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Mitochondrial DNA Replacement: Moral and Halakhic Concerns

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MITOCHONDRIAL DNA REPLACEMENT: MORAL AND HALAKHIC CONCERNS

By J. David Bleich[1]

I. INTRODUCTION

A host of maladies affecting mankind are the product, in whole or in part, of a person's genetic legacy. Once the gene responsible for the condition has been identified, the defect can be avoided in one of a number of ways: (1) Hormone treatment to induce superovulation to be followed by in vitro fertilization in the laboratory. Genetic testing can then be performed in the earliest period of cell division and zygotes bearing the defective gene discarded. In vitro fertilization is widely available and, relatively speaking, fairly successful. Nevertheless, the procedure is not always successful, involves hormone treatment that is both onerous and expensive, often requires repetition over a number of ovulation cycles, and is not without risks to the would-be mother. The procedure also gives rise to an ethical issue regarding disposal of discarded zygotes. (2) Genetic editing involving removal of the defective gene from the individual sperm or ovum prior to fertilization *ex utero*. Such procedures avoid the prospect of destroying fertilized ova and reduce the need for superovulation. That technique, however, is not fully developed and not readily available. (3) Replacement of mitochondrial DNA that involves removal of defective maternal DNA and its replacement with normal DNA donated by another woman. The primary therapeutic advantage lies in the fact that the genetic changes introduced are present in all cells of the fetus, including reproductive cells, thereby eliminating the possibility of transmission of defective genes to all future generations. In addition to technical hurdles that must be overcome, the development of this procedure raises the specter of manipulating the human genome of all future progeny. The present discussion will be limited to an analysis of issues posed by mitochondrial DNA replacement.

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II. THE NATURE OF MITOCHONDRIA; PROCEDURES OF MITOCHONDRIAL DNA REPLACEMENT

Mitochondria are bean-shaped organelles present in almost every cell type of the human body[2] which, in complex interaction with DNA in the nucleus, turn nutrients into energy.[3] Mitochondria are analogous to batteries in the sense that they power the cells of all complex life-forms by converting glucose into energy. Cessation of respiration cuts off oxygen from the mitochondria. Lack of oxygen prevents the mitochondria from converting nutrients into energy. Lack of energy, in turn, causes the cells to cease functioning and leads to death.

Mitochondria are present in the cytoplasm of the female ovum and are passed on from mother to child.[4] Mitochondria contain their own DNA. Thirty-seven genes are present in the mitochondrial DNA (mtDNA) passed from a woman's ovum into every cell of her progeny, including the sperm and ova that will eventually produce the next generation.

Mitochondrial DNA was first discovered sometime in the 1960s. Two separate studies published in 1988 by the London Institute of Neurology and

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[2] The only cells in the human body that do not contain mitochondria are red blood cells (which also do not have nuclei). *See* Zhong-Wei Zhang et al., *Red Blood Cell Extrudes Nucleus and Mitochondria Against Oxidative Stress*, 63 IUBMB LIFE 560–65 (2011), https://www.ncbi.nlm.nih.gov/pubmed/21698761. Even spermatozoa have mitochondria that are destroyed at fertilization. *See* Peter Sutovsky and Won-Hee Song, *Post-Fertilization Sperm Mitophagy: the Tale of Mitochondrial Eve and Steve*, 30 REPROD. FERTILITY & DEV. 56 (2017), http://www.publish.csiro.au/RD/RD17364.

[3] *See generally*, *Steadily Rising Increases in Mitochondrial DNA Mutations Cause Abrupt Shifts in Disease*, SCIENCE DAILY (Oct. 22, 2014), https://sciencedaily.com/releases/2014/10/141022123128.htm (study detailing how subtle changes in mitochondrial function may cause a broad range of common metabolic and degenerative diseases). The biology of mitochondria is described in many of the authorities cited *infra*. *See*, in particular, Rosa J. Castro, *Mitochondrial Replacement Therapy: The US and UK Regulatory Landscapes,* 3 J. L. & BIOSCI. 726 (2016), https://academic.oup.com/jlb/article/3/3/726/ 2566730.

[4] Marianne Schwartz and John Vissing, *Paternal Inheritance of Mitochondrial DNA*, 347 NEW ENG. J. MED. 576 (2002), http://www.nejm.org/doi/full/10.1056/NEJMoa020350. "Sperm mitochondria disappear in early embryogenesis by selective destruction, inactivation, or simple dilution by the vast surplus of oocyte mitochondria." *Id.* However, one individual suffering mitochondrial myopathy was found to have extensive paternal mtDNA. Researchers accounted for that anomaly by stating that "[t]he present case could be the result of the survival of one or a few sperm mitochondria that probably would have been diluted out and never have been recognized had the pathogenic mutation not conferred a selective proliferative advantage on the mitochondria. There is now strong evidence that highly effective processes exist for eliminating healthy sperm mitochondria in early mammalian embryogenesis." *Id.* at 579.

the Emory University School of Medicine revealed that genetic anomalies in mitochondrial DNA are responsible for various incurable diseases related to impaired energy production in cells.[5] Subsequent research has identified a plethora of mitochondrial diseases, including deafness, blindness, muscle weakness, cognitive impairment, and diabetes, as well as heart, liver, and kidney failure. Up to one in 4,300 people is affected by some form of mitochondrial disease.[6]

The mitochondrial DNA of every human is traceable to a common maternal ancestor. Over a span of generations the mitochondrial DNA of female progeny mutated significantly, at times conferring metabolic advantages and at times giving rise to deleterious effects. Apparently, because mitochondria are synthesized at a rapid pace, the mutation rate of mitochondria is higher than that of nuclear DNA.[7] Unlike nuclear DNA, mitochondrial DNA travels directly from mother to child without recombining. A woman with a mutation in her mitochondrial DNA passes on that mutation to her child when the mutated portion of her mtDNA is transmitted. A single ovum contains hundreds of thousands of mitochondrial DNA molecules that are later distributed randomly into the cells of a developing embryo. The number of cells containing mutations and the place or places in the body at which those cells lodge determine the expression of various disorders. The random distribution of mutated cells within the fetal organs determines the presence or absence of disease as well as the nature and severity of its expression.[8]

In 1996 researchers began combining cytoplasm derived from the ovum of one woman with the nucleus of an ovum of another woman unable to conceive a child.[9] The earliest endeavors did not involve a search for elimination of genetic disease, but were an attempt to find a remedy for infertility in older

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[5] I.J. Holt et al., *Deletion of Muscle Mitochondrial DNA in Patients with Mitochondrial Myopathies*, 331 NATURE 717 (1988), https://www.ncbi.nlm.nih.gov/pubmed/2830540#; Douglas C. Wallace et al., *Mitochondrial DNA Mutation Associated with Leber's Hereditary Optic Neuropathy*, 242 SCIENCE 1427 (1988), https://www.ncbi.nlm.nih.gov/pubmed/3201231.

[6] *See* Gráinne Gorman et al., *Prevalence of Nuclear and Mitochondrial DNA Mutations Related to Adult Mitochondrial Disease*, 775 ANNALS OF NEUROLOGY 753 (2015), https://www.ncbi.nlm.nih.gov/pubmed/25652200/. The statistics relate to a population in the United Kingdom.

[7] Michael W. Nachman & Susan L. Crowell, *Estimate of the mutation rate per nucleotide in humans,* 156 GENETICS 297 (2000), http://www.genetics.org/content/156/1/297.full.

[8] James B. Stewart & Nils-Göran Larsen, *Keeping mtDNA in Shape between Generations*, 10 PLOS GENET. 1371, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4191934/.

[9] *See* Jacques Cohen et al., *Birth of Infant after Transfer of Anucleate Donor Oocyte Cytoplasm into Recipient Eggs*, 350 THE LANCET 186 (1997).

women who failed to become pregnant by means of *in vitro* fertilization. Speculating that the problem might be the result of the aging process taking place within the ova, the scientific investigators sought to remedy the situation by replacing "stale" cytoplasm with cytoplasm from a younger woman. A small amount of cytoplasm removed from a donor's egg was injected into an ovum of an infertile woman. The fertilization occurred *in vitro* and the resultant embryo was then implanted in the previously infertile woman's uterus and, in May 1997, she gave birth to a healthy baby girl at St. Barnabas Medical Center in Livingston, N.J.[10] Since a cell's cytoplasm includes the mitochondrion, and since the mitochondrion contains its own DNA, there was a distinct possibility that the baby would inherit some DNA from both women. However, no mitochondrial DNA attributable to the donor was found in that infant, presumably because of the small amount of cytoplasm that had been introduced.[11] Later, it was reported that a total of 17 children had been born as a result of such a procedure.[12] The procedure became known as "cytoplasmic transfer."[13] Genetic testing confirmed that donor DNA was found in two babies born as a result of cytoplasmic transfer. In effect, those infants were "three-parent babies."[14]

One of the cytoplasmic-transfer children has been diagnosed with "pervasive developmental disorder."[15] The Food and Drug Administration halted

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[10] *Id.*

[11] *Id.* Shannon Brownlee, *Designer Babies*, 34 WASHINGTON MONTHLY, March 2002, at 25; Kim Tingley, *The Brave New World of Three-Parent I.V.F.*, N.Y. TIMES MAG., June 27, 2014, at 26–31, 38, 49.

[12] Jessica Hamzelou, *Everything You Wanted to Know about '3-Parent' Babies*, NEW SCIENTIST (Sept. 28, 2016), https://www.newscientist.com/article/2107451-everything-you-wanted-to-know-about-3-parent-babies/. "The technique was employed 30 times in 27 people and 17 babies were born. However, two fetuses developed a genetic disorder involving the absence of an X chromosome. One of those pregnancies resulted in a miscarriage, the other was aborted." *Id.* Limited postnatal studies indicate that the 17 children suffered no ill effects from the procedure. Serena Chen et al., *A Limited Survey-based Uncontrolled Follow-up Study of Children Born after Ooplasmic Transplantation in a Single Centre*, 33 REPROD. BIOMED. ONLINE 737 (2016), https://www.sciencedirect.com/science/article/pii/S1472648316305569.

[13] Linsey Cree & Pasqualino Loi, *Mitochondrial replacement: from basic research to assisted reproductive technology portfolio tool—technicalities and possible risks*, 21 MOLECULAR HUM. REPROD. 3 (2015), https://doi.org/10.1093/molehr/gau082.

[14] Hamzelou, *supra* note 12.

[15] Brownlee, *supra* note 11, at 25. More recently, a fear has been expressed that children born as a result of mitochondrial transfer might suffer reduced fertility, hearing difficulties, or cancer. *See* Jonathan Petre & Stephen Adams, *Bid to Delay 'Three Parent Babies' as New Risks Revealed*, MAIL ON SUNDAY, Oct. 5, 2014, at 44, http://www.dailymail.co.uk/

the procedure in 2002 but estimated that 30 to 50 children had already been born as the result of cytoplasmic transfer.[16] There has been no systematic follow-up to determine the health status of children born as a result of that procedure. It is known that two embryos were affected with Turner's syndrome, a rare chromosomal abnormality. One of those embryos miscarried, the other was aborted.[17]

Current research focuses, not upon the cure of infertility, but upon the elimination of mitochondrial genetic disorders. The procedure intended to achieve this involves more than the injection of donor cytoplasm: rather, it involves the replacement of mitochondria in their entirety. Total mitochondria replacement results in an embryo's having mitochondrial DNA derived entirely from the donor but nuclear DNA derived entirely from the recipient mother and the male whose sperm was used. As part of the process, *in vitro* fertilization is performed.[18] Utilizing selected normal cells, the procedure has been used to produce apparently healthy rhesus monkeys but, as yet, there has not been any implantation of a human embryo generated in this manner.[19] In October, 2012, a group of scientists in Oregon announced that, using genetic material of two women and one man, they had succeeded in creating a dozen human embryos in the laboratory and were awaiting federal approval to implant the genetically modified embryos in women willing to gestate them.[20] A baby has been born as a result of mitochondrial replacement in Mexico[21] and another in Ukraine.[22]

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news/article-2780899/Bid-delay-three-parent-babies-IVF-tests-fears-suffer-reduced-fertility-learning-difficulties-cancer.html.

[16] *See* Castro, *supra* note 3; Charlotte Pritchard, *The Girl with Three Biological Parents*, BBC NEWS MAGAZINE, Sept. 1, 2014, http://www.bbc.com/news/magazine-28986843.

[17] *See* Tingley, *supra* note 11, at 26–31, 38 & 49. *See also* Jill Neimark, *Unexpected Risks Found in Replacing DNA to Prevent Inherited Disorders*, SHOTS: HEALTH NEWS FROM NPR (Jan. 1, 2017), https://www.npr.org/sections/health-shots/2017/01/01/507244429/unexpected-risks-found-in-editing-genes-to-prevent-inherited-disorders.

[18] A detailed description of various MRT procedures is set forth in National Academies of Sciences, Engineering, and Medicine, MITOCHONDRIAL REPLACEMENT TECHNIQUES: ETHICAL, SOCIAL, AND POLICY CONSIDERATIONS (Anne Claiborne, Rebecca English & Jeffrey Kahn eds., 2016), https://www.nap.edu/read/21871/chapter/1#ii.

[19] *See* Masahito Tachibana et al., *Mitochondrial Gene Replacement in Primate Offspring and Embryonic Stem Cells*, 461 NATURE 267 (2009), http://www.ohsu.edu/xd/research/centers-institutes/stem-cell-center/faculty/upload/2009-Mitochondrial-gene-replacement-nature.pdf.

[20] "Embryos Made with Genes from 1 Man, 2 Women," CBS NEWS (Oct. 24, 2012), http://www.cbsnews.com/news/embryos-made-with-genes-from-1-man-2-women.

[21] *See* John Zhang et al., *Live Birth Derived from Oocyte Spindle Transfer to Prevent Mitochondrial Disease*, 34 REPROD. BIOMED. ONLINE 361 (2017), http://www.rbmojournal.com/article/S1472-6483(17)30041-X/abstract. The FDA wrote to the U.S. physician involved in

Mitochondrial replacement procedures differ from more widely-known somatic gene therapy in that the latter involves a process of genetic engineering in which a single abnormal gene is replaced by a healthy gene. Such modifications are not passed on to future generations because they cause no change in sperm or ova. Mitochondrial replacement, however, crosses the "germ line" in that the changes occur in all cells, including gametes, and hence are passed on to future generations as well.[23]

Manipulation of mitochondrial DNA might potentially be employed, not only for elimination of disease, but also for purposes of eugenics, i.e., genetically engineering generations of progeny endowed with supposedly superior qualities. Acceptance of germ line modification, even for therapeutic purposes, opens the door to other forms of germ line engineering that would enhance physical qualities and intellectual prowess of normal offspring.

III. REGULATORY AND OTHER RESTRICTIONS

Fifteen European nations have prohibited modification of the germ line because of ethical and social concerns.[24] However, in February, 2015 the British parliament approved a bill that results in the United Kingdom becoming the first country explicitly to permit mitochondrial replacement.[25] In 2017, the United

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this procedure, warning him of violations. Letter from Mary A. Malarkey, Director, Office of Compliance and Biologics Quality, Center for Biologics Evaluation and Research, U.S. Food and Drug Administration, to John Zhang (Aug. 4, 2017), https://www.fda.gov/downloads/BiologicsBloodVaccines/GuidanceComplianceRegulatoryInformation/ComplianceActivities/Enforcement/UntitledLetters/UCM570225.pdf .

[22] Michelle Roberts, *IVF: First Three-Parent Baby Born to Infertile Couple*, BBC NEWS (January 18, 2017), http://www.bbc.com/news/health-38648981.

[23] Alyssa Lane & Jeff Nisker, *"Mitochondrial Replacement" Technologies and Human Germline Nuclear Modification*, 28 J. OBSTETRICS & GYNOCOLOGY CANADA 731 (2016), https://doi.org/10.1016/j.jogc.2016.03.002.

[24] *See* Pablo Tebas et al., *Gene Editing of CCR5 in Autologous CD4 T Cells of Persons Infected with HIV*, 370 NEW ENG. J. MED. 901 (2014).

[25] The Human Fertilisation and Embryology (Mitochondrial Donation) Regulations 2015, SI 2015/572 (Eng.), https://www.legislation.gov.uk/uksi/2015/572/contents/made; Castro, *supra* note 16. *See also* Kate Kelland & Kylie Maclellan, *Britain Votes to Allow World's First 'Three-Parent' IVF Babies*, REUTERS (Feb. 3, 2015), http://www.reuters.com/article/2015/02/04/us-health-babies-idUSKBN0L710B20150204; James Gallagher, *UK Approves Three-Person Babies*, BBC NEWS (Feb. 24, 2015), http://www.bbc.com/news/health-31594856. *But see* Aminat Suleymanova et al., *Family Law in Ukraine: Overview*, PRACTICAL LAW—WESTLAW, https://uk.practicallaw.thomsonreuters.com/5-564-3065?__lrTS=20171025173724528&transitionType=Default&contextData=(sc.Default)&firstPage=true&bhcp=1 (creating some ambiguity as to whether there was a previous Ukrainian law).

Kingdom's Human Fertilization and Embryology Authority issued its first license to perform the procedure.[26] In the United States, the Food and Drug Administration conducted a public hearing in February, 2014 to explore potential benefits and harms that might be anticipated. The advisory panel failed to issue a formal decision with regard to a recommendation for approval of human trials.[27] Since 2015, provisions in federal appropriations acts have prohibited the FDA from acknowledging applications to conduct investigations involving a "human embryo … intentionally created or modified to include a heritable genetic modification."[28]

It is now quite likely that a moratorium is in effect regarding all genetic research that would involve crossing the germ line. As an outcome of a conference convened by the National Academy of Sciences of the United States, the Institutes of Science, the Royal Society of London and the Chinese Academy of Science, those groups issued a joint statement on December 3, 2015 declaring that it would be "irresponsible to proceed" with experimentation involving inheritable changes to the human genome until the risks are assessed and there is broad consensus that any contemplated changes are beneficial and appropriate.[29]

Although mitochondrial DNA replacement was not specifically mentioned, the group's recommendation seems to apply to such procedures as well. The meeting was prompted by a newly developed genetic technique perfected only several years ago, known as CRISPR/ Cas9, that enables DNA to be edited with unprecedented ease and precision.[30]

For the present at least, the CRISPR technique is of little value in eliminating diseases such as cancer or diabetes in which the hereditary component is

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[26] Georgia Everett, *HFEA Grants First License to Carry on Mitochondrial Donation*, 893 BIONEWS 7 (March 20, 2017), http://www.bionews.org.uk/page_804053.asp.

[27] Matt Smith, *FDA Considering 3-Parent Embryos*, CNN (Feb. 27, 2014), http://www.cnn.com/2014/02/26/health/ivf-mitochondria/.

[28] *See, e.g.*, The Consolidated Appropriations Act, 2017, Pub. L. No. 115-31, § 736 (2017), which prohibits the FDA from acknowledging applications for an exemption for "investigational use of a drug or biological product in research in which a human embryo is intentionally created or modified to include a heritable genetic modification." Provides that "any submission is deemed not to have been received, and the exemption may not go into effect." https://www.congress.gov/115/plaws/publ31/PLAW-115publ31.pdf.

[29] ON HUMAN GENE EDITING: INTERNATIONAL SUMMIT STATEMENT, The National Academies of Science, Engineering and Medicine, Dec. 3, 2015, http://www8.nationalacademies.org/onpinews/newsitem.aspx?RecordID=12032015a. *See also* Nicholas Wade, *Scientists Seek Moratorium on Edits to Human Genome That Could Be Inherited*, N.Y. TIMES, Dec. 4, 2015, at A1.

[30] Aparna Vidyasagar, *What Is CRISPR?*, LIVESCIENCE (2018), https://www.livescience.com/58790-crispr-explained.html.

the manifestation of a combination of the effects of many genes.[31] Nor can such procedures readily be employed in order to create "designer babies" since the desired traits are dependent upon the functions of multiple genes. Moreover, genes generally have more than one effect, many of which are unknown. Hence altering a large number of genes might involve undetermined hazards and result in unwanted secondary effects.[32] Many single-gene defects, known as Mendelian diseases, can be eliminated without crossing the germ line. *In vitro* fertilization, followed by pre-implantation diagnosis, can be used to destroy afflicted embryos and assure that only healthy embryos are implanted in the uterus by a newly perfected technique. The immediate benefit would be to eliminate genetically dominant maladies, e.g., Huntington's disease.[33] MtDNA replacement has the potential benefit of eliminating a large number of conditions because its basic use is to replace the entire mtDNA rather than to edit targeted genes.

Although the academics that have signed the call for a moratorium have no regulatory power they exert profound influence of scientific research. A similar call for restraint with regard to an earlier form of genetic manipulation issued in 1975 was fully observed.[34]

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[31] CRISPR gene editing only modifies a cell or organism's genetic code directly. It does not change an organism's epigenetics or environmental conditions, both of which have been associated with a variety of human diseases. *See, e.g.*, Jorge Alejandro Alegria-Torres et al., *Epigenetics and Lifestyle*, 3 EPIGENOMICS 267 (2011), https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3752894/ .

[32] *See* Neimark, *supra* note 17. Neimark reports the suggestion of a recent study to the effect that "in roughly 15 percent of cases, the mitochondrial replacement could fail and allow fatal defects to return, or even increase a child's vulnerability to new ailments." *Id.* (citing Kang et al., *Mitochondrial replacement in human oocytes carrying pathogenic mitochondrial DNA mutations*, 540 NATURE 270 (2016), https://www.nature.com/articles/nature20592). Logically, the increased vulnerability to new ailments, if transmitted through the mitochondria, should affect subsequent generations as well.

[33] "Huntington's disease is caused by an inherited defect in a single gene. [It] is an autosomal dominant disorder, which means that a person needs only one copy of the defective gene to develop the disorder." Mayo Clinic Staff, *Huntington's Disease* (2018), https://www.mayoclinic.org/diseases-conditions/huntingtons-disease/symptoms-causes/syc-20356117.

[34] Nicolas Rasmussen, *DNA Technology: 'Moratorium' on Use and Asilomar Conference*, ELS (2015), http://www.els.net/WileyCDA/ElsArticle/refId-a0005613.html.

IV. MORAL AND HALAKHIC PROBLEMS

A. In General

The introduction of *in vitro* fertilization (IVF) in humans in the 1970s and ensuing assisted reproductive technologies gave rise to medical, ethical, theological, and halakhic concerns.[35] Natural law theologians regarded the procedure as an illegitimate intervention in the natural order. Social theorists warned against introduction of "designer babies," i.e., selective implantation of embryos of a particular gender and endowed with particular physical attributes as determined by genetic testing. Ethicists cautioned that manipulation of the developing zygote might cause developmental harm to the embryo and result in defective neonates. They further cautioned that extrauterine gestation might avoid mechanisms inherent in nature that serve to interrupt the gestation of anomalous fetuses. Despite those qualms, to date, IVF has resulted in the birth of over five million babies.[36]

Forms of artificial procreation that rely upon the introduction of genetic material contributed by a person who is not a party to the marriage do not conform to traditional notions of the nuclear family and, arguably, do not conform to notions of family values so deeply engrained in the social fabric as to be regarded by some as dictated by natural law. Throughout human history,

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[35] *See generally* Janet Bataille, *Research in Human Embryos Raises Fear and Hope*, N.Y. TIMES, March 3, 1980, at A14, http://users.humboldt.edu/mahokas/English105/bataille.pdf; Jo Thomas, *British Debate Embryo Research*, N.Y. TIMES, Oct. 16, 1984, at C6; Philip M. Boffey, *The Vatican's Doctrine: Ethics Concern; Doctrine Follows Years of Debate on Procedures*, N.Y. TIMES, March 12, 1987, at B11; and Sabra Chartrand, *Experts Assess a Decade of In Vitro Fertilization*, N.Y. TIMES, April 11, 1989, at C5. For a comprehensive survey of those issues, see M. Karen McCartan, *A Survey of the Legal, Ethical, and Public Policy Considerations of In Vitro Fertilization*, 2 NOTRE DAME J.L. ETHICS & PUB. POL'Y 695 (1986).

In addition to the concerns addressed in this section, there are also issues regarding possible adultery and incest, as well as the legitimacy of progeny born as a result of IVF procedures. The consensus of rabbinic decisors is that there cannot be culpable incest or adultery without a sexual act. The more seriously contested issue of the legitimacy of offspring conceived *sina concubito* as a result of a consanguineous or adulterous relationship is not discussed in this section. *See generally* J. DAVID BLEICH, JUDAISM AND HEALING 86–89 (2nd ed. 2003) and FRED ROSNER, BIOMEDICAL ETHICS AND JEWISH LAW 132–33 (2001).

[36] *See* Suzanne Elvidge, *Five Million Births from IVF: Study Published*, 727 BIONEWS (Oct. 21, 2013), https://www.bionews.org.uk/page_94337. *See also* Kate Brian, *The amazing story of IVF: 35 years and five million babies later*, THE GUARDIAN, July 13, 2013, at 30, https://www.theguardian.com/society/2013/jul/12/story-ivf-five-million-babies.

beginning with the admonition to Noah, "Go forth from the ark, you and your wife and your sons and your sons' wives" (Genesis 8:16),[37] and the conforming conduct of Noah and his charges reflected in a subsequent passage, "whatsoever moves upon the Earth, according to their family they went forth out of the ark" (Genesis 8:19), the nuclear family has been regarded as the bedrock of the natural order.[38] As so eloquently captured by Norman Rockwell in his many artistic depictions, a family is portrayed as consisting of one father, one mother and a group of children of various ages. Traditionally, the center of the family has been understood to be a man and a woman living together with the children they have begotten together. The introduction of gametes, sections of gametes, or genetic material contributed by persons outside of the marital union results in a radical departure from the traditional bionormative family structure and constitutes an intrusion upon the essence of the marital union and of the family that arises therefrom.

In addressing IVF, rabbinic scholars have grappled with halakhic issues involved in semen procurement, ovum donation,[39] disposition of defective or excess embryos, fetal reduction, and parental identity. None of these problems lends itself to an easy and unequivocal resolution. Quite obviously, each of those issues is also present in utilization of mitochondrial DNA replacement techniques. But, in addition, a "three-parent" implantation procedure presents a halakhic issue of maternal identity echoing a similar question that arose much earlier with regard to surrogate motherhood. Surrogate motherhood presents a fairly clear-cut issue. Who is the mother, the biological mother, i.e., the genetic mother, or the gestational mother who gives birth to the child by means of parturition? In instances of mitochondrial DNA donation, the issue is whether it is the donor of maternal mitochondrial DNA or the woman whose nuclear DNA is present in the child who is the mother, or both? It may also be possible

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[37] Translation of biblical passages are taken from the King James version with modifications by the author. Translation of talmudic excerpts are those of the author.

[38] *Cf.* Rabbi Yosef Eliyahu Henkin, *Yihus Mishpahah u-Piryah ve-Rivyah*, in 27 HA-PARDES 2–3 (1953), reprinted in Rabbi Yosef Eliyahu Henkin, 1 KITVEI HA-GRIY'A HENKIN 154 (1981). *See also* Rabbi Yosef Eliyahu Henkin, *Hazra'ah Melakhutit*, 1 HA-MA'OR 9 (1965).

[39] Dr. Abraham S. Abraham, in three separate comments, quotes the late Rabbi Joseph Shalom Eliashiv as forbidding ovum donations. *See* ABRAHAM S. ABRAHAM, *Even ha-Ezer* 1:6, notes 6:10 (p. 37) and 6:15 (p. 39) and *Even ha-Ezer* 5:12, note 17 (p. 155) in NISHMAT AVRAHAM [THE SOUL OF ABRAHAM] (2nd ed. 2007). Rabbi Eliashiv makes no distinction between anonymous donations and intrafamilial donations or donations by identifiable rather than anonymous women. If ovum donation cannot be countenanced by Halakhah it would appear that donation of a portion of the ovum is also prohibited.

to combine mitochondrial DNA from multiple donors. If that becomes actual, would Halakhah recognize multiple maternal relationships?[40]

Curiously, according to *Tosafot*'s understanding of a statement of the Gemara,[41] *Sotah* 42b, the possibility of a child born of more than two parents was not only recognized by the Sages but, according to one of the Amora'im, actually occurred at least once in human history. In that instance, the child did not have two mothers; rather, he had one hundred fathers. The Gemara states:

> "And an *ish ha-beinayim* [lit. a man from among them] … went up [*oleh*] from the camp of the Philistines" (I Samuel 17:23). What is the meaning of "*beinayim*"? … R. Yohanan said, "He was the son of a hundred fathers and one mother."

The term "*ish ha-beinayim*" occurs in the introductory verse of the biblical narrative concerning the encounter between David and Goliath. The above-cited talmudic comment understands the verse as a reference to Goliath's parentage. Rabbi Yohanan interprets the appellation "*ish ha-beinayim*" as connoting "a man from among [the many of] the camp of the Philistines." Rashi[42] understands the Gemara as stating that the passage declaring that Goliath "went up" from "among the many in the camp of the Philistines" indicates that Goliath's mother consorted promiscuously with "a hundred," i.e., a multitude, of Philistines, and that Goliath "went up," i.e., that Goliath "emerged" from those assignations. Accordingly, Scripture indicates only that, although Goliath had a single, and hence identifiable, mother, his paternity was obscure because his father might have been any one of the mother's one hundred sexual partners. According to Rashi's explanation, *Sotah* 42b, the identity of Goliath's father was indeterminable but his birth was biologically unremarkable.

Tosafot[43] understand the Gemara quite differently. According to *Tosafot*, Goliath's paternity was not a matter of speculation or indeterminacy: his father, or better, his fathers, were readily identifiable. Each of his mother's consorts was quite literally his father. Goliath emerged from "a hundred" men in the sense that his mother was severally impregnated by each and every one of her paramours. *Tosafot* explain that, so long as a sperm remains viable in a

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[40] *See* J. DAVID BLEICH, 1 CONTEMPORARY HALAKHIC PROBLEMS 106–09 (1977) and 4 CONTEMPORARY HALAKHIC PROBLEMS 91–93, 237–72 (1995).

[41] The Talmud is composed of two parts. The Mishnah, redacted in the first century CE, became the text studied in the academies. The Gemara is a record of the discussions conducted in those academies and serves to elucidate and amplify the statements of the Mishnah.

[42] SOTAH 42b, s.v. *bar me'ah*.

[43] SOTAH 42b, s.v. *me'ah,* hereinafter referred to as *Tosafot*.

woman's genital tract, multiple sperm can contribute to a single pregnancy. Presumably, *Tosafot* mean to say that multiple sperm can simultaneously, or in close chronological sequence, penetrate the wall of the ovum and combine with the cytoplasm present within the ovum to create a single zygote.[44] In all likelihood, *Tosafot* would concede that such a phenomenon is exceptional in that, as a rule, once a single sperm penetrates the ovum, the ovum becomes impervious to other sperm.[45] That, of course, is the scientific understanding of the process of conception. Nevertheless, *Tosafot* did accept the empirical possibility of a child having, not only two fathers, but a hundred fathers, i.e., as being the product of genetic contributions on the part of multiple males.[46]

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[44] There are numerous statements found in rabbinic literature that appear to be in conflict with scientific *realia*. On occasion, halakhic provisions are linked with empirical phenomena in a manner now recognized by science as contrafactual. There are several possible ways to address the problem. The most obvious are either asserting a doctrine of halakhic inerrancy or accepting the conclusion that Jewish law inferences must be modified. It may also be possible to escape from between the horns of the dilemma by means of nonliteral interpretations of problematic rabbinic dicta. For discussion of that issue see *Scientific Hypotheses and Halakhic Inerrancy* in BLEICH, 4 CONTEMPORARY HALAKHIC PROBLEMS, *supra* note 40, at 73.

Tosafot's analysis of *Sotah* 42b is only tangentially related to that problem. Whether or not the talmudic description of the promiscuity of Goliath's mother implies that Goliath had one hundred biological fathers is not of significant halakhic importance. The fact that *Tosafot* do make the assertion *is* of crucial halakhic importance. That assertion can be made in the context of halakhic dialectic only if Halakhah can contemplate a non-exclusive paternal relationship. (Thus, Rabbi Asher Weiss' comment, "it appears to me to be clear and simple that, from the vantage point of Halakhah, it is not at all possible for a person to have two mothers, just as it is impossible that he have two fathers" is simply incorrect. *See* Rabbi Akiva Dershowitz, *Triple Parent IVF*, http://en.tvunah.org/2013/12/29/triple-parent-ivf.). Whether Goliath was actually a product of a genealogical *mélange à cent* relationship is of scant importance. What is significant is the theoretical acknowledgement by *Tosafot* of the possibility of multiple fathers—a halakhic stance that may well have had no practical ramification until contemporary times.

[45] *Tosafot* posit a controversy between this discussion and the statement of the PALESTINIAN TALMUD, *Yevamot* 4:2, to the effect that a woman cannot be impregnated simultaneously by two men.

[46] Curiously, there is a report of a man who subsequent to failing a paternity test was found to have genes in his saliva that did not match the genes in his semen. The paternity test was performed because the blood type of his son did not match his blood type or that of his wife. The father's sperm was found to have only a ten percent genetic match to the infant. Upon conducting a genetic ancestry test it was concluded that the man had absorbed genes *in utero* from cells of a twin who miscarried at a very early stage of gestation. Shehab Kahn, "*Human Chimera": Man Fails Paternity Test Because Genes in His Saliva Are Different to Those in Sperm*, THE INDEPENDENT (Oct. 24, 2015), http://www.independent.co.uk/news/science/human-chimera-man-fails-paternity-test-because-genes-in-his-saliva-are-

There is no logical reason why such a possibility could not also be entertained with regard to multiple mothers.

Tosafot's analysis of the talmudic statement should certainly not be construed as a theological seal of approval of such a mode of procreation. Quite to the contrary, in context, the Scriptural passage cited reflects aspersion upon the morality of both Goliath's mother and of the males within the Philistine camp. The aspersion seems to be based, not simply upon the licentious conduct of those involved, but upon the resultant confused paternity.

Even more revealing is the rabbinic interpretation of Numbers 1:18: "And they assembled all the congregation together on the first day of the second month and they declared their pedigrees (*va-yityaldu*) according to their families ...." Grammatically, "*va-yityaldu*" is the reflexive form of the Hebrew verb meaning "to give birth" and hence should be translated literally as "and they gave birth to themselves according to their families." But, of course, such a literal understanding would be incomprehensible.[47] Rashi, Numbers 1:18, citing *Sifri*, explains the phrase as meaning, not that they "declared" their pedigrees, but that they brought genealogical records or witnesses who testified to the circumstances of their births for purposes of tribal identification.

Rashi, Numbers 1:1, points out that, chronologically, the census described in the opening chapter of Numbers followed closely upon the census taken subsequent to the sin of the Golden Calf. Implied in Rashi's comment is a question regarding the need for a new census. Rashi's succinct comment "and when He came to rest the *Shekhinah* upon them on the first day of Nisan the Tabernacle was erected, and on the first day of Iyar He counted them," is designed to dispel that concern. Left unspoken by Rashi is the imperative for a new enumeration before manifestation of the Divine Presence in the Tabernacle.[48]

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different-to-those-in-sperm-a6707466.html. In another case of a human chimera, a woman was found to have one set of genes and her ovaries to hold distinctively different ones. Two of her sons had genes that differed from those of their birth mother. The genetic mother of those sons is presumed to have been a twin sister of the birth mother whose cells were absorbed by the birth mother early in her own gestation. *Id.*

[47] *See* IBN EZRA'S COMMENTARY ON THE PENTATEUCH, Numbers 1:8 (1988). Ibn Ezra understands the phrase as connoting establishment by each person of his date of birth. Establishing a date of birth was necessary because the census included only persons twenty years of age and older. That understanding is closer to the literal meaning than are others.

[48] RABBI SHABETAI BASS in his SIFTEI HAKHAMIM, in his supercommentary on Rashi, Numbers 1:18, points out that the census was taken one month after the Tabernacle was erected and hence, in point of fact, the *Shekhinah* had already appeared. *Siftei Hakhamim* explains that under Jewish law thirty days' residence was required to allow a person to be considered a "dweller," rather than a transient in a community. Similarly, the presence of the *Shekhinah* acquired permanency only after thirty days.

The implication, however, is that the census was a requisite condition for descent of the *Shekhinah* into the Tabernacle. There is little question that Rashi's comment is an oblique reference to a statement of the Gemara, *Kiddushin* 70b: "The Holy One, blessed be He, does not cause His *Shekhinah* to rest other than upon genealogically identifiable families (*mishpahot meyuhasot*) of Israel." Ramban, in his commentary on that verse, assumes that the purpose of the assembly and the attendant census was to exclude the "mixed multitude" (*erev rav*) of gentiles who seized the opportunity to escape from Egypt together with the children of Israel. Since the identities of the individuals who were members of the *erev rav* were well known, Ramban dismisses the need for further corroboration in the form of genealogical records or formal testimony. Presumably, Rashi would agree that members of the *erev rav* were readily identifiable. If so, Rashi, who does posit a requirement for genealogical corroboration, regarded such corroboration as necessary, not to exclude gentiles, but to establish familial identity and hence adherence with certainty to a particular tribe.

The Mishnah,[49] *Yevamot* 41a, stipulates that a previously married woman may not enter into a subsequent marriage until three months have elapsed from termination of her prior marriage. The Gemara, *Yevamot* 42a, cites a statement of Rav Nahman who related in the name of Samuel: "Scripture said 'to be unto you for a God, and to your progeny after you' (Genesis 17:7): [i.e.,] to distinguish between the seed of the first and the seed of the second." (The Gemara proceeds to explain that the same waiting requirement applies even to a converting proselyte couple who seek to enter into an appropriate marital relationship with one another subsequent to conversion. The reason for the waiting period is to make it possible to distinguish between "seed that was planted in sanctity" and seed that "was not planted in sanctity."). Rashi, *Yevamot* 42a, s.v. *u-le-zar'akha*, explains the Gemara's application of the biblical verse "to be unto you as a God and to your progeny after you" as an invocation of the principle formulated by the Gemara, *Kiddushin* 70a, regarding the presence of the *Shekhinah*: "for the *Shekhinah* does not rest other than upon those known with certainty [i.e.,] those whose progeny are genealogically identifiable with him." Rashi further takes note of the statement of the Gemara, *Nedarim* 20b, that quotes the verse "and I will purge out from among you the rebels and those who transgress against Me" (Ezekiel 20:38) and interprets the verse as referring, *inter alia*, to *bnei ervuvi'a*—"children of mingled descent." Rashi explains that the term "*bnei ervuvi'a*" denotes: (1) children born in circumstances in which a male has consorted with one woman among a group of women but the identity of the particular woman with whom he has consorted is

[49] *See supra* note 41.

unknown; (2) children born in circumstances in which a woman has consorted with many men and hence the identity of the father of her child cannot be established; and (3) children born to a woman who had remarried within three months of termination of an earlier marriage and, as a result, it is unclear whether the child was carried to term, and hence the first husband is the father of her child, or whether the child was born prematurely, in which case the child's father is the second husband.

These statements, individually and collectively, serve to underscore the notion that the divine wish is that parental identity be established with certitude and that individuals be clearly identified in terms of family identity. Prominent among the transgressions of the Generation of the Flood were the sins of adultery and incest.[50] Yet those transgressions are not mentioned explicitly; instead, the circumlocution "for all flesh corrupted its way" (Genesis 6:12) is employed. That phrase serves to underscore that it was not the sin of licentiousness *qua* sin that was so heinous as to require annihilation of the entire populace of the world but that the conduct of that generation thwarted the divine plan for propagation of the species. The Creator established the institution of the family as the norm; confusion of parental identity and blurring of family lines thwarts the divine will and is a corruption of the divine blueprint for the development of civilization.

A clearly identified family unit is the *grundnorm* upon which all family values depend. Identification of other family values and why they constitute values are questions of a different order and do not necessarily lend themselves to unequivocal resolution. But, in context, the verse "to be a God unto you, and unto your progeny after you" suggests an answer. The verse occurs as a reference to the covenant declared to Abraham by God. The covenant was designed to embrace Abraham's descendants as well. The essence of that covenant is that the Deity will be the "God" of Abraham and also of Abraham's progeny. As is clear from the context of the Gemara's reference, *Kiddushin* 70a, to the visitation of the *Shekhinah*, the connotation of being "your God" (*lekha le-Elokim*) is the exercise of a unique providential guardianship.

It is not difficult to comprehend why "to be a God to your progeny after you" is limited to known, identifiable and unambiguous progeny. The covenant is bilateral. Abraham accepts a Deity and His commands for himself and for his descendants. God, in return, enters into a unique providential relationship with Abraham and with his descendants. But that is only because God declares, "For I have known him, that he will command his sons and his household after him and they will observe the way of God to do righteousness and justice in order

[50] *See* KIDDUSHIN 13a.

for God to bring upon Abraham that of which He spoke to him" (Genesis 18:19). Abraham is charged with "commanding" his progeny to observe the "way of God." Scripture concurrently declares that such an outcome is feasible only "*le-zar'akha aḥarekha*," *viz.*, only when your progeny are readily identifiable. The "way of God" is designed to be transmitted by means of the family relationship. In order to do so, the family unit must be clearly defined and its members unequivocally identified. Sociologically and psychologically, the *mesorah*, i.e., the Abrahamic teachings and traditions and those of Sinai as well, can best be transmitted when family bonds are strong and unambiguous. A family whose members cannot be unequivocally identified as part of the family unit is not a functional family—at least not for the pedagogical purpose of transmitting the *mesora*; such families are not sought out by the *Shekhinah* for unique guardianship. A covenantal relationship was established solely with families optimally suited for transmission of the *mesorah*.

B. Harm to the Unborn

Certainly, society must be prepared to adjudicate the manifold legal and social issues that may arise in any and all areas of interpersonal relationship. But, first and foremost, society must be concerned with the well-being of others, including the unborn. In resolving such matters Judaism recognizes that, for any given individual, existence is not an unmitigated blessing and hence his or her personal welfare might have been better served had he or she not been born: "Better for man that he had not been created …" (*Eruvin* 13b).[51] But God created the world "not as a waste. He formed it to be inhabited" (Isaiah 45:18). Man has been given not only divine license to propagate the species but also a mandate to do so. Consideration of the possibility of less than satisfactory offspring is not a matter of human concern. As, according to the talmudic account, when King Hezekiah, who pleaded that he had desisted from engaging in procreation because he had reason to fear that his progeny would not be upright, the prophet responded, "Of what concern are the secrets of God to you?" (*Berakhot* 10a).

Procreation is integral to the natural order. To be sure, propagation of the species brings with it developments which, at least from the human vantage point, are misadventures in the form of spontaneous abortions, stillbirths, and congenital defects. To man, procreation appears to be a form of Russian

[51] The text reads: "*noaḥ lo le-adam*." The usual term indicating the concept of "goodness" would be "*tov*." In this dictum, the reference is not to fundamental goodness for which the Hebrew would have been "*tov*," but to "convenience" or "easiness," as captured by the term "*noaḥ*."

roulette but, fortunately, the odds are in our favor; inordinate burdens are the exception, not the rule.

Divine design for the propagation of the species requires the acceptance only of risks inherent in the natural order; it is reasonable to eschew even such risks in circumstances in which they are known to be uncommonly high. The Gemara, *Yevamot* 64b, declares, "A person should not marry a woman from a family of *nikhpin* or a family of *mezora'im*." We do not necessarily know the precise nature of those maladies but this we do know: the Sages regarded them as hereditary diseases, disorders we would now describe as genetically transmitted. The admonition of the Sages discouraging, and perhaps even forbidding, marital unions likely to increase the incidence of those congenital conditions is probably the earliest eugenic legislation to have been promulgated.

The rationale underlying that admonition is self-evident. Man simply does not have the right to burden the human condition when the burden can be avoided. Man does not have the right to create such burdens even if, as a result, a life will remain uncreated. Certainly, euthanasia, even when intended as an act of compassion designed to extinguish human suffering rather than human life, remains an act of homicide. Certainly, heroic measures are warranted and usually mandated in order to extend human life even when a finite human intellect cannot fathom a purpose in the continued life of the patient. But there is absolutely no obligation to use heroic or artificial measures in the genesis of life.[52] Certainly, the desire for offspring is deeply rooted, entirely natural, and highly commendable. Certainly, one must empathize with the emotional anguish of the infertile. But elimination of their pain does not justify the risk of imposing congenital burdens upon those yet to be born.

Contemporary society and its legal system have espoused a doctrine of informed consent. One dares not subject a person to medical treatment or bodily invasion without his or her permission. Consent for the treatment of children or of persons otherwise incompetent to make their own decisions is given by parents or duly appointed guardians. But those surrogates are not permitted to act capriciously. The decision must be made either in accordance with principles of substituted judgment or on the basis of a best interest standard. Those decision-making methods can be applied ethically only when a life is

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[52] *See, e.g.*, RABBI MALKI'EL ZEVI TENNENBAUM, 3 TESHUVOT DIVREI MALKI'EL no. 107 (1904), and Rabbi Shlomoh Zalman Auerbach, 1 NO'AM 158 (1958), reprinted in RABBI SHLOMOH ZALMAN AUERBACH, MINḤAT SHLOMOH, TINYANA, no. 124, sec. 2, s.v. *u-be-noge'a* (1999) and in 3 MINḤAT SHLOMOH, no. 88, sec. 8, s.v. *u-be-noge'a* (1998).

already in existence; such standards are devoid of both logical and moral meaning when the life affected by the decision is not yet in existence.[53]

At the current juncture of scientific and technical knowledge mitochondrial DNA replacement certainly poses significant risks to the yet-to-be-conceived fetus. Pioneering embryologists have candidly stated that at least one case in which such procedures have been utilized has resulted in "pervasive development disorders."[54] The decision to expose the unborn child to such a risk is inherent in the decision to employ methods of artificial procreation involving mitochondrial replacement. That decision is made well before conception at a time that the life affected by the decision is not yet in existence. For that reason alone, this procedure should be deemed unethical.

To be sure, prophets of doom—this writer included[55]—raised a similar specter with regard to earlier developed forms of artificial procreation, including the very process of *in vitro* fertilization. Damage might be introduced at any point in the procedure. Early stages of cell division *ex utero* might result in implantation of abnormal fetuses that in the course of natural gestation would have been spontaneously aborted. Those concerns were cogent then and similar concerns are cogent now with regard to mtDNA replacement. Even granting that, *post factum*, the outcomes of newly developed procedures may at some time in the future be shown to be statistically no more untoward than those of natural pregnancy, a happy outcome does not retroactively serve to exculpate an act inherently unethical at the time at which it was undertaken.[56] Daniel Callahan has insightfully observed that the history of medicine is strewn with the debris of immoral experimentation.[57] A prominent medical policymaker, Dr. Henry K. Beecher of Harvard University has been quoted as remarking that an experiment "does not become moral because it happens to produce good

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[53] For an entrée into the vast literature on this subject, see I. Glenn Cohen, *Beyond Best Interests*, 96 MINN. L REV. 1187, 1210 (2012) ("I share with others the view that 'no one is harmed in not being created, because there is no one to be harmed if we do not create someone,'") (quoting F.M. Kamm, *Cloning and Harm to Offspring*, 4 N.Y.U.J. LEGIS. & PUB. POL'Y 72 (2000–2001).

[54] Brownlee, *supra* note 11.

[55] *See* BLEICH, JUDAISM AND HEALING, *supra* note 35, at 92.

[56] To be sure, discarding superfluous fertilized ova is a concomitant moral problem. The argument herein presented is in addition to the even graver issue presented by the destruction of fertilized ova in conjunction with even conventional IVF procedures. *See generally* William Hough, *1.7 Million Human Embryos Created for IVF Embryos Thrown Away*, THE TELEGRAPH, Dec. 31, 2012, http://www.telegraph.co.uk/news/health/news/9772233/1.7-million-human-embryos-created-for-IVF-thrown-away.html.

[57] *Doctor Doubts Ethics in Case of British Baby*, N.Y. TIMES, July 27, 1978, at A16.

results."[58] The shocking Tuskegee syphilis study is but the tip of the iceberg.[59] It cannot be gainsaid that unethical acts have led to significant benefits. In no area is that more true than in medicine. But the end does not justify the means; most emphatically, a welcome result—even a highly welcome one—does not exculpate immoral means.

The late Professor Paul Ramsey branded all manner of fetal experimentation as unethical on the grounds that: (1) all experimentation of such nature can have deleterious effects, many of which may not even be contemplated; and (2) the fetus does not yet exist and cannot give consent to the assumption of such risks.[60] His point is well taken. Nature does not require human consent. Consent to actions and hazards imposed by natural processes has been granted by the Deity. Inherent in the natural order is that parents assume prudent risks on behalf of their children for their children's own benefit. It is not part of the natural order that prospective parents assume unknown and inordinate risks for unborn infants who have not yet been entrusted to their care.

It has been argued that harm is to be defined as that which causes a person to be worse off than he would have been otherwise.[61] When, absent the risk-causing procedure, there would be no person, goes the argument, that person could not be worse off as result of the procedure.[62] That argument would strike many as semantic, even sophistic, rather than substantive.

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[58] *See* Paul Ramsey, *Shall We 'Reproduce?'*, 220 J.A.M.A. 1349 (June 5, 1972).

[59] *See* JAMES H. JONES, BAD BLOOD: THE TUSKEGEE SYPHILIS EXPERIMENT (1981) and SUSAN REVERBY, EXAMINING TUSKEGEE: THE INFAMOUS SYPHILIS STUDY AND ITS LEGACY (2009).

[60] *See* Ramsey, *supra* note 58, at 1346–50, 1480–85 and PAUL RAMSEY, THE ETHICS OF FETAL RESEARCH (1975). *See also* J. DAVID BLEICH, 2 BIOETHICAL DILEMMAS 34–38 (2006).

[61] *See* Joel Feinberg, *Wrongful Life and the Counterfactual Element in Harming*, 4 SOC. PHIL. & POL'Y 145 (1986) and JOEL FEINBERG, 1 HARM TO OTHERS 31–64 (1984). *See also* G. Bahadur, *Ethical Challenges in Reproductive Medicine: Posthumous Reproduction*, 1266 INT'L CONGRESS SERIES 299 (2004). Further discussion of this argument can be found in Carson Strong et al., *Ethics of Sperm Retrieval after Death or Persistent Vegetative State*, 15 HUM. REPROD. 739 (2000). *See also* W. Ryan Schuster, *Rights Gone Wrong: A Case Against Wrongful Life*, 57 WM. & MARY L. REV. 2330 (2016), and Jillian T. Stein, *Backdoor Eugenics: The Troubling Implications of Certain Damages Awards in Wrongful Birth and Wrongful Life Claims*, 40 SETON HALL L. REV. 1117 (2010).

[62] *See* HARM TO OTHERS, *supra* note 61, at 95–104. A New York trial court awarded damages to an infant owing to negligence on the part of custodians in not preventing the pregnancy of a mentally deficient patient in a state institution but noted the seeming paradox inherent in the idea that a tort can "be inflicted upon a being simultaneously with its inception." Williams v. New York, 260 N.Y.S.2d 953, 956 (Ct. Claims 1965) (quoting Zepeda v. Zepeda, 190 N.E.2d 849, 852 (Ill. Ct. App. 1963)). As stated by one commen-

Far more engaging as a basis for justifying the risks involved in such experimental procedures is a pronatalist thesis: that an unconceived child already has a right to be conceived. It might then be argued that risks may be assumed in generating a life just as risks are warranted in endeavoring to preserve an already existing life.[63]

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tator: "[N]o comparison is possible since were it not for the act of birth the infant would not exist. By his cause of action, the plaintiff cuts from under himself the ground upon which he needs to rely in order to prove his damage." Gad Tedeschi, *On Tort Liability for 'Wrongful Life,'* 1 ISRAEL L. REV. 529 (1966). More recently, another commentator has stated that a claim for wrongful birth does not fit coherently into the framework of common law negligence because it "[f]ail[s] to adequately describe the legally compensable injury without defining the injury as the plaintiff's very existence." Schuster, *supra* note 61, at 2337. Of course, absence of legal liability does not at all signify that a person acting in that manner acts with moral impunity.

At the other end of the continuum between conception and death, one court found that no damages are available to a stroke victim who was resuscitated despite having executed a valid DNR order. The court declared that the value of the pleasures enjoyed during his enhanced longevity cannot be properly evaluated in monetary terms but serves to offset the distress occasioned by living with a handicap. *See* Anderson v. St. Francis-St. George Hosp., 671 N.E.2d 225, 228 (Ohio 1996). The same court had earlier recognized "the improbability of a jury placing a price tag" on the benefit of life. Johnson v. Univ. Hosp. of Cleveland, 540 N.E.2d 1370, 1378 (Ohio 1989). Later, the Supreme Court of New York, Appellate Division, addressed a case in which the decedent was twice resuscitated in violation of DNR orders. The court dismissed the complaint on the ground that the plaintiff was asserting a claim for "wrongful living" and that no such cause of action could be maintained. Cronin v. Jamaica Hosp. Med. Ctr., 60 A.D.3d 803, 804 (N.Y. 2009). The many cases denying recovery for wrongful birth similarly recognize that the inherent value of life may exceed the burden of congenital disability.

[63] This point is a matter of significant discussion in a number of judicial decisions. Negligent failure to detect congenital defects *in utero* may lead to an action for "wrongful birth," i.e., a claim advanced by the parents for compensation for the burden of raising a handicapped child. Some few states allow the handicapped child to maintain his own action but limit damages to the economic costs engendered by the disability. *See* Turpin v. Sortini, 643 P.2d 954 (Cal. 1982). Most courts, however, have rejected such claims because they regarded the problems of assessing damages as insurmountable. In *Gleitman v. Cosgrove*, 227 A.2d 689, 692 (N.J. 1967), the Court stated: "By asserting that he should not have been born, the infant plaintiff makes it logically impossible for a court to measure his alleged damages because of the impossibility of making the comparison required by compensatory remedies."

In a concurring opinion in *Williams v. New York*, 223 N.E.2d 343, 345 (N.Y. Ct. App. 1966), Justice Keating wrote:

> Damages are awarded in tort cases on the basis of a comparison between the position the plaintiff would have been in, had the defendant not committed the acts causing injury, and the position in which the plaintiff presently finds herself.

That position presumes that existence is a *bonum per se*. Judaism posits a much more nuanced view. As has already been cited, "Better for man that he were not created" (*Eruvin* 13b). Assuredly, human life is a beneficence bestowed by the Creator. But life carries with it risks and burdens with the result that human life is not an unmitigated and unequivocal benefit. The divine lawgiver ordained that men engage in procreation; risks to the as yet unborn are

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> The damages sought by the plaintiff in the case at bar involve a determination as to whether nonexistence or nonlife is preferable to life as an illegitimate with all the hardships attendant thereon. It is impossible to make that choice.

In *Gleitman*, Chief Justice Weintraub expressed agnosticism with regard to that question:

> Ultimately, the infant's complaint is that he would be better off not to have been born. Man, who knows nothing of death or nothingness, cannot possibly know whether that is so. We must remember that the choice is not between being born with health or being born without it .... Rather the choice is between a worldly existence and none at all. Implicit, beyond this claim against a physician for faulty advice, is the proposition that a pregnant woman who, duly informed, does not seek an abortion, and all who urge her to see the pregnancy through, are guilty of wrongful injury to the fetus, and indeed that every day in which the infant is sustained after birth is a day of wrong. To recognize a right not to be born is to enter an area in which no one could find his way.

Gleitman, *supra*, 227 A.2d at 711 (Weintraub, J., dissenting in part).

Later, Justice Schreiber, in a dissenting opinion in *Procanik by Procanik v. Cillo*, 478 A.2d. 755, 772 (N.J. 1984), endorsed that view in stating "man does not know whether non-life would have been preferable to an impaired life." However, some courts have rejected the claim that not having been born would be preferable to being born with a defect. In *Berman v. Allan*, 404 A.2d. 8 (N.J. 1979), instead of rejecting the claim because the problem of assessing damages is insurmountable, the court expressed the belief that life, no matter how burdensome, is preferable to non-existence. For a list of similar decisions, see Deana A. Pollard, *Wrongful Analysis in Wrongful Jurisprudence*, 55 ALA. L. REV. 333 fn. 35 (2004).

In a parallel vein, an Ohio court refused to award damages for pain and suffering experienced as a result of unlawful resuscitation. The patient expressed a desire not to be resuscitated in the event of cardiac arrest and a DNR was duly issued. The patient was resuscitated despite the valid DNR. Two days later he suffered a stroke and required nursing home care for a two-year period until his death. The court categorized this action as a claim for "wrongful living" and declared:

> This court has recognized "the impossibility of a jury placing a price tag" on the benefit of life .... We have also disapproved of awarding damages on the relative merits of "being versus non-being".... These views are consistent with the views expressed by the courts of other states.

Anderson v. St. Francis-St. George Hosp., *supra* note 62, 671 N.E. 2d at 228.

imposed by nature. But man does not have license to accept unknown risks in generating life though experimental intervention in the natural order.[64]

C. Parental Ambiguity

1. Difficulty Identifying the Mother

A negative assessment of the propriety of mtDNA replacement does not obviate the need for a determination of maternal identity *post factum*. That which is possible in the physical universe tends to become actual, at least sporadically. "In technology, whatever can be done, will be done,"[65] regardless of moral reservations on the part of some. A *fait accompli*, even if immoral in inception, poses halakhic questions that, even if unwelcome, must be answered.

In instances of mitochondrial DNA replacement, who is the mother?[66] Is the mother the woman who produced the ovum from which the nucleus was taken or the donor of the mitochondrial DNA? If only some defective mitochondrial genes are replaced, who is the mother? In as yet unanticipated situations in which replacement genes are donated by multiple women, who is the mother? Is it possible that the infant may have multiple mothers since each donor of genetic material is to be considered to be one of the neonate's mothers?[67]

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[64] *Cf.* RABBI ABRAHAM SHERMAN, 22 TEḤUMIN 402 (2002).

[65] ANDREW S. GROVE, ONLY THE PARANOID SURVIVE: THE THREAT AND PROMISE OF STRATEGIC INFLECTION POINTS 5 (1996).

[66] The authors of Justinian's digest declare "*[mater] semper certa est, etiam si vulgo conceperit: pater vero is est, quem nuptiae demonstrant*," which can be translated, "[the mother] is always identifiable even if [the son] has been conceived in promiscuity. The father indeed is declared by the marriage." CORPUS JURIS CIVILIS, Dig. 2.4.5 (Theodor Mommsen & Alan Watson, eds., 1985). As Professor Scott FitzGibbon has pointed out to me, that legal maxim must be reevaluated in light of contemporary reproductive technologies.

[67] The possibility of transfer of genetic material from any nonsperm cell into a human ovum has recently been demonstrated by Masahito Tachibana et al., *Human Embryonic Stem Cells Derived by Somatic Cell Nuclear Transfer*, 153 CELL 1228 (2013). By transferring the nucleus of a somatic cell from one woman into the enucleated ovum of another it would be possible to produce a child without any male genetic contribution. The child would have no father, but which woman would be the mother? Or would the child have two mothers? A chimeric infant might also be produced by merging genetic material taken from three or more genetic parents. Production of such chimera has already been accomplished in rhesus monkeys. *See* Alan Trounson and Uta Grieshammer, *Chimeric Primates: Embryonic Stem Cells Need Not Apply*, 148 CELL 285 (2012).

It seems quite apparent that the principle of *rov*, or "majority," does not apply in such a situation. In an early discussion of maternal identity of a child born as the result of donated cytoplasm, Rabbi Eliyahu Bakshi-Doron cryptically comments that the quantity of the donated material should not be the determining factor.[68] The principle reflected by the phrase "*bittul be-rov*" reflects the fact that, in a mixture, the identity of the lesser quantity of material is suppressed and hence submerged in the identity of the major component. That principle does not apply in situations in which the lesser component remains readily discernible in the composite mixture. Genes that govern the determination of physical characteristics would seem to be of that nature. To take a trivial and entirely hypothetical example: assume that eye color is determined by a particular dominant gene and that the particular gene governing eye color was present in the mitochondrial DNA of a gene obtained from a donor. The identity of the donor of that gene would be readily perceived in the offspring simply by gazing at the eyes of the child; hence "nullification" of that gene cannot be said to have occurred on the grounds that the majority of the genes are those of the recipient.

The genes that are most likely to be replaced are those that would result in some type of disease or physiological disorder. Those genes do not necessarily manifest themselves in discernible physical characteristics. Nevertheless, such genes seem to be analogous to a *davar ha-ma'amid* that is not subject to nullification. An emulsifier is an example of a *davar ha-ma'amid*. A *davar ha-ma'amid*, literally, "a substance that holds up" or stabilizes other substances, is not subject to nullification because, although it is itself not directly seen in the compound, a discerning observer can perceive its effect and hence its identity cannot be regarded as having been suppressed. Arguably, genes that preserve physical or physiological integrity "stabilize" the health of offspring with the result that those genes should be regarded as perceivable in the functioning of a normal, healthy human body.[69]

A question directly parallel to that posed by the DNA issue would arise in a situation in which each of two males provided half of the genetic material inserted into an enucleated ovum contributed by a female donor. *See* David Orentlicher, *Beyond Cloning: Expanding Reproductive Options for Same Sex Couples*, 65 BROOKLYN L. REV. 656 (2000) and Erez Aloni, *Cloning and the LGBTI Family: Cautious Optimism*, 35 N.Y.U. REV. L. & SOC. CHANGE 21 (2001).

[68] 4 BINYAN AV no. 75 (2001), reprinted in his BINYAN AV: REFU'AH BE-HALAKHA, no. 17 (2015).

[69] *Cf.* Weiss, *supra* note 44, who ascribes maternal identity to the woman who contributes the major portion of the DNA. Rabbi Weiss rejects consideration of factors that militate against application of the principle of *rov*. However, he does so without either citation of sources or a reasoned explanation but simply on the basis of the notion that having multiple mothers is

Moreover, many authorities maintain that the loss of identity by means of nullification is a principle applicable only to forbidden substances and hence applies only to negation of prohibited status but not to positive determinations of identity.[70] Those scholars point to Leviticus 16:18, which describes the sprinkling of blood by the High Priest as part of the sacrificial ritual of the Day of Atonement. The blood of the goat offered as a sin-offering on behalf of the community and the blood of the bullock sacrificed as the High Priest's personal offering were mingled and thereupon Aaron was commanded to "take of the blood of the bullock and of the blood of the goat" and pour it upon the horns of the altar. The blood of the much larger bull was more copious than the blood of the smaller goat; yet the identity of the goat blood remained distinct and was not regarded as having been submerged in the greater quantity of blood that gushed from the bull. Applying the principle that positive forms of identity cannot be nullified or submerged, exclusive maternal identity cannot be ascribed either to the source of the numerical majority of the maternal genes or to the contributor of the major portion of the material of the physical mass of which the ovum is constituted.

The question of maternity in instances of DNA replacement would become moot if it were determined that the biological source of the ovum was irrelevant because parturition is the sole determinant of maternity. DNA replacement does not represent a case of first impression with regard to that issue. The question first arose with the advent of surrogacy and again later with regard to ovum donation and has been previously addressed by this writer.[71] Accordingly, a brief synopsis of the relevant sources will suffice.

The most authoritative source to be considered in resolving this problem is the Mishnah, *Yevamot* 77b. The Mishnah describes a gentile woman pregnant with twin sons who converts during the course of her pregnancy. A fetus conceived while the mother is a gentile could not be Jewish at the time of conception. Accordingly, the fetus would require conversion in order to become a Jew. Conversion can take place subsequent to birth or, if the mother converts at any time during the gestational period, the conversion of the mother serves to effect

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counterintuitive. The possibility of multiple mothers is entertained by Rabbi Samuel ha-Levi Woszner, 3 TESHUVOT SHEVET HA-LEVI no. 175 (1976); RABBI ELIYAHU BAKSHI-DORON, *supra* note 69; and BLEICH, 1 CONTEMPORARY HALAKHIC PROBLEMS, *supra* note 40, at 107–08 and 4 CONTEMPORARY HALAKHIC PROBLEMS, *supra* note 40, at 252.

[70] *See* 3 ENCYCLOPEDIA TALMUDIT 69 (1951).

[71] *See* BLEICH, 1 CONTEMPORARY HALAKHIC PROBLEMS, *supra* note 40, at 106–09; 2 CONTEMPORARY HALAKHIC PROBLEMS 91–93 (1995); and 4 CONTEMPORARY HALAKHIC PROBLEMS, *supra* note 40, at 237–72. *Cf.* 4 CONTEMPORARY HALAKHIC PROBLEMS, *supra* note 40, at 243, n. 13.

conversion of the fetus within her womb as well. As a convert, the fetus has no halakhically recognized father and hence no halakhically recognized paternal siblings. Similarly, it might seem that, as a convert, the fetus has neither a halakhically recognized mother nor halakhically recognized maternal siblings. Nevertheless, in the case of a female proselyte pregnant with twin sons, the Mishnah declares them to be maternal brothers. Such a relationship can arise only if they share a common mother. But, in the case of proselytes, any maternal relationship stemming from conception is extinguished. In order for them to be considered maternal brothers, a maternal-filial relationship must arise subsequent to, or simultaneously with, their mother's conversion. If so, then it is parturition, or perhaps gestation in any of its stages,[72] that establishes a maternal-filial relationship.[73] The result then is that in all cases of ovum donation, surrogacy, or DNA replacement the source of the maternal genetic material is of no consequence; parturition establishes maternity and it is the birth mother who is the mother.[74]

A second proof-text supporting that conclusion is a statement of the Gemara, *Megillah* 13a, indicating that the verse "and with the death of her father and her mother Mordecai took her [Esther] to himself as a daughter" (Esther 2:7) signifies that Esther never had either a father or mother, i.e., her father died after her conception and her mother died in childbirth. The statement that Esther never had a "mother" because her biological mother did not survive childbirth implies that motherhood is established upon birth of the child. Hence it must be concluded that maternal relationship is a concomitant of parturition.[75]

Further support may be adduced from a comment of *Tosafot*, *Ketubot* 11a, s.v. *matbilin*. The Gemara, *Sanhedrin* 68b, speaks of a minor who might own real property but who could not possibly have an heir. Every Jew has relatives who are eligible to inherit his estate. Ostensibly, a proselyte who is a minor cannot possess his own real estate nor does he have a relative whose estate he might have inherited. *Tosafot* explain that a situation in which a proselyte who

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[72] *Cf.* 4 CONTEMPORARY HALAKHIC PROBLEMS, *supra* note 40, at 248–51.

[73] *Cf. id.* at 242, n. 11, and 245, n. 15. *See also* RABBI SAUL ISRAELI, 3 ḤAVVOT BINYAMIN no. 108, sec. 2:4–5 (1998).

[74] *Cf. id.* at 243, n. 13.

[75] Presumably, delivery by caesarian section is the halakhic equivalent of parturition. However, it is not entirely clear whether it is parturition *per se*, i.e., emergence from the body of the mother that constitutes "birth" or whether it is the culmination of pregnancy that constitutes "birth." That question is of consequence in a situation in which the mother perishes before delivery of the baby. *Id. See* RABBI DAVID FRIEDMAN OF KARLIN, YAD DAVID, PISKEI HALAKHOT (Warsaw 1899), *Hilkhot Ishut* 14:144 and his citation of the apparently contradictory positions of *Tosafot*, *Bava Batra* 142a, s.v. *mohel* and *Niddah* 44a, s.v. *ihu*.

is a minor might own property would occur if the proselyte's mother converted while pregnant with him and subsequently died. Her son, declare *Tosafot*, would inherit her estate—a fact that explains how the proselyte acquired property. But, since the son is yet a minor, he could not have sired children and hence he himself has no heirs. Even if his mother had other children, maternal half-brothers are not heirs.

The novel point that emerges from *Tosafot*'s formulation of this scenario is that a pregnant woman's child born subsequent to her conversion is her halakhic heir. For that to be the case, there must be a maternal-filial relationship but that relationship could not be a continuation of a relationship that came into existence at the time of conception since such relationships are extinguished upon conversion.

An additional text is aggadic in nature.[76] There are numerous sources that indicate that Leah was aware that Jacob would father no more than twelve sons. Leah herself had already given birth to six sons; Bilhah and Zilpah had each given birth to two sons. Rachel was the mother of only one son. Leah found herself pregnant and realized that, if her fetus were male, it would be Jacob's final son. If that were to transpire, her sister Rachel would be humiliated because she had given birth to but a single male child while the maidservants had each borne two sons. Thereupon, Leah prayed that her child be a daughter so that her sister might yet bear an additional son. One source indicates that Leah's prayer did not at all determine the gender of her fetus. Rather, Rachel was already pregnant, but with a daughter. Thus both sisters were pregnant, Leah with a male fetus and Rachel with a female fetus. Leah's prayer was answered with an *in utero* fetal transfer—the female fetus, later named Dinah, was transferred from Rachel's womb to that of Leah and the male fetus, later named Benjamin, was transferred from Leah's womb to that of Rachel. Thus, Rachel was in fact the genetic mother of Dinah. Nevertheless, Scripture refers to Dinah as the daughter of Leah (Genesis 30:21) thereby indicating that the Torah recognizes the birth mother as the mother.[77] That version of the narrative is reflected in the liturgical poem "*Even Ḥug*," attributed to Rabbi Eliezer ha-

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[76] *See* PALESTINIAN TALMUD, *Pe'ah* 2:4. Normative halakhic rules are not generally derived from aggadic dicta. Aggadic statements are often unclear, allegorical or hortatory in nature and, at times, they express pietistic aspirations rather than normative rules. Nevertheless, such statements, even if not dispositive, may be persuasive. See *Oẓar ha-Ge'onim*, *Ḥagiggah* (1932), nos. 67–68 and 1 ENCYCLOPEDIA TALMUDIT, *supra* note 70, at 132.

[77] Some writers have unconvincingly attempted to employ this source to establish the opposing view, *viz.*, that it is the genetic mother who is regarded as the mother. *See* 2 CONTEMPORARY HALAKHIC PROBLEMS, *supra* note 40, at 93 and 4 CONTEMPORARY HALAKHIC PROBLEMS, *supra* note 40, at 247, n. 18.

Kalir, that is recited in the part of the reader's repetition of the *shaharit* prayer on the first day of *Rosh ha-Shanah* immediately following the conclusion of the blessing "Who resurrects the dead."[78]

The sources that have been adduced demonstrate only that the parturitional mother is *a* mother; they do not establish that she is the sole mother of the child. Of course, it is entirely possible that Halakhah might recognize that a child may have multiple mothers and that the parturitional mother is *a* mother rather than *the* mother of the child.[79] That conclusion may be compelled on the basis of another halakhic consideration.

With regard to animals, Halakhah establishes identification as a member of a species, not on the basis of phenotype, but on the basis of maternal descent. Thus the progeny of a cow are recognized as kosher bovines regardless of physical characteristics. The question is whether the animal's father plays any role at all in determining the offspring's identity as a member of a species. The issue is whether "*hosheshin le-zera ha-av*—the seed of the father is to be considered"—or is to be ignored. If "the seed of the father is to be considered" it is evident that a parental relationship can be established other than on the basis of parturition. The "seed" here referred to is clearly the male gamete. If that "seed" is to be regarded as a source for transmission of identity it would stand to reason that the female gamete should be regarded in a similar manner, i.e., the female seed should be recognized as a source of parental identity no less so than the male seed. In effect, the genetic mother would have a status comparable to that of a genetic father. *Hosheshin le-zera ha-av* is an unresolved issue of Halakhah and therefore is treated as a matter of doubt.[80] If so, although the birth mother is certainly *a* mother, whether the biological mother is also recognized as a halakhic mother would similarly remain a matter of doubt.

Nevertheless, there are a number of writers who maintain that it is the biological mother, rather than the birth mother, who is recognized as the halak-

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[78] See RABBI MOSHE STERNBUCH, BE-SHEVILEI HA-REFU'AH, no. 8 (1984) and RABBI ZALMAN NECHEMIAH GOLDBERG, 5 TEḤUMIN 248–59 (1984). Both Rabbi Joseph Shalom Eliashiv, quoted by NISHMAT AVRAHAM, *supra* note 39, at *Even ha-Ezer*, 1:6, n. 6:10 (p. 33) and RABBI ELIEZER WALDENBERG, 19 ẒIẒ ELI'EZER no. 40 (1992), maintain that it is reasonable to assume that the birth mother is regarded as the halakhic mother. *But see* 15 ẒIẒ ELI'EZER no. 45 (1983) (advancing the curious position that a child born of *in vitro* fertilization has no halakhically recognized mother). *See* 4 CONTEMPORARY HALAKHIC PROBLEMS, *supra* note 40, at 234. *See also* RABBI MOSHE HERSHLER, 25 TORAH SHE-BE-AL PEH 260 (1984) and 1 HALAKHAH U-REFU'AH 316–20 (1980).

[79] *See* 4 CONTEMPORARY HALAKHIC PROBLEMS, *supra* note 40, at 251–58. *Cf. supra* text accompanying note 44.

[80] *See, e.g., Shulḥan Arukh, Yoreh De'ah* 16:2 and 28:3. *Cf, Shakh, Yoreh De'ah* 16:17.

hic mother.[81] Other authorities regard the issue as involving a matter of doubt that cannot be resolved on the basis of available halakhic sources.[82]

2. Jewish Law's Proscription of Activities Resulting in Parental Ambiguity

The former Sephardic Chief Rabbi of Israel, Rabbi Eliyahu Bakshi-Doron, cites unnamed sources who maintain that it is forbidden to engage in activity that results in halakhic ambiguity with regard to parental identity.[83] The earlier cited verse "and to your progeny after you" (Genesis 17:7) serves to establish a prohibition against suppressing family relationships, e.g., by raising families in different locales whose identity are unknown to one another. A three-month waiting period before a woman's remarriage was ordained by the Sages in order to obviate doubt with regard to the paternal identity of a child who might be born less than nine months subsequent to contracting the second marriage.[84] The talmudic examples represent instances of factual ambiguity. The authorities quoted by Rabbi Bakshi-Doron regard that principle as encompassing not only situations of empirical ignorance but situations that give rise to halakhic doubt as well. Those authorities apparently maintain that parental identity must be known with halakhic certainty no less so than with factual certainty. If doubt exists with regard to which of the contributors of somatic material is the mother, or whether there may be multiple mothers, creating such a situation, they contend, is encompassed with the parameters of the prohibition derived from the verse "and your progeny after you."

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[81] *See* 4 CONTEMPORARY HALAKHIC PROBLEMS, *supra* note 40, at 246 n. 17, 247 n. 18, and 255 n. 27.

[82] Eliashiv, *supra* note 79, and Rabbi Shlomoh Zalman Auerbach, quoted by NISHMAT AVRAHAM, *supra* note 39, at *Even ha-Ezer*, 1:6, n. 6:10 (p. 35). *See also* 4 CONTEMPORARY HALAKHIC PROBLEMS, *supra* note 40, at 252–55.

[83] 4 TESHUVOT BET AV, no. 75, reprinted in his BET AV: REFU'AH BE-HALAKHAH, no. 17,

[84] Although the principle that "*rov nashim le-tet yaldan*—the majority of women give birth at nine months" (*Yevamot* 37a) assigns paternity to the first husband, the rule formulated by the Gemara serves to forbid reliance in such instances upon *rov* in order to establish paternity with certainty. *See Tosafot*, *Yevamot* 37a, s.v. *rov*. *See also* RABBI JOEL TEITELBAUM, 2 TESHUVOT DIVREI YO'EL no. 107, sec. 3 (1981). Nevertheless, both DIVREI YO'EL and RABBI MOSHE FEINSTEIN, 1 IGGEROT MOSHEH, YOREH DE'AH no. 162 (1960) and 1 EVEN HA-EZER no. 7 (1961), regard the underlying concern, *viz.*, suppressing, or creating ambiguity with regard to, parental identity, to be a reflection of a biblical prohibition derived from the verse "and to your progeny after you." *Cf.* Henkin, *supra* note 38. In accordance with his thesis that "and to your progeny after you," establishes a biblical prohibition, *Iggerot Mosheh* declares participation in closed adoption, in which records are sealed and thereby create ambiguity with regard to parental identity, to be a biblical infraction.

3. Jewish Law's Proscription of Adulterous Parenthood

Use of a portion of an ovum donated by another man's wife would present a further problem according to the rather novel view espoused by Rabbi Samuel ha-Levi Woszner.[85] G-d declared to Adam, "Therefore a man shall leave his father and his mother and cleave to his wife and they shall be one flesh" (Genesis 2:24). The Gemara, *Sanhedrin* 58a, derives the prohibition against adultery incorporated in the Noahide Code from that verse. The phrase "and cleave to his wife" is construed as implying "to his wife, but not the wife of his fellow." *Ha-Makneh*, *Kiddushin* 13b, explains that *Tosafot* obviously regard that implied admonition as also having been incorporated in the Sinaitic Code, and hence binding upon Jews as well.

The concluding phrase "and they shall be one flesh" is construed by the Gemara, *Sanhedrin* 58a, as a reference to the child born to the couple.[86] Rabbi Woszner understands that biblical phrase as also constituting an admonition. The child is to be the product of a union between husband and wife in which each contributes to the child's genesis and development. By implication, the verse serves to exclude genesis of a child by a man in concert with "the wife of his fellow." According to that reading, the inferred prohibition "but not to the wife of his fellow" applies, not only to engaging in the sexual act inherent in cleaving "to the wife of his fellow," but also to procreation of a child, i.e., co-option of, or being co-opted by, the wife of another man in generating "one flesh," regardless of how the child is conceived.

Rabbi Woszner developed this thesis in expressing censure of artificial insemination when the semen of a donor other than the husband is employed in achieving pregnancy. The donor participates together with the "wife of his fellow," rather than with his own wife, in the conception of a child. Dr. Abraham S. Abraham reports that Rabbi Woszner orally acknowledged that, for precisely the same reason, the prohibition also applies to employing a married woman as a surrogate mother.[87] Rabbi Bakshi-Doron observes that Rabbi Woszner's reasoning would extend to utilization of any somatic material contributed by a married woman for purposes of conceiving a child with someone other than her husband. Rabbi Joseph Shalom Eliashiv is similarly quoted as prohibiting transfer of any portion of the cytoplasm from the ovum of one woman to another.[88] It is, however, unclear whether Rabbi Eliashiv shared Rabbi Woszner's view or whether his concern was with regard to creating an ambiguous or

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[85] 3 TESHUVOT SHEVET HA-LEVI, no. 175.
[86] *See* Rashi, *ad locum*, s.v. *mi* and Rashi, Genesis 2:24.
[87] NISHMAT AVRAHAM, *supra* note 39, at *Even ha-Ezer* 5:6, n. 1:50 (p. 33).
[88] *Id.* at *Even ha-Ezer* 1:6, n. 6:15 (p. 39).

doubtful maternal relationship, or whether his ruling was based upon both factors.

V. CONCLUSION

In summation, it can be stated that, apart from the serious concerns presented by crossing the germ line that may affect the very nature of future generations of human beings, the potential for harm to the prospective neonate as a result of mtDNA replacement represents an assumption of risk to a potential human being that, even if not formally interdicted, is antithetical to moral principles announced by the Sages of the Talmud. Moreover, formidable rabbinic opinion maintains that blurring of maternal identity and comingling of male sperm with genetic material of the wife of another man is prohibited by Halakhah. *Post factum,* whether the birth mother is to be recognized as the sole halakhic mother or whether the child has multiple mothers remains a matter of significant dispute.[89]

[89] Depending upon how the procedure is carried out, sperm procurement and excess embryos may also present halakhic problems. For a discussion of semen procurement, see J. DAVID BLEICH, I BIOETHICAL DILEMMAS 219–24 (1998). For a discussion of the status of preimplantation embryos, see *id.* at 209–11 and II BIOETHICAL DILEMMAS, *supra* note 51, at 211–15.