is Dr. Harvey L Gordon.[342] Dr. Gordon writes that for him, "human cloning –genetic replication–is not just another means of assisted reproduction." He says, "It is nothing new for Reform Jews to look beneath the surface for the deeper meaning of *mitzvot.* Words like, *Peru urevu*— Be fruitful and multiply," must be studied and contemplated 'in order to understand their meaning." For him, God creates us in his image; therefore, each human being unique. For Dr. Gordon, *genetic diversity* is an important part of God's plan, so human cloning does not fulfill the obligation of *peru-urevu.* I wanted to bring his comments to this chapter to show that Reform Judaism supports diversity.

To summarize what the three main movements in Judaism believe, I would like to quote an article in *The Jerusalem Report* regarding human cloning. After reporting the Vatican disagrees with the subject, saying that human cloning is "playing God," the article says (emphasis mine):

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[342] Gordon, M.D, H., pages 13-16, Summer 1998.Chair, UAHC, Bioethics Committee

> But experts on Jewish medical ethics are much less unnerved. In principle, say the rabbis and doctors who spoke to The Jerusalem Report, **human cloning is acceptable under *halakhah*, Jewish religious law**. It poses no danger to the distinction between God and human, no threat to the divinity of Creation. **The consensus crosses denominational lines, with top Reform and Conservative bioethicists joining Orthodox colleagues** in approving the procedure in principle.[343]

From this article we can learn that even though we, as Jews, throughout our history have disagreed a lot, it seems from the impressions of this magazine, there is in general a consensus, regarding human cloning. Of course, as I have discussed there are some religious authorities that disagree. While other religions and cultural traditions do not allow in some cases, cloning or even embryonic research, Judaism does.

I have discussed artificial insemination, in vitro fertilization and human cloning from a Jewish perspective. As a preamble to my next and final chapter where I will express my thoughts and my learning regarding these issues, I would like to cite Rabbi Walter Jacob in his responsum on Genetic Engineering (emphasis mine):

> As we learn more about the nature of genetic engineering we must discuss its moral implications both with regard to animals and human beings. We realize that the line between plants, animals, and human beings is thin and in some ways does not exist at all. So **we must proceed with caution**. In consort with others we must set limits and provide direction. We have, of course, **become especially sensitive to all of these issues since the Holocaust and the terrible medical experimentation, which occurred during the Holocaust.**

[343] Hirschberg, P., April 16,1998.

> We may be ready to accept genetic changes made for medical purposes and experimentation as *pikuah nefesh* is an overriding consideration.[344] **Human life must be saved if it is at all possible and even some pain to animals is permitted for this purpose**. Economic reasons, however, could not justify such a course of action. These should always be reviewed carefully."[345]

Having said that, I will proceed with my conclusions, drawn from the Jewish and medical knowledge I have acquired regarding this important and "hot" topic— human cloning.

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[344] *Talmud Babli, Shabbat* 132a; *Yoma* 85b; *Tosefta Shabbat* 17 and *Alfasi; Shulhan Arukh Orah Hayim* 328.1; *Hatam Sofer Responsa Hoshen Mishpa* t #185.

[345] Jacobs, Rabbi W. "Questions and Reform Jewish Answers"; (*New American Reform Responsa,)* CCAR, pages 247-252, 1992.

CHAPTER IV: Conclusions

I described the medical methods that involve cloning; then I discussed the Jewish answers to the reproductive techniques such as artificial insemination (AIH/AID) and in vitro fertilization, then I discussed the Jewish articles that analyze human cloning from a therapeutic and reproductive standpoint. With all this information, I will give a Jewish *halakhic* Reform answer to reproductive human cloning.

One of our earliest sources, *Sanhedrin* 65b, teaches that our ability to create is limited only by our immorality.

> Rabba said, if the righteous desire it they could create worlds, for it is written, "But your iniquities have distinguished between you and your God (Isaias 59:2) Rabba created a man and sent him to Rabbi Zera. Rabbi Zera spoke to him (the artificially created man) but received no answer. Thereupon he (Rabbi Zera) said to him (the artificially created man); You are from the companions. Return to your dust. Rabbi Hanina and Rabbi Oshaia spent every Sabbath studying the *Sefer Yetzirah* (The Book of Creation) by means of which they created a third grown calf which they ate.

As I have discussed before, this passage shows us that was very little written about artificial people in our sources, our sages had ideas about artificial people. Also, the sources always can be interpreted in different ways according the scholar and according the time. Having said that, there is no objection in our sources to human cloning in general and, specially, to reproductive human cloning. As some of the authorities in the former chapter said, when something is not forbidden, it is permitted. This is one my main conclusions why human cloning must be permitted.

Almost all authorities agree about allowing therapeutic human cloning, so I will concentrate my views on reproductive human cloning.

I am aware of why people are against human cloning and of their reasons. That is why, with my respect for them, I will argue their points in this chapter.

As I have discussed in this thesis, Judaism, teaches that medicine must do what ever it is necessary to cure a human being. That is why I do believe that therapeutic human cloning should be practiced. Some of the reasons are:

- Therapeutic human cloning genetic knowledge, it is obtained from the genome project, which does not violate the Torah by undermining God's creation of the world, as Ramban explained in Leviticus 19:19.

- Human cloning will help people in cases of rejections of organ transplants, diabetes and other diseases.

- The benefit related to transplants would be that creating people with similar immune systems will help in cases where they could serve as organ donors for each other. The same could be true in cloned animals with suitable characteristics for use as organ donors.

- Diseases such as Parkinson or Alzheimers will benefit from human cloning. This will happen by renewing the function of damaged cells, or by replacing dead cells with others.

- Human cloning will help to stop the uncontrolled reproduction of cancerous cells, curing different types of cancers.

I believe that Reform Judaism should be in favor to reproductive human cloning. Why?

- Reform Judaism must answer the new questions of science with a progressive approach. In this case, the answers are progressive in scientific realm, with caution.

- We will help infertile families to fulfill the *mitzvah* of *peru urevu.*

- As I have discussed before, artificial insemination and in vitro fertilization are already accepted, and cloning for reproductive will simply be another technique available.

- Human cloning will use cells that already exist in the natural reproduction process. Embryo cloning pulls apart a zygote at the two-cell stage and

creates two one-celled organisms. This is the base of the technique that I have already discussed.

- A human clone will not have the same feelings and emotions of his/her parents. Since environment and education play important roles in shaping one's personality, a clone would be different from his or her genetic donor.

- Human cloning is not a forbidden interference in nature when it is used **only** to benefit human beings.

- For *halakhic* people, human cloning will not involve any danger of *mamzerut,* but when the time comes it will important to deal with *halakhic* questions regarding fatherhood and motherhood.

- A human clone would be as "human" as an identical twin because both are derived from a single fertilized egg. Like a twin, a clone will have its own soul.

- Human cloning does not imply we do not believe in God as the creator of the universe. Human cloning is a technological innovation, and a response to the knowledge that God gives us.

- Human cloning will not involve "playing God." The technique does not involve the creation of life from "nothing." Human cloning will produce life

from existing life. That is why human cloning could be seen as an extension in-vitro fertilization.

- Someone who is dead cannot be cloned. All current techniques to clone an adult cell use the method of nuclear transfer, which requires the donor cell to be alive. This means genius or evil people that passed away, could not be cloned.

Therapeutic and reproductive human cloning shared these reasons:

- Reform Judaism always thinks about human prosperity ahead of *halakha*.

- As I have explained, it is not forbidden by the *halakha*.

- Helping people, done morally, seriously and with equal opportunity, is good.

- There are Orthodox authorities, like Dr. Steinberg and Rabbi Broyde, that use *halakha* to support cloning, so if we wanted to find *halakhic* support, we could.

- The comments of Ramban regarding Genesis 1:28 could help us to understand and support cloning. He taught that God command Adam to

conquer the earth and gave him power and control on earth to do as he wishes with the animals and insects and everything, which crawls on the earth, and to build, to uproot what is planted, to quarry copper from the mountains. The use of scientific knowledge to benefit humankind is biblically mandated. When this information is used to heal illness and cure disease, it is the best use of scientific knowledge.

- The act of human cloning, helps to "perfect the world" and it is a *mitzvah*. The cost of improvement must have a benefit that exceeds the damage it will cause. Hopefully, this will happen.

- Reform Judaism must answer the new questions of science with a progressive approach. In this case, the answers are progressive in scientific realm, with caution.

These are my reasons why I believe Reform Judaism has to support science and of the human cloning project. I do recognize some of the rejections and fears some authorities have, such as:

- The risks of producing serious birth defects in human cloning are not known.

- The use of mature cells with better capacities to develop into a complete organism with also unexpected changes that will be passed to next generations. This means, the creation of immortal human beings.

- The creation of a market where people will ask for specific physical characteristics like eye color, IQ.

- Environmental problems with clones caused by higher mobility and mortality.

- The possible creation of eugenic techniques to duplicate terrible personalities that have made the human beings as animals without hearts like in the Nazi Germany period.

- The productions of armies of clones like some science fiction movies have shown.

These are some of the reason why people disagree with human cloning. I must say that the positive reasons far outweigh the negative opinions. I am aware that Judaism tries in most cases where scientific and social advancement are uncertain to move with caution, and this is the way it should be. But it is important to keep in mind the Jewish principle that all the reproductive techniques share: "Anything there

is no reason to forbid is permissible, and needs no justification. For the Torah has not enumerated all permissible things, rather forbidden ones."[346]

As has occurred throughout human history, people and institutions—for political, religious, moral reasons—have tried to stop or to be very resistant to any new scientific advancement. Examples of scientific pioneers who have experienced this resistant include Galileo, Copernicus, Colon, and many others. The same could happen with human cloning. Today, however, different groups of scientific people are working with human cloning. Unlike the science of yesterday, human cloning is not a delirium or a mere possibility or a dream. It is reality for the present or near future. Eventually, human cloning will be developed. In the year it has taken to write this thesis various news reports showed how many scientists took ownership of being the first to clone a human baby. At this point no scientific group has completed any work that seems to be serious, but I am sure that it will happen.

Speaking about institutions and countries, it is important to remember that only England and Australia allowed *in vitro* fertilization when it first become viable almost twenty years ago. The United States did not agree at that time with *in vitro fertilization.* At present, this technique is used in United States and in the whole world among Jews and non-Jews, helping a lot of couple that suffer from infertility. Today, many nations have banned human cloning and other forms of biomedical research that will lead to human cloning. This practice only repeats the negative

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346 *Tiferet Yisrael, Yadayim,* 4: 3.

experiences of the past, when scientific breakthroughs were delayed because of the resistance of people in power.

Today, in the United States Congress, the Bond-Frist bill and the Ehlers bill go far beyond restricting the cloning of humans. Both decisions would put a stop to all cloning experiments that use human cells. This is the first time in history that the Congress has passed legislation to halt a single kind of scientific or medical research.

I do believe that Reform Judaism has to stop this moratorium against human cloning and stem cell research. Reform Judaism must support science because Reform Judaism supports any way to improve the world. Reform Judaism must deliver a clear massage against that moratorium explaining why we are not "playing God." Reform Judaism, being pro-choice for abortion, must prevent illegal cloning in the future. It seems this moratorium was influenced by a different religious influence in the government, and this can only end up being negative for Judaism on the whole. That is why Reform Judaism has to stand up to political opponents of cloning and genetics.

While I take the objection to human cloning very seriously but I do not think, a moratorium it is a solution. It is not good to cover our eyes when something happens. Genetic technology exists, therefore it is important to see what are the benefits instead of the disasters.

As many authorities have done before me, I would like to propose that investigations on cloning animals should continue so that science will learn more about genetic engineering and apply this knowledge to medicine. Of course, cloning research with human tissue should be carefully supervised and regulated by governments. I believe an international committee, should regulate the medical, ethical, religious and moral conditions under which an embryo or a clone blastocyte would be implanted into a womb. This happened with DNA technology in the seventies and eighties, and nowadays, the world has seen the benefits. Probably, if the research continues, human cloning will be used for cases of severe infertility and or to correct genetic defects in children.[347] This outcome will equal or even exceed the parallel success of DNA technology.

I recognize also that for some *poskim*, cloning presents major problems related to issues of *derekh ha-teva*. Also, the social implications of human cloning could arise. As I have discussed before, there are no clear biblical or Talmudic precedents. Even though *peru urevu* is a *mitzvah,* in the future cases where the genetic donor—the clonor— is a man, he will not be obligated to do that, he will be no under religious obligation as I have discussed regarding artificial insemination. Human cloning seems to be a topic where in general Judaism agrees: It would be a good opportunity for Orthodox, Conservatives, Reforms, and Reconstruccionist Jews to come together and come up with a joint responsum to the world.

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[347] Steinberg, M.D. A. and Loike, PhD, J.D., pages 31-46, 1998.

I started this thesis with an account about Dolly, the first mammal cloned from an adult cell. This feat occurred in 1996, although her birth was not announced until 1997. On February 14,2003, the Institute Roslin of Edimburgo (Scotland) announced that Dolly was put down due to the pulmonary disease she suffered. The ewe had been born with chromosomic anomalies and last January underwent very premature arthritis for her age. This teaches that cloning is not perfect; it does not create immortal beings and science has to continue in its learning process.

In *Pirkei Avot* (2:21), it is written: "You are not obliged to finish the task, neither are you free to neglect it." I am accustomed to finish that teaching with "*Ela leatchil.*" This means that we do no have to wait to start. Human cloning will become reality in the close future that we, and we, as Jewish people, must set our sights on it. Judaism must give a response fitting the reality of the twenty-first century. We searching our sources, and when we do not find precedents, we use our knowledge and wisdom as our sages did. A dynamic *halakha* will help to find answers to difficult issues. Even though these answers may not be obvious, we have a responsibility to the Jewish people as rabbis and a responsibility to the world as human beings to create a better world. We need to use our best capacities to come up with an answer. This is the goal of this thesis, and I feel very proud, after searching and studying precedents in the topic of in vitro fertilization and artificial insemination, and after studying the major works published until the present about human cloning, to come up with an answer I believe Judaism should adopt—in support of science and therapeutic and reproductive human cloning.

I hope that humanity will have the capacity to continue allow the investigation of this topic. I wish we would use these procedures for our own well-being, for cures and to help people who suffer. I pray that God will illuminate the whole world with more knowledge and will inspire people to create and not to destroy, living in peace.

APPENDIX: Interview by email with Dr. Jose Cibelly[348] and personally with James M. Robl, Ph.D.[349]

1. What are new developments about cloning since Dolly?
[Jose Cibelli] Cloning of other species from somatic cells such as: Cow, pig, goat, mouse, cat and rabbit.

2. Can the procedure that produced Dolly be carried out successfully in other cases?
[Jose Cibelli] Absolutely.

3. Are there true species differences in the ability to achieve successful nuclear transfer?
[Jose Cibelli] No much.

4 Will the phenomenon of genetic affect the ability of nuclei from later stages to reprogram development?
[Jose Cibelli] Perhaps, this is still subject of further investigation; there are clear differences between cell types in the body.

5. Will cellular aging affect the ability of somatic cell nuclei to program normal development?
[Jose Cibelli] no.

6.Will the mutations that accumulate in somatic cells affect nuclear transfer efficiency and lead to cancer and other diseases in the offspring?
[Jose Cibelli] This is unknown; I suppose we can always check for mutations before the procedure is done.

7.Why pursue Animal Cloning Research?
[Jose Cibelli] Mainly economic and medical reasons, we are trying to produce animals that have a superior genetic value and also animals that produce human therapeutic proteins at low cost (transgenics).

8. Do you work with Ethics Committees and have you got any disagreement?
[Jose Cibelli] ACT has its own ethic advisory board; we do not use any protocol that the board does not approve (see www.advancedcell.com).

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[348] Cibelly, M.D. Ph.D, Jose. He is the vice-president of a biotechnology company named Advanced Cell Technology. http://www.advancedcell.com/default.html

[349] Robl, Ph.D, James M. He is President, CSO, Director and Co-Founder of Hematech, LLC. Also, Dr. Robl is a former professor at the University of Massachusetts for 15 years. Dr. Robl joined Hematech in 2000. He is internationally known for his cloning work and was the first scientist to clone a transgenic cow in January 1998. http://hematech.com/hematech/team/executives.asp

9. Do you agree with Therapeutic Cloning and in which way it could help Medicine? Which are the potential therapeutic applications of nuclear Transfer Cloning?
[Jose Cibelli] Yes I agree with it. It has three mayor advantages over current cell therapy approaches:
1- It will generate unlimited number of cells of all the cell types the human body has.
2- these cells will be 100% compatible with the patient.
3- cells will be rejuvenated.

10. Do you agree with Reproductive Cloning? Do you agree with Cloning Human Beings?
[Jose Cibelli] Not at the moment. This technique is highly unreliable and can jeopardize the lives of the baby and the mother.

11. Are there any researchers that are working with Reproductive Cloning?
[Jose Cibelli] Not to my knowledge but I wouldn't be surprised if they are doing it in silence.

12. Is Dolly still alive? if not what can be done so other experiments will be better?
[Jose Cibelli] Yes she is

Once again thank you very much.
[Jose Cibelli] Good luck and sorry for the delay on answering.

GLOSSARY OF CLONING TERMS

From the National Academies Report
Scientific and Medical Aspects of Human Reproductive Cloning

Adult stem cell - An **undifferentiated** cell found in a **differentiated** tissue in an adult organism that can renew itself and can (with certain limitations) differentiate to yield all the specialized cell types of the tissue from which it originated.

AI - See **Donor insemination**

Amniocentesis - A prenatal test performed by inserting a thin needle through the abdomen into the **uterus** and withdrawing a small amount of amniotic fluid (the fluid around the **fetus**) for laboratory testing. The fluid contains skin, kidney, and lung cells from the fetus that can be tested for chromosomal abnormalities, and the fluid itself can be tested for biochemical abnormalities. Amniocentesis is usually performed during the 15th week of pregnancy or later.

Andrology - The science dealing with the structures, functions, and disorders of the male reproductive system.

Antigen - Any substance or molecule that is recognized by the body as 'foreign" and that stimulates a specific immune response when it enters the tissues of an organism.

ARTs - See **Assisted reproductive technologies**

Artificial insemination - See **Donor insemination**

Assisted reproductive technologies (ARTS) - Fertility treatments or procedures that involve laboratory handling of **gametes** (**eggs** and **sperm**) or **embryos**. Examples of ARTs include **in vitro fertilization** and **intracytoplasmic sperm injection.**

Autoimmune disease or **disorder** - A category of diseases and disorders in which one's own cells are mistakenly identified as "foreign" by the body and are therefore attacked by the immune system, causing tissue damage.

Blastocoel - The fluid-filled cavity within the **blastula**.

Blastocyst - A **preimplantation embryo** in placental mammals (about 3 days after fertilization in the mouse, about 5 days after fertilization in humans) of about 30-150 cells. The blastocyst stage follows the **morula** stage, and can be distinguished by its unique morphology. The blastocyst consists of a sphere made up of a layer of cells (the **trophectoderm**), a fluid-filled cavity (the **blastocoel** or **blastocyst cavity**), and a duster of cells on the interior (the **inner cell mass, or ICM**). The ICM, consisting of **undifferentiated** cells, gives rise to what will become the **fetus** if the

blastocyst is implanted in a uterus. These same ICM cells, if grown in **culture**, can give rise to **embryonic** stem cell lines. At the time of **implantation** the mouse blastocyst is made up of about 70 **trophoblast** cells and 30 ICM cells.

Blastocyst cavity - The fluid-filled cavity within the **blastocyst**, sometimes referred to as the **blastocoel**.

Blastomere - A cell from a **morula**-stage embryo.

Blastula - Term (often used in lower vertebrates) to describe an early stage in the development of an **embryo** consisting of a hollow sphere of cells enclosing a fluid-filled cavity called the **blastocoel**. The term blastula sometimes is used interchangeably with **blast cyst**.

Cell line - A general term applied to a defined population of cells that has been maintained in **culture** for an extended period and usually has undergone a spontaneous process, called **transformation**, that allows the cells to continue dividing (replicating) in culture indefinitely.

CGH - See **Comparative genomic hybridization**

Chimera - An organism composed of cells derived from at least two genetically different individuals.

Chorion - The outermost of the two membranes surrounding the **embryo/fetus**, part of which forms the fetal portion of the **placenta**.

Chorionic villus sampling (CVS) - A prenatal test performed by removing a small sample of the **placenta** from the **uterus** with either a catheter (a thin flexible tube) or a needle. The sample can be tested for genetic abnormalities. Chorionic villus sampling is usually done between the 10th and 12th weeks of pregnancy.

Chromosomes - Structures composed of very long **DNA** molecules (and associated proteins) that carry most of the hereditary information of an organism. Chromosomes are divided into functional units called **genes**, each of which contains the genetic code (instructions) for making a specific **protein**. A normal human body cell **(somatic cell)** contains 46 chromosomes; a normal human reproductive cell **(gamete)** contains 23 chromosomes.

Cleavage - The process of cell division in the very early **embryo** before it becomes a **blastocyst**.

Cleavage pattern - The pattern in which cells in a very early **embryo** divide; each species of organism displays a characteristic cleavage pattern that can be observed under a microscope. Departure from the characteristic pattern usually indicates that an embryo is abnormal, so cleavage pattern is used as a criterion for

preimplantation screening of embryos.

Clone - 1) An exact genetic replica of a **DNA** molecule, cell, tissue, organ, or entire plant or animal. 2) An organism that has the same nuclear **genome** as another organism.

Cloning - The production of a **clone**. (For the purpose of this report, generating an individual animal or person that derives its nuclear **genes** from a **diploid** cell taken from an **embryo, fetus**, or born individual of the same species.)

Comparative genomic hybridization (CGH) - A chromosomal screening technique that permits the detection of quantitative changes in chromosomal copy number without the need for cell culturing. It provides a global overview of chromosomal gains and losses throughout the whole **genome** (including extra, missing, and broken **chromosomes**), but cannot detect small changes in DNA sequence or change in the **imprinting** state of a **gene**.

Culture - Growth of cells, tissues or **embryos in vitro** on an artificial nutrient medium in the laboratory.

CVS - See **Chorionic villus sampling**

Cytoplasm - The contents of a cell other than the **nucleus**. Cytoplasm consists of a fluid containing numerous structures, known as organelles that carry out essential cell functions.

DI - See **Donor insemination**

Differentiated - Having **developed** into a specialized cell or tissue type

Differentiation - The process whereby an unspecialized early embryonic cell or **stem cell** acquires the features of a specialized cell, such as a heart, liver, or muscle cell.

Diploid - Refers to a cell having two sets of chromosomes (in humans, 46 chromosomes). In contrast, a **haploid** cell, such as a **gamete**, has only one set of chromosomes (23 in humans).

DNA - A chemical, deoxydbonucleic acid, found primarily in the **nucleus** of cells (some is also found in the **mitochondria**). DNA is the genetic material that contains the instructions for making all the structures and materials the body needs to function. **Chromosomes** and their subunits, **genes**, are made (primarily) of DNA.

DNA methylation -See **Methylation**

Donor insemination (DI) or **Artificial insemination (AI)** - Deposition of **sperm** from

a male donor inside a female reproductive tract for the purpose of achieving pregnancy.

EBs - See **Embryoid bodies**

EG cells - See **Embryonic germ cells**

ES cells - See **Embryonic stem cells**

Egg - The mature female reproductive cell.

Embryo - A group of cells arising from the **egg** that has the potential to develop into a complete organism. In medical terms, **embryo** usually refers to the developing human from **fertilization** (the **zygote** stage) until the end of the eighth week of gestation when the beginnings of the major organ systems have been established.

Embryo splitting - Separation of an early-stage **embryo** into two or more embryos with identical genetic makeup, essentially creating **identical twins** or higher multiples (triplets, quadruplets, etc.).

Embryoid bodies (EBs) - Irregularly shaped dumps of cellular structures that arise when **embryonic stem cells** or **embryonic germ cells** are cultured.
Embryoid bodies usually contain tissue from all three of the germ layers: endoderm, mesoderm, and ectoderm. Embryoid bodies are not part of normal development and occur only **in vitro**.

Embryonic germ (EG) cells - **Pluripotent stem cell lines** that migrate, during early development, to the future **gonads** to form the **progenitors** of **egg** or **sperm** cells. The properties of EG cells are similar e of **embryonic stem cells**, but may differ in the **DNA methylation** of some imprinted regions.

Embryonic stem (ES) cells - Primitive **(undifferentiated)** cultured cells from the **embryo** that have the potential to become a wide variety of specialized cell types, (that is, are **pluripotent**). They are derived from the **inner cell mass** of the **blastocyst**. Embryonic stem cells are not embryos; by themselves, they cannot produce the necessary cell types, such as **trophectoderm** cells, in an organized fashion so as to give rise to a complete organism.

Embryonic stem (ES) cell lines - Populations of dividing cells established from **embryonic stem cells** and cultured in the laboratory. Within embryonic cell lines are cells that can produce more embryonic stem cells or, under conditions of **differentiation**, give rise to collections of cells that include most or all cell types that can be found in a postimplantation embryo, **fetus**, or developed organism.

Enucleation - A process whereby the nuclear material of a cell is removed, leaving only the **cytoplasm**. When applied to an **egg**, the removal of the maternal

chromosomes, which are not surrounded by a nuclear membrane.

Epigenetic effects - Changes in **gene** expression that occur without changing the **DNA** sequence of a **gene**; for example, in the epigenetic effect called genomic **imprinting**, chemical molecules called methyl groups attach to DNA and "turn off" the gene's expression.

Extraembryonic tissues - Intrauterine tissues derived from the **zygote** that supports the **embryo** (for example, the **placenta**, the umbilical cord, and membrane such as the amniotic sac).

Fertilization - The process whereby male and female **gametes (sperm and egg)** unite.

Fetus - 1) Legally, refers to the developing organism from the completion of **implantation** in the **uterus** to the time of birth. 2) In medical terms, refers to the developing human from the end of the eighth week to birth. At the end of the eighth week, the **embryo** is 2.0-3.0 cm (0.8-1.2 in.) long and weighs 1-4.5 g (0.04-0.16 oz). The major organ systems (for example, the nervous and cardiovascular systems) and rudiments of limbs, fingers, and toes have formed.

Fibroblast - Cells that give rise to part of the connective tissue.

Fluorescence in situ hybridization (FISH) - A technique that can be used for **prenatal diagnosis**, in which specifically designed fluorescent molecules are used to "light up" particular **genes** or sections of **chromosomes** to make them visible under a microscope. The fluorescence makes even small abnormalities in the chromosomes visible.

Gamete - A reproductive cell (**egg** or **sperm**). Gametes are **haploid** (having only half the number of chromosomes found in **somatic cells** - 23 in humans), so that when two gametes unite at **fertilization**, the resulting one-cell embryo **(zygote)** has the full number of chromosomes (46 in humans).

Gene - A functional unit of heredity that is a segment of **DNA** in a specific site on a **chromosome**. A gene directs the formation of a **protein** or **RNA** molecule.

Gene expression - The process by which **RNA** and **proteins** are made from the instructions encoded in **genes**. Alterations in gene expression change the function of the cell, tissue, organ, or whole organism and sometimes result in observable characteristics associated with a particular gene.

Genome - The complete genetic material of an organism.

Genomic imprinting - See **imprinting**

Germ cell or Germline cell - A **sperm** or **egg,** or a cell that can develop into a sperm or egg; all other body cells a-re called **somatic cells**.

Germinal vesicle transfer - See **Oocyte nuclear transfer**.

Germline cell- See **Germ cell**.

Gestation - The period of development of an organism from **fertilization** of the **egg** until birth.

Gonad - The reproductive organ that contains the developing **sperm** or **eggs.** The mature male gonads are the testes, and the mature female gonads are the ovaries.

Graft-versus-host disease - A condition that occurs after tissue transplantation in which the donor-derived T cells attack the hosts tissues.

Haploid - Refers to a cell (usually a **gamete**) having only one set of **chromosomes** (23 in humans). In contrast, body cells **(somatic cells)** are **diploid**, having two sets of chromosomes (46 in humans).

Hematopoietic stem cell - A **stem cell** from which all red blood cells, white blood cells, and platelets develop.

Heteroplasmy - See **Mitochondrial heteroplasmy**.

Identical twins - See **Monozygotic twins**.

Implantation - The process by which an embryo becomes attached to the inside of the **uterus** (7-14 days in humans).

Imprinting - A process whereby **DNA** obtains biochemical marks that instruct a cell how and when to express certain **genes.** Imprinting often results in **gene expression** from only one copy of a gene - either the maternal or paternal copy.

In utero - Latin: literally, "in the **uterus**."

In vitro - Latin: literally, "in glass"; in a laboratory dish or test tube; in an artificial environment.

In vitro fertilization (IVF) - An assisted reproduction technique in which **fertilization** is accomplished outside the body.

In vivo - Latin: literally, "in the living" subject; in a natural environment.

Informed consent - A process in which a patient gives written consent (agreement) to undergo a medical procedure after having been provided with information about

the nature of the procedure, risks, potential benefits, alternatives, and so on by his or her doctor.

Inner cell mass - The cluster of cells inside the **blastocyst**. Before **implantation**, these can give rise to **embryonic stem cell lines**. After implantation, the inner cell mass gives rise to all the tissues of the **fetus**, as well as some of the membranes around it.

Institutional review board (IRB) - An administrative body in an institution (such as a hospital or university) established to protect the rights and welfare of human research subjects recruited to participate in research activities conducted under the auspices of that institution. The IRB has the authority to approve, require modifications in, or disapprove reseae(h activities in its jurisdiction, as specified by both federal regulations and local institutional policy.

Intracytoplasmic sperm injection - An assisted reproductive method in which a **sperm** is injected directly into an unfertilized **egg** with a microscopic needle; this procedure is used in cases of severe **male factor infertility**.

IVF - See **In vitro fertilization.**

Karyotype - The full set of **chromosomes** of a cell arranged with respect to size, shape, and number. This arrangement allows visual comparison of the chromosomes and identification of gross abnormalities (e.g. extra, missing or broken chromosomes).

Major histocompatibility complex (MHC) - A group of **genes** that code for cell surface **proteins** that plays a major role in histocompatibility (tissue compatibility; Latin: histo=tissue) in transplantation. Differences between the MHC proteins of a transplant donor and recipient are the major cause of transplant tissue rejection.

Male factor infertility - Condition in which a male patient is infertile for such reasons as very low **sperm** count, sperm that cannot swim properly, sperm that are unable to penetrate the **egg**, or blocked sperm ducts.

Meiosis - Cell division in the specialized tissues of ovaries and testes that results in the production of sperm or eggs, which contain half the number (23 in humans) of chromosomes found in somatic cells. During **fertilization**, the **nuclei** of the sperm and egg fuse to produce a **zygote** with the full number of chromosomes (46 in humans).

Methylation - A biochemical process involving the addition of chemical tags called methyl groups (-CH3) to **DNA**. Methylation can be a signal for a **gene** or a section of a **chromosome** to turn off **gene expression** and become inactive or "silent."

MHC - See **Major histocompatibility complex**.

Minor H antigens - See **Minor histocompatibility antigens**.

Minor histocompatibility antigens or Minor H antigens - A group of **proteins** (in addition to those encoded by the **major histocompatibility complex** (MHC) that can cause transplant tissue rejection. Minor H antigens can cause tissue rejection even when donor and recipient are matched for MHC. Immune response to minor H antigens is far less potent than response to MHC-encoded proteins, so the rejection is a slower process.

Mitochondria - See **Mitochondrion**.

Mitochondrial heteroplasmy - An atypical condition characterized by the presence of more than one type of mitochondrial **DNA** in a single individual. Normally, each individual has only one type of mitochondrial DNA, inherited from his or her mother through the **egg** at **fertilization**. (**Mitochondria** from the sperm are systematically eliminated by the egg at fertilization.)

Cloned organisms may exhibit mitochondrial heteroplasmy (having a mixture of mitochondria from both the donor cell and the recipient egg) because this elimination system may be bypassed during the cloning process.

Mitochondrion (plural, Mitochondria) - A cellular structure in the **cytoplasm** that provides energy to the cell. Each cell contains many mitochondria. In humans, a single mitochondrion contains 37 **genes** on a circular mitochondrial **DNA**, compared with about 35,000 genes contained in the nuclear **DNA**.

Monozygotic twins - Twins derived from one **egg** and one **sperm** (often called identical twins).

Morula - The **preimplantation embryo 3-4** days after **fertilization**, when it is a solid mass composed of 12-32 cells **(blastomeres)**. After the eight-cell stage, the cells of the preimplantation embryo begin to adhere to each other more tightly, becoming "compacted". The resulting embryo resembles a mulberry and is called a morula (Latin: morus = mulberry).

Multipotent stem cells - **stem cells** from the **embryo, fetus**, or adult, whose progeny are of multiple **differentiated** cell types and usually, but not necessarily, all of a particular issue, organ, or physiological system.

Mutation - A change in **DNA** that alters a **gene** and thus the gene's product, leading in some cases to deformity or disease. Mutations can occur spontaneously during cell division or can be triggered by environmental stresses, such as sunlight, radiation, and chemicals.

Nuclear transfer - A procedure in which a **nucleus** from a donor cell is transferred into an **enucleated egg** or **zygote** (an **egg** or zygote from which the

nucleus/pronuclei have been removed). The donor nucleus can come from a **Germ cell** or a **somatic cell**.

Nuclei - See **nucleus**.

Nucleus (plural, **nuclei**) - The compartment of a cell that contains the **chromosomes**.

Oocytes - The developing female reproductive cells (the developing **eggs**) produced in the ovaries.

Oocyte nuclear transfer or Germinal vesicle transfer - An assisted reproductive technique involving transfer of an **egg** nucleus (usually from a woman with age-related infertility or mitochondrial disease) into a healthy donor egg whose nucleus has been removed. This reconstituted egg can then be fertilized by a **sperm in vitro**. This technique may restore fertility to older women or to prevent the passing of mitochondrial disease to offspring.

Ooplasmic transfer - An assisted reproduction technique that essentially enhances the defective (egg **cytoplasm**) from the patients **egg** with healthy cytoplasm from a donor egg. This "enhanced" egg can then be fertilized by a **sperm in vitro**. This procedure may restore fertility to older women.

Parthenogenesis: In this technique a woman's oocyte is directly activated without the removal of its DNA to begin development on its own, forming a preimplantation embryo from which totipotent stem cells are isolated.

PCR - See **Polymerase chain reaction**.

PGD - See **Preimplantation screening**.

Placenta - A **vascular** organ-like structure that develops in the **uterus** during pregnancy, serving to anchor the **embryo** or **fetus** after **implantation**. The placenta enables oxygen and nutrients to pass from the maternal blood to the embryo or fetus. It also eliminates carbon dioxide and waste products from the embryo or fetus by passing them to the mother, who excretes them through her liver, kidneys, or lungs.

Pluripotent stem cells (PSCS) - **Stem cells** that include in their progeny all cell types that can be found in a postimplantation **embryo, fetus**, or developed organism.

Polymerase chain reaction (PCR) - A technique for making multiple copies of a specific stretch of **DNA** or **RNA**; can be used to test for **mutations** in DNA. For

example, if a stretch of DNA-is mutated, the copies of it made with the PCR can be longer or shorter than normal.

Precursor cells or Progenitor cells - In fetal or adult tissues, these are partially **differentiated** cells that divide and give rise to differentiated cells.

Preimplantation embryo - The very early, free-floating **embryo**, from the time the **egg** is fertilized **(zygote)** until the beginning of **implantation** (in humans, a peri6d-of about 6 days). Also includes embryos resulting from **nuclear transfer**, in all the developmental stages through the **blastocyst** stage.

Preimplantation screening or Preimplantation genetic diagnosis (PGD) Before an **in vitro-fertilized embryo** is implanted in a woman's uterus, it can be screened or specific genetic **mutations** that are known to cause particular genetic diseases or for chromosomal abnormalities. One or more cells are removed from the **preimplantation embryo** for testing.

Prenatal diagnosis - Detection of abnormalities and disease conditions while a **fetus** is developing in the **uterus**. Many techniques for prenatal diagnosis, such as **chorionic villus sampling** and **amniocentesis**, require sampling **placental** tissue or fetal cells found in the amniotic fluid or fetomaternal circulation. Others, such as **ultrasonography**, can be performed without cell or tissue samples.

Progenitor cells - See **Precursor cells.**

Pronuclei - See **Pronucieus**.

Pronucieus (plural, **pronuclei)** - Refers to the **haploid nucleus** of **egg** or **sperm** prior to **fertilization**, and immediately after fertilization, before the sperm and-egg nuclei have fused into a single **diploid** nucleus.

Protein - A large complex molecule made up of one or more chains of amino acids. Proteins perform a wide variety of activities in the cell.

PSC - See **Pluripotent stem cells**.

Recloning - See **Serial nuclear transfer**.

Reprogramming - Resetting the developmental clock of a **nucleus**; for example, resetting the developmental state of an adult **differentiated** cell nucleus so that it can carry out the genetic program of an early embryonic cell nucleus, making all the **proteins** required for embryonic development. In **somatic cell nuclear transfer**, components of the recipient **egg cytoplasm** are thought to play an important role in reprogramming the somatic cell nucleus to carry out the functions of an embryonic nucleus.

RNA (Ribonucleic acid) - A chemical that is similar in structure to **DNA**. One of its main functions is to translate the genetic code of DNA into structural **proteins**.

Serial nuclear transfer or Recloning - The first step of this technique is a normal **nuclear transfer**, in which a **nucleus** is transferred into an enucleated **egg**, forming a **embryo**. In the second step, a nucleus from the resulting cloned embryo is transferred info another enucleated egg or an **enucleated** zygote (a fertilized egg with both male and female **pronuclei** removed). The second step can be repeated one or more times. This technique allows the nucleus to have two (or more) opportunities to be **reprogrammed** by egg **cytoplasm** (one during the original nuclear transfer, and more during subsequent nuclear transfers), thus potentially improving the chance of successful reprogramming of the nucleus.

Somatic cell nuclear transfer (SCNT) - Transfer of the nucleus from a donor **somatic cell** to an unfertilized **egg** cell from which the maternal **chromosomes** have been removed. Basically, in this technique, commonly designated "Human Therapeutic Cloning" a patient's body cell is combined with an egg cell that has its DNA removed. As a result the body cell's DNA is reprogrammed back to an embryonic state, and totipotent stem cells are produced identical to the patient.

Somatic cell - Any cell of a plant or animal other than a reproductive cell or reproductive cell precursor. Latin: soma = body.

Sperm - Mature male reproductive cells.

Stem cells - Nonspecialized cells that have the capacity to divide indefinitely in culture and to differentiate into more mature cells with specialized functions.

Stochastic - Random or involving a random variable.

Telomerase - An enzyme composed of a catalytic **protein** component and an **RNA** template and that synthesizes the telomeric **DNA** at the ends of **chromosomes**. When active, telomerase can continually add to the length of the telomeres on the ends of chromosomes within a cell, thus conferring on that cell the ability to continue dividing past its normal lifespan.

Telomeres - "Caps" (made of repeated DNA sequences) found at the ends of **chromosomes** that protect the ends of the chromosomes from degradation. The telomeres on a chromosome shorten with each round of cell replication. Telomere shortening has been suggested to be a "clock" that regulates how many times an individual cell can divide (that is, when the telomeres of the chromosomes in a cell shorten past a particular point, the cell can no longer divide).

Tissue culture - See **culture**.

Totipotent cells - **stem cells** that have unlimited developmental capability. The totipotent cells of the very early **embryo** (an embryo prior to the **blastocyst** stage) have the capacity to differentiate into **extraembryonic** tissues, membranes, the embryo, and all postembryonic tissues and organs.

Transcription - Making an **RNA copy** from a **gene** or other **DNA** sequence. Transcription is the first step in **gene expression**.

Transformation - A genetic process resultings in a heritable alteration of the properties of a cell. In the case of **cultured** cells, transformation often refers to the acquisition of new properties, such as unlimited culture lifespan.

Translation - The process of forming a **protein** molecule from information contained in messenger **RNA**.

Trophectoderm - The outer layer of the developing **blastocyst** that will ultimately form the embryonic side of the **placenta**.

Trophoblast - The **extraembryonic tissue** arising from the outer layer of the **blastocyst**, involved in **implantation** and later in development of the **placenta** and **chorion**.

Ultrasonography - Commonly called "ultrasound." An imaging technique that uses high-frequency sound waves to create an image. During pregnancy, ultrasonography can be used to provide an image of the developing **fetus**, including the entire body, organs and surrounding tissue.

Undifferentiated - Not having developed into a specialized cell or tissue type.

Unipotent stem cell - A **stem cell** that both divides and gives rise to a single mature cell type, such as a spermatogenic stem cell, which only gives rise to sperm.

Uterus - The muscular pear-shaped organ (in humans, located in the lower part of a woman's abdomen) in which the **fetus** develops.

Vascular - Composed of or having to do with blood vessels.s

WGA - See **Whole genom amplification**

Whole-genome amplification (WGA) - A technique that allows production of enough **DNA** from a single cell to do multiple genetic analyses; involves nonspecific **Polymerase chain reaction** (PCR) amplification of an entire **genome**, providing templates for later PCR to produce more copies of the genome.

X inactivation - Normal inactivation of one of the two **X chromosomes** in females.

X chromosome - One of the two sex **chromosomes**, the other being the Y chromosome. Females have two X chromosomes, and males have one X chromosome and one Y chromosome.

Y chromosome - The **chromosome** that determines male gender.

Zygote - The one-cell **embryo** formed by the union of **sperm** and egg at fertilization.

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