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THE BIOETHICS OF HUMAN CLONING

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Abstract

The authors take you through a brief history of the technologies that lead to the development of cloning technologies, as well as many of the issues these technologies have faced on the way to their current state of acceptance. Current issues on human cloning are also presented, discussed, and concluded upon. The authors then recommend what people, the government, and the world community should do regarding this issue. This report was written in order to educate the reader on all of the issues surrounding this controversial topic.

Executive Summary

In today's world, science and technology bring new ideas and innovations into existence at a rapid rate. These advances often challenge our ethics and morals, as we are forced to consider factors and consequences that previously never needed to be examined. Such is the case with the majority of experiments that are conducted on human beings, both born and unborn. A prime example of this is the development of human cloning technology and the possible use of this technology to create new human beings in the future. In the past forty years, increasing research into this area and new understanding in the fields of genetics, developmental biology, and biochemistry have turned the idea of successfully creating a human clone from science fiction into near reality. There is widespread bioethical, moral, and scientific debate on this issue. The purpose of this report is to fully examine the debate on human cloning, researching and considering both the positive and negative potential that this technology has. From this examination we were able to make personal conclusions and recommendations on the future use of human cloning technology.

To begin our research we looked at the historical development of genetic manipulation practices by human beings. Since ancient Greek times the practice of eugenics, or selectively breeding an organism for desired traits, has existed. Early acts of tampering with human genetics and heredity specifically are seen with the introduction of reproductive technologies to treat infertility and sexual dysfunction. In the 1962, successful amphibian cloning experiments marked the beginning of a new age in human technological evolution. This ability to asexually create animals was, and still is, very powerful. In the 1970's, applied cell and DNA science led to the development and

widespread implementation of gene level cloning. This has become an indispensable tool in molecular biology and other fields of study. The cloning of an adult sheep into a viable offspring (Dolly) in 1997 was a milestone in the advancement of cloning technology. Ian Wilmut and his colleagues were the first to successfully use a new technique called somatic cell nuclear transfer on mammals. Later in 1997, Meng and his team were able clone rhesus macaque monkeys from early embryonic cells. These developments show the real possibility of cloning human beings in the near future, if we choose to pursue this line of biotechnology.

In reaction to the advance of research involving human genetic manipulation, many bioethical and religious interjections have been made. There is agreement between most on one main point: there must be limits placed on science when it may violate important moral and ethical ideals. This is the cause of the widespread apprehension that is seen in regard to human cloning, as this technology could be grossly abused. Opinions beyond this vary, with strong arguments existing both for and against the development of human cloning technology.

Opposition is based on several main arguments. There is much tentativeness expressed about humans blatantly altering natural processes, and doubt as to whether we have the right to play creator. There is also concern about unforeseen complications that may arise. These include the personal wellbeing of the clone and potential individuality and identity uncertainties that may arise. Cloning on a large scale would also decrease genetic diversity in our species. Many serious moral and human rights issues are inherent with this technology.

Support for the development of cloning technology is also shown for a number of reasons. The medical implications of human cloning are immense. Generation of new organs and tissues would eliminate the need for matching donors. Elimination of many genetic diseases may also be possible. Cloning would provide another reproductive option for those who cannot bear children naturally. Other potential benefits include preserving lineages that are threatened or that have been nearly lost, such as Jewish families destroyed by the holocaust.

The conservative attitudes of most authorities on this issue are reflected in the current legal status of human cloning. In 1997, after Dolly was born, the National Bioethics Advisory Commission recommended the prohibition of all attempts to clone human beings for a period of three to five years. Similar action was taken by countries in other parts of the world. In the future, after further examination of the bioethical and moral issues surrounding human cloning, these laws can be modified or changed.

From our research, we have reached several conclusions and have made recommendations on the development of human cloning technology. Due to the potential harm that may come to the clone, both of physical and psychological cause, we conclude that cloning a full human being is both unethical and immoral. However, due to the potential medical and scientific benefits that can come from human cloning research, we recommend slow, highly regulated development of this technology and embryo experimentation that does not result in the birth of a clone. We also recommend reassessment of current legislation, and the formation of federal and global institutions to closely oversee the regulation and development of human cloning technology.

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Introduction

With recent advances in the fields of biotechnology and genetic engineering, and the cloning of Dolly the sheep and rhesus macaques in 1997, cloning has resurfaced as a major issue in the world today. This report will be a critical study of both the history of cloning, including other related sciences that have pushed it along, as well as the past and present issues surrounding it. Through a better understanding of the material, we have used this opportunity to give the reader our educated opinions on the bioethics of human cloning, scientific recommendations on future use of human embryo research and cloning technology, and on current governmental regulations that are in place today.

With the cloning of Dolly, old concerns surrounding the science of cloning in general have been raised. This is a multidisciplinary debate, and it forces world leaders, ethicists, moral leaders, and scientists to communicate in order to preserve both technological and humanitarian interests. There are various interpretations that can come from the prospect of cloning human beings, spanning from the most creative science fiction to unprecedented medical achievement. Though the general population is yet unaware of the basic science and applications of this technology, public opinions from moral and ethical standpoints must be recognized. The future of human cloning must be determined by the people, and the people must be informed.

Our main objective for this report is education. We have detailed all issues thoroughly to give people with little knowledge on this subject a firm basis from which to form their own personal opinions. In order to come to our conclusions, research on the bioethics, science, and technology involved with human cloning was conducted. In terms of ethics and religion, we found varying opinions including those for and those against

pursuing cloning research. The main opposition to human cloning here is in the quality of life that the clone would have, with issues such as lack of individuality and identity problems. Religious opposition stems from the act of man playing creator and basic moral issues. Opinions in the scientific field were also varied. There is debate as to whether somatic cell nuclear transfer will work in humans. At this point, little is known as far as the biochemical mechanisms that control the early stages of fertilization and embryo development. Therefore, getting a concrete idea of what potential this technology has at this time is speculative.

The following sections show the results of our research. Key sections on the development of cloning technology and the bioethical concerns about it, current legislation regulating this type of research, and an overall examination of all of these factors have been created to cover all sides of this debate. We conclude this report with our personal recommendations on the future of human cloning along with our justification based on all current information available to us.

II.A Eugenics

Eugenics is a broad science, which can be traced back as far as ancient Greece. It involves a variety of practices on a wide range of species, but it all entails the improvement of a certain organism by using selective breeding techniques.

The science of eugenics starts by studying the heredity of an organism or group of organisms to find both good and bad traits that may be passed down from generation to generation. This could be as simple as identifying a cow which gives the most milk per day, or corn which grows the best ears, to a much more complex examination involving generations of people passing on genes for a trait such as color blindness. Once the heredity is examined, the organisms with desired traits will be bred to pass down these traits, while organisms with undesirable traits will not be allowed to breed. Male and female subjects of the organisms carrying different traits can also be mated to pass on both traits. (Haller, 1963)

Since early times, these practices have been carried out in the agricultural field both on plants and animals. Even now, with all of the modern advances in genetic technology, many of the fundamental principles and actions taken agriculturally are still very useful. In early times, farmers would evaluate the performance of their current crops and livestock, and depending on what they are looking for from each, they will decide which plants to get seeds for the next year from, or which cows to breed with the strongest bull. Currently, farmers can use this kind of selective breeding in combination with genetic technology to strengthen all of their crops and livestock to more of a peak potential.

One of the biggest advances in the field of eugenics came with The Origin of Species by Charles Darwin. Here Darwin shows us that in nature animals that have stronger, better adapted traits will survive, while the animals with weaker traits will be eliminated through a normal struggle to survive in the wild. These findings initiated much more research into the idea of natural selection, a sort of natural eugenics, and how animals gain either the strong or the weak traits.

Sir Francis Galton is considered the first modern eugenicist. Galton not only coined the term "eugenics," for "good in birth," but also started much of the groundbreaking research for this evolving science. The foundation for most of his work was applying The Origin of Species to the human race. He was very interested in the origin of the human race, both in what we came from and why we became what we are. He also agreed with the increasing belief that the care and treatment of the unfit, or weak, in asylums, hospitals, and through charity was ruining the human race. (Kevles, 1985)

Kevles goes on to show how, by studying the pedigrees of famous men, Galton was able to theorize that mental abilities were inherited, since they showed up along only certain strains of the pedigree and not others. He also theorized that a man's character and capacity were shaped by this heredity, and because of this, nature dominates nurture in the shaping of man. Along with this, he saw that although traits can be passed on from generation to generation through genetics, traits that are acquired throughout life cannot be passed on. Some of his most groundbreaking advances, however, were not what was found in his research, but the techniques he used to attain some of them. Galton was the first to use twins in genetic research, since twins are genetically the same, and also did some pioneering work in the study of different races for traits such as mental abilities.

After Galton, and due greatly to his work, there were many studies on criminal and degenerate anthropology as well as the heredity of people of different races. Many of the anthropology studies involved researching the heredity of inmates in prisons and mental asylums. This research showed that many of the people in both types of institutions had descendants who were also institutionalized. Due to this and the fact that acquired traits throughout life cannot be passed on genetically, many people thought that even through the institutionalization of these people, the entire line of people is contaminated. With the widespread acceptance of this theory, and the fear that these 'less competent' people may be lowering the average of people, many efforts were then taken to prevent these people from breeding by sterilizing them. (Kevles, 1985)

An extension of this work, which added race to these theories, came from the writings of Madison Grant and Lothrop Stoddard. Their thought was that, due to the rising immigration rates into the United States and Europe, the white, Nordic (tall, blond hair, blue eyed) influence will eventually be dominated by people from Asia and Africa. Studies on race were also completed, many of which added to the increasingly racist society by showing scientifically that non-white races were generally of poor heredity and therefore destined to be less intelligent and morally deficient. These findings increased racial tensions even more between whites and all other races. Adolf Hitler took these findings one step further, however, by instituting his blond hair, blue eyed, Aryan army (mostly men of pure Nordic descent), and enforcing his belief that his Aryans were superior to all others. He then went on to kill millions of non-Aryans, in an effort to cleanse and to do what he thought was going to save society. (Haller, 1984)

This was indeed the lowest point for the science of eugenics. The era, however, saw the birth and flourishing of many new sciences in this area, such as genetics, which, when applied to the then accepted eugenic principles, disproved many of their misconceptions.

II.B Reproductive Technologies

In the early 1700's, scientists viewed human sperm under a microscope. Previous to this, many believed that the male ejaculate carried an entire human being, which simply grew in the womb of the female. With increasing studies on the subject, over many years, it was discovered that both the male and the female had to pass something on to the offspring in order for it to be created. This leads to the possibility that one of the two parties involved cannot properly pass on the necessary material, and is therefore infertile, preventing the conception of an offspring. If a couple wants a child, this is a serious problem. (Shannon, 1988)

With this now understood, there were many possibilities to be explored. If a couple did not want to have children, but wanted to have sexual intercourse, it would be necessary to block or impair their passing of material, whereas if a couple wanted to have children, and couldn't, it would be necessary to complete the process in other ways. The solutions to these problems were part of a sexual revolution in the mid-1900's, which made it more possible for humans to control their procreation and take the reproduction out of sexual intercourse.

If a couple were to have sexual intercourse and did not want to conceive a child, the couple would have to keep the sperm of the male from reaching and thus fertilizing

the egg of the female. Two of the most popular ways to do this are: the male wearing a condom, which keeps the sperm from entering the female, and the female taking a birth control pill, which stops the female's normal production of eggs every month.

If a couple wanted to conceive a child, but were unable to because the male sperm is bad, or the male is infertile, another man's sperm, through the use of artificial insemination could impregnate the female. During artificial insemination, sperm is obtained from a host male through masturbation, and injected into the cervix of the female. Fertilization occurs when the sperm reaches and penetrates the egg. (Blank, 1984)

Since it is sometimes very difficult to get the sperm to reach and fertilize the egg in the woman's body, a technique called in vitro fertilization was introduced in 1978. In this technique, the egg is removed from the female, and the sperm is coaxed into fertilizing the egg outside of the body in a lab. When completed, the fertilized egg is placed back into the female and allowed normal gestation.

Each of these three methods of artificial reproduction were met with an initial disapproval on both moral and ethical grounds. One of the biggest issues with reproductive technologies is that they interfere with the natural process of procreation, and it is not good to tamper with natural reproductive abilities. Other problems were fear of safety of the technology and the ethics of a couple taking the love out of the conception of a child as well as their relationship by buying sperm and or eggs. There were also fears of the de-humanization of man, since children could now be obtained at a hospital or clinic, rather than conceived by two loving parents through a natural act of love.

Eventually, however, despite all ethical arguments, all of the technologies listed above have undergone widespread application and implementation, and now are generally accepted. Much of the reason for their widespread acceptance is their benefit to people who are lacking fully functional reproductive capabilities, but still want to provide a loving home for children of their own.

II.C Development of Cloning Technologies

The term clone is broadly defined as the growing of an organism from a single cell by asexual reproduction. It can be expanded to a more contemporary and practical form to include the production of an identical copy of a gene sequence. The existence of cloning as a serious and plausible scientific feat is fairly new, as our understanding of cell biology, molecular biology, biochemistry, and organism reproduction has been expanded. As early as the 1960's, with early amphibian cloning experiments, it became apparent that cloning is actually possible though the mechanisms and science were hardly understood. This research was pioneered by J. B. Gurdon in 1962. He successfully created adult frogs from tadpole cell nuclei. This carried with it tremendous scientific significance. He proved that cloning was feasible. The next advance of this science was gene level cloning, where specific genes from bacterial nuclei were identified and reproduced. In the latest step, with the creation of Dolly the sheep, an adult mammal has been cloned.

To create a clone, DNA from a cell must be duplicated. This can then be used for a number purposes. The first gene was successfully cloned in 1972 by isolating the gene and inserting it into a yeast cell. The yeast incorporated this gene into its own genome

and several copies were generated upon replication (Cloning Timeline, 1997). This type of cloning is called molecular cloning, and is commonly used to insert DNA fragments into host cells (usually bacteria) for amplification. It became an indispensable tool for the molecular biologist, as scientists can insert genes into other organisms in order to replicate the desired gene quickly and in large amounts.

Cellular cloning differs from molecular cloning in that entire cells are replicated. This can be done to all cells in the body except for germ, or sex, cells. The cells are copied and grown in culture in the lab. The new cells are generated after normal cell division occurs. This is a very reliable method, and it is commonly used in the biology laboratory. The cells provide a level of consistency important to good experimental technique, which is critical when doing research or testing compounds on the cloned cells.

There is a somewhat compatible example of organism cloning in nature. This is the genetic phenomenon of identical twins. Twinning happens when a developing embryo, containing the genes of both parents' sex cells, splits at an early stage of development. The result is multiple embryos with the same genetic material contained within each. This process can be induced in vitro by a process known as blastomere separation (Nash, 1997).

It is from this cloning research and knowledge that the unraveling of the genetic mystery has taken place. This is not to say that all has been uncovered, but the principles and techniques used in cloning technology have allowed a direction of genetic research that was before unrealized. This new information has helped scientists to view and define life in a way that one hundred years ago would be scoffed at by the scientific

community. The simple structure and functioning of genes, the fundamental building blocks of life, is what has brought on the next phase in the cloning legacy, a technique known as somatic cell nuclear transfer.

III. Modern Cloning Technology

Before the principles behind modern cloning technology are developed, a fundamental background in basic animal biology must be established. In all life, the blueprint for an organism's body is contained within DNA, which is a nucleic acid usually contained in an organized cellular structure called the nucleus. On a functional level, DNA is organized into small frames that, when read, code for an amino acid. Amino acids (which form proteins), along with nucleic acids, sugars, lipids, and fatty acids, are the main macromolecules needed for life. As this shows, the genes of an individual are what define the physicality of an organism.

Higher level animals naturally procreate by sexual reproduction. Each parent has germ cells with 23 chromosomes, which are organized groups of the parent's genetic material. These germ cells, sperm for males and oocytes for females, are referred to as haploid. The haploid cells are generated through a process called meiosis, during which a normal cell's genetic material is halved. Through the mechanics of meiosis and random organization of chromosomes, diversity in the genetic characteristics of sex cells is achieved (Raven, 1995). Upon fertilization, the chromosomes of these cells merge forming a zygote that has 46 chromosomes and is now referred to as diploid. The newly formed zygote with its full genetic identity will then begin dividing into an embryo. During this time the individual genes responsible for development of the various cell types that comprise the organism are turned on and off as needed, a biochemical process known as differentiation.

Cloning an animal bypasses sexual reproduction in the creation of a new individual. To create a genetically identical clone of an entire animal, two distinct

processes exist. These are blastomere separation and nuclear transplantation. Blastomere separation involves the splitting of a developing embryo soon after fertilization, when the embryo contains between two and eight cells. These cells still have the ability to generate all the cell types needed to make a fully developed individual. This process closely resembles the natural phenomenon of identical twins and multiple offspring births.

Nuclear transplantation cloning is different than blastomere separation, as it does not involve a newly fertilized egg cell. Somatic cells, or body cells other than germ cells, are diploid and therefore contain the full genetic complement necessary for an individual organism. In the early 1980's, a technique was developed where the nucleus of a somatic cell was inserted into an oocyte with its nucleus removed. This completely bypasses sexual reproduction, and the new individual in actuality comes from only one parent. The offspring is in essence a delayed genetic twin of the individual whom from which the somatic nucleus came. This technique, specifically called somatic cell nuclear transfer, has been an advancement that carries with it much intrigue and scientific information.

In 1962, a research team began developing nuclear transfer science. In an attempt to establish whether a somatic nucleus contained all of the same genes as an embryo, the scientists used a somatic cell nucleus from a tadpole and injected it into an enucleated oocyte. The success of this experiment proved that all the genes contained at fertilization, though differentiated to varied extents, are still present in somatic cells (Gurdon, 1962). Later experiments by this group took donor nuclei from adult cells, and the success rate was significantly reduced due to timing differences and chromosomal abnormalities caused by the transfer. This experiment proved that a full differentiation of

an adult somatic nucleus is not irreversible (Gurdon, 1975). Further research into gene expression, the process by which genes are made into proteins, has led to the finding that regulatory molecules control expression. If the proper regulatory molecules are present, it should be possible to reprogram a nucleus (Blau, 1992)

Early nuclear transfer experiments in mammals showed initial success when transferring early stage embryo nuclei into enucleated egg cells. This is seen in the work of many scientists in the 1980's and 1990's (McGrath and Solter, 1984, Willadsen, 1986, Cheong, et al., 1993). Slight modifications to this technique made by Scottish scientist David Wilmut in which the donor nucleus was kept from replicating before transfer led to the first successful clone from an adult somatic cell nuclear transfer into a viable offspring. In 1997, Wilmut and his colleagues announced the birth of Dolly the sheep (Wilmut, et al., 1997). This was a tremendous feat, but one with serious ethical and moral implications.

In August of 1997, soon after the creation of Dolly, researchers at the Oregon Regional Primate Research Center reported successful nuclear transfer production of viable offspring in rhesus macaque monkeys. This was done by enucleating oocytes taken from a female and transferring the diploid nucleus of a blastomere created by in vitro fertilization. The success of this experiment was moderate. Nine females were implanted with a total of 29 embryos, three of which became pregnant, and two resulted in live births (Meng, et al., 1997). Though the donor nucleus was from a blastomere, which is a cell created once a fertilized egg starts dividing and whose nucleus is undifferentiated, this shows the possibility of using nuclear transfer on primates, including humans. The possibilities that could arise from this success are vast, from the

development of somatic cell nuclear transfer techniques in primates to providing new options for assisted reproduction in humans (Wolf, et al., 1998).

In June of 1999, a group of scientists at the University of Wisconsin-Madison published the results of their mammalian somatic cell nuclear transfer experiments. They took nuclei from adult skin cells of cows, sheep, pigs, monkeys, and rats, and they then transferred them into bovine oocytes. Success was achieved with all species as many of the transfer units began to divide, and several advanced to later stages (Dominko, et al., 1999). The group did not attempt to implant the embryos into surrogate mothers. These results give evidence that the mechanisms which regulate early embryonic development may be conserved among all mammals, and that the bovine oocyte can support differentiated nuclei of various ages and numbers of chromosomes. As with the successful cloning of macaques, this provides evidence that this technique could likely work in a variety of mammalian species, even humans.

The fact of whether somatic cell nuclear transfer would work safely and efficiently on human beings is disputable, as the success rate when producing Dolly was 1/277 and virtually zero for all other higher level species. The success rate in the creation of cloned macaques was slightly improved, but this may be due to the undifferentiated state of the donor nucleus. At that point in 1997, and today, the full picture is not yet complete. Unforeseen complications that time may bring about will be of critical interest. It has already been seen that Dolly has aged faster than a normal sheep. This is shown by the length of her telomeres, which are cellular structures that help pull a cell apart during division. Most cells are constantly dividing and replicating to replenish and maintain the body. In natural aging, these structures gradually shorten and diminish,

making cell renewal slow and eventually stop. Though Dolly and the cloned macaques give much hope into new advances that would benefit agriculture, medicine, and science, the potential for use on humans creates an issue of monumental concern and debate.

IV. Early Bioethical Issues

As is the typical case, the technology of cloning has guided and fueled vast arguments on the issues, both in positive and negative ways. Many of these issues first came up while the backbone technologies were being discovered and perfected in mid-1900's. This technology, therefore, not only lead to the scientific breakthroughs of today, but also fought many of the same bioethical battles, paving their way toward the general acceptance that allowed the technology to grow. Therefore, in order to properly understand the issues surrounding these technologies, the details at hand must first be examined.

IV.A Technological Implications

Cloning of an entire organism was successfully achieved in 1962. As indicated in previous sections, this technology was very preliminary and weak, but lead the way to many future advancements. Although human applications of this technology were still far out of reach, this preliminary work spawned the imaginations of many ethicists on their possible applications. (Gurdon, 1962)

Gene level cloning was introduced in the 1970's. Since the introduction of this technology, the fields of molecular biology and biochemistry have undergone incredible progress. This technology made the possibility of cloning a human being a much more reachable feat. Due to these developments, the world realized how quickly this science was advancing and how real of a possibility that cloning would some day be applied to humans. It turns out that much of the original cloning debate was introduced in the early 1970's due to the advancements in this science. (*Cloning Human Beings*)

IV.B Positive Arguments

When early cloning was introduced, there were many potential benefits that were seen. Many of these benefited the scientist directly, leaving it hard for the average person to understand much about the science or advantages. With the new and growing scientific advancements however, came huge achievements, which could effect the population directly and not just the scientist in the lab. At this point, most scientists saw this technology as a tool which could open many doors to the newly growing field of molecular biology, as well as some of the keys to life in all living things. There were also many bioethical positions taken regarding the new advances. Many of these view points noted that there was a growing fear of the technology and what could possibly be done with it, which lead to arguments against it.

From an academic standpoint, much insight into the chemical explanations of DNA's complex properties became the cornerstone of molecular biology. With a better understanding of DNA, we could then gain further insight into the nature of heredity and genetic disease, and the fundamental code for life. By understanding DNA, and subsequently genes, we are now able to target, locate, identify, and use an incredible number of genes. With this ability we can attempt to cure disease by targeting the specific gene through gene therapy. This is a tremendous advantage, as often this type of therapy is highly non-invasive and effective.

On the experimental level, the use of cloned genes improved the quality and certainty of results when exploring animal biology and biochemistry. This means a scientist will now have the ability to run tests on many genetically identical organisms in

the lab, thus reducing many variables and increasing his/her confidence in the results obtained.

This early research has become the backbone of modern life sciences such as molecular biology and genetic engineering. The advances that have come from this technology have helped increase the quality of life for millions of people, both in detecting, fighting and curing disease as well as increasing the accuracy and efficiency of genetic sciences. The benefits to the sciences have revolutionized the way we view life, giving us greater appreciation and understanding of it, and increased ability to improve upon it.

Many ethicists, however, can see this technology getting out of hand. Some feel that touching deeper into creation is not our place and that it could backfire or possibly lead to the demoralization of human beings. This situation brings up two very powerful ethical fallacies. The first is the theory that just because we have the technology to do something, we should do it. The second is the thought that just because we have the power to do something, it is inevitable that it will be done (Fletcher, 1974). Fletcher adds on to this a third idea, stating that it would be bad to stop the growth of a technology, simply due to the worry that it could get out of hand. He says that humans should fully explore all implications of a technology before that technology is either used or condemned. If a technology or process is deemed unethical or immoral, condemning this technology is the only ethical thing to do. Since, even with the cloning of genes, human cloning was still years away, he deemed it silly to stop the technology from growing, but thought that humans should watch it with a moral and ethical eye.

IV.C Negative Arguments

Together with these positive implications came opposition from a variety of sources. The most common argument against the use of the potential cloning technology is the degree to which humans should interfere with natural processes. There were also fears of the de-humanization and de-moralization of people in general. These fears stemmed from the trend toward artificial means of reproduction, which would someday lead to cloning (almost entirely artificial), as well as from moral and religious questions on humans playing the role of creator.

The considerations on humans interfering with natural processes are twofold. The first is a religious argument, which was seen before, during the advancements in reproductive technologies. This said that since god is responsible for creating all creatures and man, a man artificially creating his own living organism in a lab is, in a sense, playing god. Since in most western religions there exists only one, omnipotent entity which has the power of creation, a man with this power would be going against not only the thought, but the religion and would therefore be deemed blasphemous. (Ramsey, 1970)

An argument in a bioethical sense also arose, stating that if we tamper with something in such a new field as it is, there could be many, unforeseen complications and side-effects which come about, that could harm a patient. This argument takes into account that at some point of the process, humans will have to be used in the experimentation to somehow perfect the process. At this time, these human guinea pigs to be used in the research, will be not only an immoral creation, but will most likely be used unethically in a lab for tests. (Fletcher, 1974)

An argument that has both religious and ethical views is that of the tainted role of sex and the family in reproduction. The Roman Catholic religion sees sex as an act of love for means of procreation only. Sex for other reasons besides procreation is considered to be a sin, which is also the reason that birth control methods are also opposed by the Catholic religion. Since procreation is taken out of the sexual act, and the sexual act is taken out of procreation, the Roman Catholic religion sees this as wrong. Added to this there are many family issues that must be taken into account. If sex is taken out of the reproduction process, many feelings of love and family may also leave the process. This could lead to children being brought into the world to less of a family structure or possibly to a single parental figure. Although this seems almost normal on a small scale, large scale dysfunctional families could be traumatic to the human race (Ramsey, 1970).

In the pursuit of science, we have learned much of the intricate balance that nature operates in. No matter where we look, there are no species in the world that engage in the types of practices that we have been using since the 1960's, with the introduction of cloning and reproductive technology. This has been an immediate cause for apprehension in the past when attempts to advance these technologies were made. No matter whether one believed in creation based on theology or evolutionary science, there was considerable question as to how much we should interfere with natural processes. The potential consequences and side effects of these actions were, and still are, dangerous on a grand scale. Whenever we start to change our genetic make up and ability to procreate, two attributes that define us and give us our identity, we may be diminishing the ability of our species to succeed in the future.

V. Contemporary Bioethical Issues

As many past arguments were resolved, newer, more in depth technologies were developed, bringing up many of the old issues once again. New issues arose with this as well, with the real possibility of cloning a human being exemplified by Dolly. With these new developments in higher level genome cloning, a serious concern, which has existed since the beginning of the cloning debate, is in controlling the growth and use of it. It is a great challenge to establish where lines must be drawn, and it is nearly impossible to imagine all potential outcomes when dealing with such powerful technology. As was the case in the 1970's, this is again a two-sided debate and the technological implications must first be discussed to fully understand the issues.

V.A Technological Implications

With the advent of higher level genome cloning, it is becoming more and more possible to understand and control the living world around us through the use of modern genetic technology. There are also many areas of research which are right around the corner and will soon enter the debate as well. This research will give us the power to actually grow entire organs in a lab, or going further, clone an entire human being from a single parent.

In the world around us, there are many implications of this technology. Agriculture, especially, can benefit from this science, as we are now able to, through the use of transgenics, engineer dairy products which may come from the animal already enhanced with pharmaceuticals. We can also grow human tissues on other animals for our use in tissue grafting for burn victims for example. Soon, we may have the power to

clone an entire herd of a cow that gives more milk than any other, a pig that can grow a human liver, or a turkey that gives us only white meat. (Kolata, 1998)

By using this technology on humans, it becomes possible to control our own evolution as well. We now have the power to identify and wipe out genetic diseases, grow artificial tissues in labs, and test babies for genetic diseases even before they enter the world. Soon, we may have the power to clone perfect match organs or tissues for people who need them, reducing the waiting lists for transplants down to nothing. We may also have the power to clone human beings, ending the 'genetic roulette' and possibly wiping out all forms of genetic disease.

V.B Positive Arguments

Among the potential benefits of this higher technology are three major life changing applications. The first application is the growing of actual human organs in a lab. The second is the elimination of many serious genetic diseases through the use of gene therapy. The third application, which will be discussed, is reproductive assistance. (Kolata, 1998)

The generation of new organs for transplanting would eliminate the need for actual human donors. If a scientist could grow a real life human heart, perfectly matched to the patient it is for, in his lab, rejection of transplants would be obsolete, and waitlists for these transplants would be reduced to nothing. Lives would be saved through this technology and the quality of life greatly increased.

With respects to genetic disease, many serious defects have been identified and can potentially be treated through this technology. Many of these defects can already be

identified while the child is still in the womb, meaning the parents can already plan for the child's arival and the doctors can plan tests and procedures ahead of time. In many ways, this would drive medical science into the new millennium.

Cloning will also come into play in the not so distant future. There are many advantages to human cloning technology. A popular example that comes to mind is of the last remaining man of his family line wanting to have a child of his blood line, to carry on his name.

With all of the good foreseen however, we must once again ask the question of whether we should go forward with a technology that could lead to such bad outcomes. Once again the issue of throwing away all of the good possibilities that the science could bring, as listed above, in order to protect the world from potentially bad occurrences is weighed. Although now, when much more is known about the technology and implications, it is seen that there are many more advancements that could be useful in other areas as well, and to risk losing them for fear of something else would be silly. Orthodox Jewish rabbi Moshe Tendler, quoting the Talmud, said it best, "The question is posed, 'Is there not a time when you say to the bee, neither your honey nor your sting'?" Meaning is there ever a time when you should risk throwing away all of the good things that could come from something, because you are so afraid of the bad (Kolata, 1998)?

V.C Negative Arguments

Again, for the opposition, we see many fears with man's interference with nature, which turns out to be a much broader subject, when the possibility of an actual human clone is so close. These new concerns involve an actual clone's rights as a human being

as well as his view toward himself and life. Man playing god has also taken a whole new turn, since it is possible for man to create man as he sees fit, or in his image. Venturing into uncharted scientific waters also carries with it tremendous concern. To examine potential negative effects of human cloning, we must examine the issues from a natural and ethical point of view.

From a biological perspective, the elimination of disease will reduce factors that work against us in nature, but keep us in check and away from catastrophe. One of the major ways that nature regulates the expansion of any given species to overpopulation is by weeding out the unfit through disease. By eliminating disease, we are eliminating one of the last natural elements that regulate human growth. If we can procreate without limit and nothing is out there to stop us, inevitably, as is seen throughout natural history, a mass extinction will occur to restore the natural balance.

There are also religious and bioethical concerns with the actual treatment and identity of the cloned being. These concerns are that a cloned human being would have trouble grasping his/her own individuality and identity with the knowledge that he/she may not be an 'individual.' This could create problems with the clone fitting into and being a normal part of society. Questions then arise on the treatment of these clones by both their parent and by society. Do these clones have the same rights as humans, would the parent be responsible for the clone all his/her life, and how can the clone be distinguished from the parent once both are matured. (Kolata, 1998)

An interesting view of a problem that cloning may create is in the commodification of cloning and clones. If a person can be developed from a single parent, without sexual reproduction, it may become very easy to buy and sell cells or

even cloned beings (geniuses and supermodels, for example, would be very popular). Since the clone is also a human being, and buying and selling human beings has been frowned upon morally, ethically, and legally since the 19th century, this leads to a very serious dilemma on the rights of cloned human beings. (Holland, 1999)

In conclusion, most of the new arguments against cloning are worries concerning the well being of the clone himself. This shows the importance of our actions taken toward the other issues, since there is no way to answer many of the newer questions without some actual tests on humans. An example is that we cannot properly understand how a person gets an identity or a soul, so it is impossible for us to test, scientifically or psychologically, how the clone will react in society. The lesson we should gain from this is of the importance and weight our current decisions have on future generations of people as well as future scientific advancements.

VI. Government Regulations

The role of the United States government in regulating scientific research and its use in new technologies is of great importance and dispute. This is especially seen in the subject of cloning, and specifically, human cloning research. Most will not argue the necessity for exercising moral and ethical decision-making when it comes to these issues. There is debate, however, on which ethical framework to use. In the scientific community, there is often the common feeling that science and the professionals contained within its many disciplines have the best viewpoint for imposing regulations, since it is they who have the most tangible knowledge of the details of these new developments. On the contrary, many factions would empower the government to have complete control in an effort to prevent science from deteriorating the moral fabric of our society on the whims of mere discovery and personal glory. This section will explore past trends in government regulation of reproductive science and cloning technology and also give the current status of the legislation in place regarding the issue of human cloning in the United States and in other countries around the world. From this, personal recommendations will be made.

Since the dawn of the technological revolution beginning at the end of the nineteenth century, an explosion of new applied science has occurred. We have ventured into uncharted territory with respect to legislative precedence. The federal government prohibits the use of funds for research that creates embryos for strictly research purposes and results in their destruction. On the state level, laws regarding safety and efficacy of medical practices hinder private embryo research that would develop human cloning. Though some federal laws exist to prevent some types of human embryo research, there

is nothing too detailed or explicit. In the biological sciences especially there are profound feelings of hesitance and urgency on which direction our actions should be allowed to proceed. This is seen as early as the 1960's with the coming of assisted reproduction and early cloning research. . The need for such technology has often been challenged, as well as whether or not we have the right to do these things. Government action on all such issues has traditionally been reactionary, as we humans seek to protect ourselves from dangerous and potentially self-destructive practices. Public misinformation and lack of knowledge in these areas sometimes leads to hasty preventive action by the government to protect us from dangers that are not necessarily there.

As a parallel to the current debate on legislative requirements for research and implementation of cloning technology, reactions to earlier advancements in reproductive science, genetic engineering, and gene therapy can be looked at. In the past, moratoria have been passed on many issues as a means for allowing time for more careful examination of the issue at hand. These issues include recombinant DNA technology in the mid-1970's, fetal research in 1974, and germ line gene therapy at the beginning of the 1990's. In each instance, action was taken to prevent dangerous, secretive, and problematic use of this technology, to allow time for consideration and review, and to explore the variety of opinions from different people on these subjects. These measures allowed time for a thorough examination of potential safety and risk issues (*Cloning Human Beings*, 1997).

The important reason for examining these past moratoria is to establish what value and preventive ability, if any, they had. A ban still remains on federally funded fetal research of more than "minimal risk" on ethical grounds, and there is still constant

fighting over the issue. This is compounded by the fact that this research is widespread in the private sector. In the case of recombinant DNA technology, the moratorium was based on biohazard concerns. In each case the ban caused much controversy and ambiguity, some of which is still unresolved. The problems that are seen with previous bans are very apparent. Since the moratorium passed on human cloning in 1997 will be over in a couple of years, what will be the next step? A renewal of this would suppress public upheaval and unrest over the issue, but it would not establish a firm stance on the issue of human cloning as would a complete ban. The knowledge gained in hindsight from these earlier cases establishes two major needs for legislation concerning human cloning research. First, action must be taken for reasons such as potential harm to the individual whom on which the technology is used. Second, a ban that merely prevents federally funded human cloning research does not carry over to the private sector. Therefore, if the federal government sees this technology as both detrimental and undesirable for the nation, a complete ban must be established (*Cloning Human Beings*, 1997).

Difficulty in deciding which legislative path to take when dealing with cloning and reproductive technologies exists for a number of reasons. One key reason for this is the fact that commonly agreed upon definitions of what life, individuality, and freedom really mean when applied to cloning are seldom found. Another problem comes when trying to reach the best possible decision that will be met with the fewest objections. It is clear that for the welfare of our species, carefully considered and firm decisions must be made. Practices that would cause potentially harmful effects to our future must be regulated. This is not a cut and dried issue by any means. In this country, our

government operates on the fundamental doctrines of the Constitution. The federal government must make its decisions within the bounds of this document, a feat that carries with it much difficulty and complexity. Several obstacles exist in the road to proper legislative action.

The federal government has the power to enact laws that will regulate the future of cloning research. If it chooses to do so, it must be expected that opposition will be formed with a number of legitimate objections. If the federal government decided to ban all cloning research, states could challenge this on the grounds that they have the right to make their own laws as there is little effect of cloning law on interstate commerce. This is a valid point, but it is expected that the federal government will be granted more power by the Supreme Court when cloning is the central focus. In ten states there are already laws which govern research on embryos and regulate assisted reproduction practices. Many would oppose federal regulation on the grounds that the state legislatures have the right to determine what research goes on within a given state's borders (*Cloning Human Beings*, 1997). This, although it may be true, is not a strong approach when trying to establish clear and indisputable regulation on an issue as important and potentially dangerous as human cloning. If some states allow cloning and some do not, there are many negative consequences. This may be viewed internationally as a sign of moral and legal ambiguity. It could also cause economic disruption as institutions wishing to pursue the potentially lucrative technology of cloning would flood into the states where it is permitted. This would leave the states that did not allow cloning at a commercial disadvantage, and it could raise unemployment rates and standards of living.

When dealing with cloning legislation, the First Amendment right to free speech is often cited. If ideas can freely be expressed, then it is assumed that practices that allow for the formation of these ideas should also be protected under this amendment. This brings into light the idea of the right to scientific inquiry, an idea that is undoubtedly supported by many in the scientific community for obvious reasons. The right to pursue new knowledge could not be restricted merely for the purpose of preventing these new findings from coming into existence. However, due to the potential harms and risks that the use of certain technologies may impart upon those who utilize it, this right may be disregarded.

Another source of opposition to federal regulation of cloning and reproductive issues is the right that individuals reserve over their reproductive practices. This is very complicated because of this right's simple truth: an individual should have this freedom. In a day where many assisted reproduction options are available, most couples strive to procreate and utilize whatever means are available to them. This has been upheld by the Supreme Court under the constitutional right to privacy, but when considered with respect to the issue of cloning and the implications that come with the practice, exceptions should be made (*Cloning Human Beings*, 1997).

Other uses of cloning, such as generating organs and tissues for transplant, would violate the Thirteenth Amendment in its literal form. This amendment explicitly prohibits the institution of slavery and any form of involuntary servitude unless convicted of a crime. A person made for the purpose of having their body used for an others benefit would in essence be a genetic slave. This established situation of genetic slavery, coupled with the inability of the clone to volunteer its body parts for donation, clearly goes

against the Thirteenth Amendment. If a federal cloning ban were established, opposition based on reproductive freedom would likely be overruled on these grounds.

Another set of legal problems that would arise from cloning has to do with parental status and the laws in place that have to do with parenthood. Legally, the cloned individual may in fact be able to claim their own parenthood if they were the product of a nuclear transfer from one person. This is due to the existence of two people with the same genes, with the clone being able to claim they had the same right to parenthood as the somatic cell nucleus donor. In the case of the clone being engineered from a many different individuals genetic material, parenthood would be very confusing to establish. This is so because multiple parents, each with varied amounts of contribution to the offspring, would have different amounts of parenthood biologically. If a clone is created from an individual who is deceased, who will have the responsibility of raising and caring for the child? These problems merely scratch the surface of the plethora of new circumstances that would arise from creating cloned human beings.

With the generation of a cloned individual come many legal problems from the side of the cloned individual. With potential identity and individuality problems may come the desire for legal action against the creators. As has been seen before, the cloned being may sue the institution that made them in a wrongful life suit. This is similar to the wrongful life case of *Curlender vs. Bio-Sciences*, where the company erroneously told the child's parents that the father did not carry the Tay-Sachs disease gene, when in fact he did and the child ended up having Tay-Sachs (*Cloning Human Beings*, 1997). Similar action may be sought by clones, who through a belief in their own uniqueness being

compromised by their parents and facilitators may seek a wrongful life suit. Though this is speculative, the potential implications are apparent.

With the announcement of the successful cloning of an adult sheep in 1997 by a group of Scottish scientists to make Dolly, the reality and imminent possibility of cloning human beings was catapulted into the forefront of the scientific, religious, and bioethical spotlight. Reactions to this were widespread. In the United States, a voluntary moratorium was imposed on the private scientific community to halt further research into the applications of this technology to humans until a full investigation of all aspects of the issue could be made by the National Bioethics Advisory Commission (NBAC). Also, no federal research funds would be used for human cloning research. It is the intent of our government to prevent any harmful application of cloning, and also to satisfy the desire of the public majority. This is where the NBAC came in. The committee was commissioned to make a thorough investigation, and from this they were able to make their recommendations to the federal government (*Cloning Human Beings*, 1997).

After a full examination of the bioethical, scientific, and religious issues, the NBAC concluded that an immediate moratorium be enacted in both the public and private sector to prevent the creation of a human child through the use of somatic cell nuclear transfer. This conclusion was due to the current lack of safety in using this technique and the ethical issues surrounding arising from the risk to the well-being of the clone. The commission also recommended that federal legislation be made to enforce this, with a sunset clause to allow possible reconsideration after the science and technology of the technique are improved. An important point made in the report was that whatever action was taken, that it be worded carefully so as to not obstruct other vital

areas of research. They also stressed the importance of continuing ethical and religious discussion on the topic to further develop the social and moral implications of cloning. As their final recommendation, the commission advised that the public be provided with more information on genetics and biomedical science, so that in the future they will be educated on how advances in these fields may affect cultural practices, values, and beliefs (*Cloning Human Beings*, 1997).

The legal status of human cloning and embryo research is of key concern on the international level as well. In the mid-1990's, two international ethics committees were created for the purpose of to study the legal, ethical, and social issues concerning human genetics. The UNESCO International Bioethics Committee is a governmental organization dedicated to protecting the human genome cloning was not specifically mentioned in the organization's *Universal Decalaration on the Human Genome and the Protection of Human Rights*, it is an issue that is in its domain. The *Conduct of Genetic Research*, likewise upholds the ideals of human dignity and freedom (*Cloning Human Beings*, 1997). Again there is no direct mention of cloning, but it can be applied to this technology. Both institutions are a valuable asset to the proper supervision and regulation of genetic research and technology. This type of international exchange of morals, ethics, and human values is essential. Other organizations such as the Council of Europe and the European Union have adopted similar doctrines. In their history, these organizations have taken significant steps to responsibly regulate experimentation on human genes.

When looking at specific countries and their legislation regarding human genetic research, similar stances are seen. In Austria and France, embryo research is only

permissible when using viable cells to create a pregnancy. In France and Spain, the embryo may be altered in these instances only to protect the child from the transmission of a disease. Norway, France, Sweden, and Switzerland prohibit all experimentation on human embryos. Laws in Australia and Germany specifically prohibit cloning by certain techniques, but do not encompass somatic cell nuclear transfer. Denmark and Spain, however, do. Actions similar to those of the United States were enacted in Italy in early 1997 (*Cloning Human Beings*, 1997).

It is evident that throughout the world there is profound concern and caution with regards to the development and eventual use of cloning technology. There comes a point where we as a species must come together and agree on what we should do, regardless of ethnicity or religion. Cloning technology is not a scientific competition between nations, like a biological race to the moon. The impact of using cloning technology spans further than we can imagine at this time, as the mere possibility has only recently started us considering the consequences. The national and global position at this time is one of appropriate hesitance, and all institutions should continue bioethical and scientific examination before the doors are opened to extensive human embryo research and attempts at human cloning.

VII Conclusions

In this final section of this report we will describe not only our opinions on many of the issues that have been presented thus far, but also what we feel should come out of the knowledge of all of these issues and the impending technologies. In order to do this we first want to present an overview of all of the issues that have been presented on the idea of cloning human beings thus far. Our object is to show the reader what issues we feel are present that pertain to this problem, discuss the issues we feel are the most important to this problem, and finally come to a conclusion on where this technology should head in the years to come.

VII.A.1 Scientific Arguments

When one looks at the development of science and technology in this century, a number of seemingly impossible ideas and advances have become not only believable but commonplace in our everyday lives. The ability of mankind to dream and realize these dreams has come to a pinnacle at the end of the millennium. The development of cloning technology provides strong evidence of this, as science now allows us to perform the task of creating new life. In previous times, the ability to control the miraculous process of procreation has been assumed to be a right reserved by a power higher than ourselves. The imminent possibility of creating humans by a means other than natural reproduction and to control the identity of this person calls into question traditional philosophic and religious conceptions that have been held for hundreds, even thousands, of years. The pursuit, development, and use of cloning technology would signify our willingness to assume the responsibilities and liabilities that would come with the ability to create. In

order to take the science of human cloning to a point where the process is efficient and safe, much research will need to be done. Inevitably, many sacrifices will need to made before the process is perfected. In this section, we will examine the current scientific feasibility of cloning human beings and based on this, we will look toward the research and implementation of such technology in the future.

The biochemical intricacies of organism development are not understood very well at this point. Due to this, there is question as to whether or not cloning by somatic cell nuclear transfer or other methods will be possible. There may be species differences that will make this technique impossible in humans. The level of nuclear differentiation in an embryo varies between species at different stages of development. This lack of uniformity in the window open for nuclear reprogramming may be due to this fact. Gene activation occurs at different times in different species. In mice this occurs at the 2-cell stage (Schultz, 1993), in humans the 4-8 cell stage (Braude, et al., 1988), and in sheep at the 8-16 cell stage. The success to this point of cloning larger mammals may be due to factors such as this. It could be that the extra time before activation allows the nucleus to be reprogrammed (*Cloning Human Beings*).

Other factors that exist in assessing the possible future success of cloning humans by somatic cell nuclear transfer may provide reason for not pursuing this. If genes of a donor cell are a given age, is it then true that in essence the new organism generated will be that same age in a cellular sense? This is very important, as the life span of a clone may be limited by the age of the donor organism. The telomeres, which are involved in cell division, shorten with each division. The inability to divide stemming from this shortening is one of the key factors in the aging process. This could possibly be avoided

by exposing the nucleus that would be used for a transfer to an enzyme called telomerase. This enzyme is expressed by all egg and sperm cells, and it keeps the telomeres of these cells at full length (Mantell and Greider, 1994). Another source of complication that may arise from cloning by this method involves abnormalities that naturally form in genetic material as genes are copied. This could lead to cancer and other cellular problems (*Cloning Human Beings*).

These and many other obstacles, both present and those yet to come, make for a very uncertain future for the application of this technology to human beings. The only way to overcome these barriers is through extensive research and the development of a more in depth understanding of developmental biology. It is a definite possibility that if this knowledge is gained that some day, not in the too distant future, the asexual production of a human being by somatic cell nuclear transfer will be successful.

VII.A.2 Ethical Arguments

Many of the ethical issues surrounding the cloning of human beings come from not only the potential clone's personal and societal perceptions but also how and what the society sees the clone to be. Issues that come into play here are the clone's self-identity, individuality, and rights, as well as our rights in controlling our own evolution and fate. It will be of uppermost importance, before cloning is practiced on humans, to understand or try to understand how being a clone will make a person feel and act, as well as how it will make others around him/her act toward him/her. Further, it will be important to understand exactly what a clone's rights will be, for example, if the clone will have rights as any other citizen of the world, or if he/she is under the responsibility of the parent.

One must also look at the ethical considerations surrounding this potential technology, and how having so much control over our fate and existence will effect our behavior toward life as well as the quality of life that may be more artificial.

The way a person views him/herself relative to the people around him/her is important to understand since it effects the way that he/she will interact with both people close by and society as a whole. Due to this fact, it is important to understand the implications being a clone will have on an individual's perception of self, before the cloning is carried out. A person's individuality is how he/she separates him/herself from the rest of the world. This is what makes that person unique and, in a sense, special since he/she is different from everyone else. Ethicists say that a clone may have trouble with individuality since he/she would be genetically identical to someone else in the world (his/her parent). Without a sense of individuality it is hard to say how the clone would react or see him/herself. It is also difficult to see how the rest of the world will see this clone. Can a person who is created directly from another person have all of the same rights and freedoms as everyone else, even though this person was created in a lab, and not begotten in the normal fashion? Can this person ever form a unique identity, even though this person is genetically the same as another? These issues are very important to understand, and must be understood before the cloning process takes place. If cloning does take place, we could be diminishing the quality of life of the person being cloned, and in turn, not giving that person a fair chance at living a normal, healthy life. This would be unethical. (Kolata, 1998)

The commodification of this science would also be unethical. If the process of cloning were ever perfected and used, many people would begin to ponder what specific

traits they would like to see in their child. Who wouldn't want a child with a genius's brain, or a supermodel's looks for example. Due to this, people could start to buy and sell cell or possibly even clones. If a person is bought in such a manner, how can this person ever be worth the same as a normal person? How could someone put a price on a person in the first place, and when that price is placed on the person, how can that clone ever be equal, or treated as an equal to someone who wasn't bought. This buying and selling of human beings detracts from the clone's quality of life, as well as the quality of life of our race as a whole. (Holland, 1999)

Another, even larger issue involves the role that humans play in life, and the lengths to which we should go to control our own destiny or fate. It is an important issue to decide whether we should be in control of our own evolution, and in turn the fate of our species on this planet, or whether we should leave that to nature. Many say that it is unnatural and Narcissistic to design our race how we see fit and how we want it, while others say that if we have obtained the ability to do so, it must be natural. Unfortunately, there is no real way to tell what is natural and what is not, or what is tampering with the power of the gods and what is not. These decisions must be left up to us to decide, and our decisions must encompass all of the technological, ethical and religious viewpoints, in order to make them work everyone.

VII.A.3 Religious Arguments

Some of the biggest and most complicated issues surrounding cloning come from religion. One of the main issues that religion has with cloning is its likeliness to humans playing the part of creator and in turn god. Added to this, however, there are issues

having to do with the morality, which we will be portraying, both to ourselves, and to the people we will potentially develop, using this technology. Both of these issues must be taken into serious consideration while facing an issue with such a humanitarian concern.

The idea of man playing god or tampering with nature has been around since man found he was able to change things within his environment. This idea has grown with almost all technological advances dealing with nature or biology. As man learned more of how nature and the world works these issues grew larger and more apparent. It seemed that each time this issue came up, though, it was eventually quashed by the overall advantages to the technology in question and the fact that there were still many mysteries to life that were god's domain, in a sense. With these newer advances in the way that humans are created, however, it again becomes a question of whether we are entering into god's domain, or can simply push back the boundary once again.

Along with the ideas of entering into god's domain are issues on humans entering into a technology that is immoral and wrong to use. These issues state that creating a person in such an unnatural way will take the idea of family and love out of procreation, and what will be left is an empty, less special experience. Many religions hold the ideas of family and sex under high esteem, since they are both, in a religious context, expressions of love, and in turn promote a happy, moral society. If the expression of love is taken out of procreation through the destruction of the family unit and bond between two people when they have sex, the morality is taken out as well. The overall fear here then is that if cloning technologies are actually implemented on humans, human morality will take a serious fall as well.

VII.A.4 Popular Opinion

Despite the huge amount of publicity that the successful cloning of Dolly the sheep received in 1997, a relatively small amount of the research that has been done on cloning is widely known. The understanding that those who are not directly involved in science or bioethics have is often vague. To gain insight into popular opinion on this topic, it is helpful to look at forms of media such as science fiction. By doing this we are able to understand some of the information readily available to the general public.

One of the first bits of popular opinion on the issues of artificial reproduction and cloning came from the novel Brave New World by Aldous Huxley. In Brave New World, Huxley describes a society in which children are created and grown in a factory on an assembly line. These children are programmed from birth to be in a specific class, do certain jobs and act in certain ways. They are also taught to respect all classes and to follow all rules set by the authorities above them. All sense of love and intimacy, along with procreation, is also taken from the sexual act through the use of a drug called Soma. It is these issues that are frequently brought up against the use of reproductive technologies, since the society that was supposedly created from this technology was portrayed as immoral and de-humanized. (Huxley, 1932)

Further insight into this novel came a few years after it was written, however, by Huxley himself. In a more recent addition of the text, Huxley notes that this novel is heavily politically centered, and that in his mind, very few of the outcomes of the society were due to the reproductive technologies. He notes that the reproduction methods that lead to the dehumanization of the society were a result of the politics of this society and it

was not the case that the reproduction methods led to the politics and the dehumanization. (Fletcher, 1974)

There have also been several science fiction films made since the 1970's that explore the idea of cloning and the consequences that come from this. In the film *Star Wars*, the Empire had a program to create cloned soldiers to fight their wars (*Star Wars*, 1977). These soldiers are similar in both looks and behavior. They seem impersonal and almost vacant. There are some discrepancies in this idea, but some valuable implications can be drawn from this. The idea that cloned beings would all look the same is inaccurate. Unless a technique was developed where an exact copy of a developed individual could be made, the cloned beings would vary in appearance. Though the film is fictional, it depicts an interesting scenario. If cloning human beings becomes efficient and widespread, nations could begin mass-producing creating the "perfect" soldier. The sole purpose of this being would be to fight, and they would have no choice as that would be the sole reason for their existence. This type of activity carries with questionable ethical and moral decisions. Would it be ethical and fair to create individuals that were not born with the same human rights and freedoms as others?

The film *Jurassic Park* is another science fiction film that explores the idea of cloning (*Jurassic Park*, 1993). In this film, genes from dinosaurs were obtained. This was done by extracting blood from mosquitoes that lived in this era and fed on the many species of dinosaurs. Using nuclear transfer techniques, scientists were able to bring back these species by growing the transferred genetic material in reptiles. This movie made knowledge of the existence of nuclear transfer technology into mainstream culture. In the end of this movie, the cloned animals defy their creators and break free, showing

the uncertainty of behavior that would exist if clones are made. This film contains dialogue that explores the ethics of such practices. The founder of the project believes that if the ability is there, then it logical that it be used in a controlled and responsible manner. The mathematician in the movie has a different view. He makes the important note that often we strive to see if we can achieve something without thinking of whether we should do it. This has merit when paralleled with modern cloning debates. The film is also of interest because the technology used in it is most likely going to be used in real life very soon. Explorers found a superbly preserved woolly mammoth beneath the frozen ground in Siberia. Upon its excavation they will attempt to bring it back via nuclear transfer and implantation of the embryo into an elephant.

Perhaps the best film to date that examines the ethics and moral issues surrounding genetic manipulation is *Gattaca* (*Gattaca,* 1997). Though the film does not deal with cloned individuals, it deals with people created in a way that is unnatural. The movie centers around a man who dreams of becoming an astronaut from his youth, but cannot because his genetic profile is not good enough. At the time he was born, there were techniques to diagnose the genetic makeup of a person, and based on this they could tell what diseases he would have, some of his personality traits, and when he would die. Soon after, science perfected the science of genetics, and couples could choose the genetic makeup of their children. This man was found to have a heart condition that would kill him in his prime, and his vision was imperfect. As a result, he would never get to be an astronaut as he was inferior to the people who were engineered. He ends up using another man's superior biological material and, falsifying his identity, achieves his goal, and in his relationship with this donor and others in the film a good examination of

individuality and nature is made. When the engineering of people began, there was a new type of discrimination created. People where judged on their genetic identity, which could easily be read, and their fate was in effect sealed from birth. The ideal that "all men are created equal" was no longer true. This issue of individual status and worth based on genetics is an issue that very well could result from cloning humans.

The ideas expressed in these works, though they are fictional, explore interesting ideas and scenarios. These are the types of things that we will have to deal with if we decide to extend the use of cloning technology to human beings. They are readily available to the public and play a critical role in shaping popular opinion. To most people, it is difficult to understand the science and technology of cloning. Therefore, opinions are based on somewhat biased news coverage and works of fiction. Due to the fact that cloning humans will have an impact on our entire race, it is important that everyone learns about this so that they can form an educated opinion. With this knowledge, it is hoped that people will think about the ethics and moral issues surrounding human cloning and let their thoughts be heard. From this, a decision on what will be done with cloning technology in the future that accurately reflects public opinion can be made.

VII.B.1 Bioethical Recommendations

It has been shown that there are many bioethical, religious and moral obligations that the human race must uphold in the pursuit of science. On the issue of cloning, none are so apparent as the obligation to treat other humans in a moral and just way, no matter how they are created or begotten. In order to treat a clone in a moral and just way, since

that clone is a person, he/she must be given the same rights and freedoms and be allowed similar lifestyle issues and choices that every other person is guaranteed. It is believed by the authors that there is no way a clone will be allowed the same life as a normal person and for this reason it is deemed unethical.

One of the serious concerns surrounding this issue is of the cloned being's self-identity and individuality. In the natural process, each person is born an unpredictable combination of two different parents leading to the child being a completely new individual. With the application of cloning, this unpredictable nature of procreation is lost, and we are left with a copy of someone that already exists. As a copy of a pre-existing being, it is likely that it will be very hard for that person to define him/herself as a separate individual. This could create some serious self-identity problems within the cloned person, which is a very unfair, immoral creation of the start of a person's life. Added to this is the fact that, after a while of using this technology, genetic diversity and in turn individualism will be diminished. This lack of diversity will lead to a society in which people cannot properly distinguish themselves from others, in turn, possibly dehumanizing the human race as we have seen in the fictional Brave New World.

A second issue with this technology is in the tampering of natural processes and the destruction of god by playing the part of the creator. This is an issue, which is highly religious, but also has many ethical connotations as well. Many things have been taken into account in this issue, but it is believed that man was placed here and given 'dominion over the all creatures' by god, and it is believed that due to this, the technology, to a point is not unethical.

Tampering with natural processes is something that the human race has been doing since he was able to observe and attempt to understand his surroundings. It is seen as natural that man tries to understand what he doesn't know, and due to this, he is always, naturally, interfering with nature and natural processes. This in no way says that man is playing god. The current science of cloning involves simply the development of a way for cells to react and grow. This science in no way is fully artificial. Nature still must run its course, from the acceptance of the nucleus into the new cell to the growth of the new organism, in order for this to happen, and therefore still has dominion over the actual creation. Man has simply developed an alternative method for this to happen and is therefor not tampering too heavily into nature or god's duty as creator.

Many of the issues that may come up within bioethics also come up in the scientific context. For this reason, we believe that this area of the topic should also be explored and concluded upon in order to get an overall feel of the issue.

VII.B.2 Scientific Recommendations

The research done in the making of this paper has given the authors much insight into the scientific and bioethical factors involved in deciding whether to allow human embryonic research and the use of cloning technology on human beings in the future. From this information, we have been able to consider the potential benefits and harms associated with such allowances. We have also come to several personal conclusions on the subject, and in the following section we will make our personal recommendations in both scientific and bioethical terms. We will begin with our scientific recommendations,

and subsequently we will reinforce and expand upon these with our bioethical recommendations.

Upon careful consideration of the numerous scientific implications of human cloning, we recommend closely monitored advancement of human embryo and human cloning research. Though efficiency and understanding are lacking in these areas at this time, the only way to expand our knowledge and master these new techniques is through experimentation. At this point in time with the relative immaturity of cloning technology and the potential for abuse, it is understandable that the common reaction to human cloning is one of fear and uncertainty. However, one must consider the good that can come from this research.

Development of human cloning technology is likely to lead to great advances in medicine and reproductive science. If we were able to take an individual's genes and selectively express specific pieces that were needed from the clone, many medical obstacles would be overcome. This would be of great aid in tissue transplanting. For patients in need of new organs, we would be able grow a new organ by turning off all genes except those controlling generation of that specific organ. In patients needing cells such as bone marrow, only one in several thousand people has compatible cell types. This makes the patient's likelihood of finding a suitable donor very small. This would eliminate the need for donors and the recent incidences of people selling their organs to the highest bidder. Also, this would most likely be more cost-effective as there would not be a limited number of organs or tissues. If an unborn embryo was grown in a controlled environment, either *in vivo* or by some new method, development could be stopped at a point where the needed cells have been made. From this point, these cells

could then be taken and reproduced in culture with minimal harm coming to the clone. Alternatively, these new organs and tissues could be grown from early stem cells of the clone, which are undifferentiated and have the ability to express all genes. If the clone were not allowed to fully mature and be born, then many moral and bioethical issues can be resolved. However, issues over when life begins and prenatal rights are still debatable, and these will be discussed later on.

Knowledge gained from embryonic and cloning research may also lead to new methods in the early detection of disease. As the intricate mechanisms governing early embryo development are still somewhat mysterious, new experimentation along these lines may give us new abilities to correct genetic problems at an early stage so that the developing individual can properly form and live a more healthy and normal life. This is just one of numerous possibilities that may result from these lines of scientific investigation.

Another potential benefit of human cloning comes with the ever-present risk of mass extinction of the human species. This could result from a natural disaster or a great plague, both of which periodically occur naturally. If we possessed the ability to clone, we may be able to regenerate our species if for some reason this was necessary. It would provide us with a sort of doomsday insurance.

The key element to all of these potential benefits is the therapeutic and conceptual advances to be gained. However, there are serious scientific risks and uncertainties that we will also address. Cloning in general is extremely risky. When handling genetic material, there is always the risk of causing unseen damage that could result in serious defects to the embryo. Besides the technical and physical risk involved, cloning is risky

because once the technology is available, different groups and people will want to use it for all kinds of reasons. These reasons could range from keeping the family lineage alive to a misguided attempt for eternal life. This is why we believe that embryo research and cloning should only be allowed and pursued in the context of gathering knowledge with minimal harm to the new life created and for the development of life-saving therapeutics. In no case at this time do we recommend the creation of cloned human beings that will be allowed to fully mature and be born. At this time, we believe the scientific risk associated with this practice is too high for using cloning as a means of reproduction.

Though there are many hypothetical benefits to human embryo research and human cloning technology, there is tremendous potential for irresponsibility and abuse. If the federal moratorium expires and the floodgates are opened to allow free exploration of these sciences, the harm and damages that may result could be scientifically and morally deplorable. We do advocate the gradual expansion of research in these areas, but we also believe that through responsibility and regulation we can bring forth the positive applications of the research while minimizing the negative.

When dealing with the idea of cloning human beings and creating human life for research, there is much apprehension due to many scientific and moral uncertainties. In all experimental procedures there are unforeseen complications and errors that undoubtedly arise from tampering with such delicate and highly regulated processes. Thus, we recommend strict control of human embryo and cloning research. We believe the best way to minimize risks to clones and to those who will receive elements from them is to carry out experimentation at a very slow pace. To supervise and oversee all human cloning research, we recommend the establishment of a federal agency whose sole

responsibility is to oversee all human embryo and cloning research. This agency should consist of highly reputable scientists, lawyers, and law enforcement officials so the best possible research and decision-making can take place. Legislation should be made to allow this organization and all of its employees absolute authority over all of this new science and technology. No research on human embryos and human cloning should be conducted unless in an institution established by and strictly supervised by this regulatory agency. Funding for this research could come from federal and state funding, or private corporation sponsorship in exchange for employment opportunities. The details of this would need to be well pondered and carefully planned. This agency should also work closely with the National Bioethics Advisory Commission, so as to keep in the forefront of constantly evolving bioethical views and new issues that will arise. With strict monitoring and enforcement, along with frequent bioethical and moral assessments, the development of these technologies can be well documented and strictly regulated. Frequent reviews and thorough examinations of new advances in these fields would provide opportunities to examine new developments and new complications. This will allow the agency to enact appropriate legislation, or if needed cease all projects in its jurisdiction.

Along these same lines, we also recommend that the United States pioneer the establishment of a global organization that can oversee this research worldwide, and regulate it with agreed upon scientific and bioethical restrictions. This could be made as an extension of the United Nations, or created independently. This would be a very difficult task, as global interests vary from nation to nation. However, it would be beneficial to all countries if a global morality could be established with respect to cloning

technologies. As has been stated before in this paper, this issue is of global concern. The identity and prosperity of the human race could be forever altered by the irresponsible use of this science and technology.

The ideas and recommendations arrived at in this section are the product of careful scientific and ethical consideration. As with all new technology, especially when dealing with humans, there is a natural fear that exists due to the instinct of self-preservation. We have reached this point and see the good that can come from this research. We believe that with moral and ethical integrity, and close regulation, the risks of using associated with this technology can be minimized, or even prevented.

VII.C Closing Remarks

Within this report we have discussed many ethical, bioethical, religious and scientific views on the topic of cloning human beings. Through this research, we have come to the conclusion that, at this point in time, the cloning of an entire human being should not be done, due to both bioethical and scientific concerns. We feel that once the technology is better perfected, it will have many outcomes that will greatly benefit the human race, and at that point, man should go ahead with the technology, but only as far as his moral and ethical bounds may take him. Diving into a science that is deemed unethical, just because we can, could prove to be extremely harmful and destructive. In the future, if strong ethics, morals, and scientific integrity are preserved, we should be able to achieve dual success. We will harness the therapeutic power of human cloning, while protecting ourselves from its dangerous potentials.

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