Project Number: TAS-9351 -48

HUMAN CLONING

An Interactive Qualifying Report

submitted to the Faculty

of the

WORCESTER POLYTECHNIC INSTITUTE

in partial fulfillment of the requirements for the

Degree of Bachelor of Computer Science

By

Benjamin G. Boyden

Date: May 6, 1999

Approved:

Professor Thomas A. Shannon, Advisor

1. **cloning**
2. **genetics**
3. **bioethics**

The inevitable existence and application of human cloning technology is discussed. Different points of views were looked at and it is apparent that there are legitimate needs for human cloning, but that experimentation must proceed slowly and cautiously as the implications of error and misuse are vast.

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1. INTRODUCTION

The scientific community must be cautious in their exploration of the technology of cloning and how it may someday apply to humans. On the February 24th, 1997, the Roslin Institute announced the birth of Dolly, a cloned sheep. Since then, the topic of human cloning has been subject to much debate and controversy. What was once subject matter only suitable to science fiction is becoming reality. The scientists and scholars involved in the pursuit of this new technology must act responsibly and cautiously. The public must be made aware of the truths of the technology of cloning, and educated by the arguments for and against the application of the science.

The science of cloning is rapidly evolving. Since Dolly's birth in early 1997, scientists have cloned several other animals. In the summer of 1997, scientists at the University of Massachusetts cloned cattle (using fetal cells). In summer of 1998, researchers in Japan successfully cloned calves. Also in the summer of 1998, researchers in Hawaii cloned dozens of mice. In August of 1998, scientists in New Zealand announced the cloning of the last cow of a rare breed. In April of 1999, researchers in Massachusetts reported that they cloned three genetically enhanced goats. [16] There will undoubtedly be more experiments to come in the future, each one taking us one step closer to the first human clone.

Different religious groups have taken a stance on the topic of human cloning. One of the strongest voices to speak out against the technology has been the Church of Scotland. They even have a web site devoted to the subject with numerous documents that argue against the acceptance of human cloning. [11] Their

condemnation of the experiments and research is representative of the broader view of Catholicism, Islam and some other religions. However, not all religions are against human cloning. Those religions that may be open to the idea include Protestant, Buddhism and Judaism.

The United States, Great Britain and other governments around the world are struggling to determine their position on human cloning before it becomes a reality. The Clinton administration has setup review boards to research the technology and determine if regulatory laws are necessary. The National Bioethics Advisory Committee is currently reviewing the social and ethical implications of human cloning. The U.S. House of Representatives has been discussing different laws to deal with the application of the science. Great Britain and other countries are cautiously weighing their options before committing to any sort of regulation. However, there are many countries that have not even addressed the issue. When the first human being is cloned in the coming years, those governments will have to rush to determine how they will regulate cloning. The position that the United States and other world powers take in the near future will play an important role in how other governments will deal with the issue.

Whether or not human cloning is a reproductive right is a subject of heavy debate. Couples who cannot reproduce other ways are certainly looking forward to trying the cloning alternative. There are other families that see cloning as a way to avoid genetically based diseases such as cancer. Fertility clinics are certainly advocating human cloning experiments in the hopes that this may become an

alternative for their clients. However it is apparent that the clinics have a vested interest in human cloning since it would be another source of income for them.

There are potential ethical dilemmas and abuses to the application of human cloning. For example, unauthorized cloning of an individual could lead to devastating consequences. On a larger scale, excessive cloning could lead to a loss of diversity in the gene pool. There will also people who wish to clone someone for the wrong reason. A grief stricken mother may want to "resurrect" a dead child, which could lead to severe psychological problems for the clone if the parents do not understand that the new child is its own entity with the exception of its physical make up. These are just a few of the potential misapplications of the technology.

There is clearly a need for caution when it comes to human cloning. Technology must advance further before human experimentation is allowed. Failed human tests are certainly more meaningful than failed animal tests. Furthermore, animal experimentation is still yielding new and useful information about the science of cloning. Until animal experimentation has been exhausted, human cloning should not be considered.

When human cloning experiments are a reality, it is important to proceed slowly. Experimentation should be limited to begin with. It would be unacceptable to have scientists "competing" with one another and rushing with experiments. Agreement is needed on an international level as to how to proceed in a coordinated and united fashion with the experimentation. It would also be prudent for discussion to take place to determine for what uses human cloning will be used. Further

intellectual debate about the ethical and social implications of human cloning should take place.

Finally, there will need to be a firm government stance on the issue of human cloning. Ignoring the possibility now may be all right in the short term, but when human cloning is a reality a position needs to be worked out. Legislation should be based on the consensus of ethicists and scientists. The wording of such legislation is critical to prevent any loopholes. There should also be periodic evaluation of the government's position on the technology and an updating of related legislation since the science of cloning is rapidly evolving. To be effective, there should be an international agreement made between the countries that are most likely to be involved in the research of this technology. This includes the United States, Great Britain, Japan, New Zealand, and other countries that are currently making breakthroughs in the field.

Cloning and how it will apply to humans is a very important issue that needs to be looked at in detail. Thorough analysis of the ethical, social and legal implications of human cloning is required before the technology progresses much further. To not address this issue would itself be unethical. Governments around the world need to bring this debate into the light and formulate their positions in regards to regulatory legislation. Current events have included many breakthroughs in cloning technology. It is just a matter of time before human cloning experimentation is a reality, and the first human clone is created. This technology must be approached cautiously and should be thoroughly debated on all levels until an informed position is reached.

2 TECHNOLOGY OF CLONING

It has taken much research to advance the technology of cloning to its current level. While the idea of cloning has persisted in science fiction for several decades, it was not until recently that the possibility became a reality. Very little experimentation took place until the mid-90s when the Roslin Institute [10] successfully carried out several successful cloning procedures, including the one that produced the now famous Dolly. Dolly's birth was a catalyst to genetic researchers everywhere, who rushed to duplicate the results using varied techniques and species.

2.1 Technological Achievements

There have been recent breakthroughs in cloning that imply human cloning is possible and in the not so distant future. There are also several different types of cloning, including modecular cloning, cellular cloning, embryo twinning and nuclear somatic transfer. The history of cloning can be traced from 1938 to the present. While once just a topic of science fiction, the technology is now here and cloning is a reality. It is just a matter of time before the first human is cloned.

To understand the technology of cloning, it is important to take a look at its history:

In 1938, Hans Spemann of Germany discussed the possibility of transferring a nucleus from an adult cell to an enucleated egg. He published a book *Embryonic Development and Induction* to describe his experiment. Spemann created an identical twin of a 16-cell salamander embryo using the methods he outlined. [12]

In 1952, Robert Briggs and Thomas King of Philadelphia cloned tadpoles. They used frog early embryo cells in their experiments. A total of 27 tadpoles developed from 197 nuclear transfers. [12]

In 1962, John Gurdon of Oxford achieved a 2% success rate when cloning sexually mature frogs from intestinal cells of adult frogs. However, it has been questioned as to whether or not Gurdon accidentally used primordial sperm or egg cells in his experiment. It has been shown that 2 to 5% of frog intestinal cells are of that variety. Later in 1963, J.B.S. Haldane of Britain described Gurdon's frog experiments with the word "clone". [12]

In 1977, Karl Illmensee of the University of Geneva claimed to have cloned mice. His experiments reportedly used cells from early mouse embryos. In 1983 Illmensee lost his research grant after being accused of fraud. In 1978, David Rorvik of the United States published *In His Image: The Cloning of a Man*. The freelance writer reported that a millionaire had secretly had himself cloned. The book caused public alarm and in turn congressional hearings were held. It was determined that the story was fiction. [12]

In 1984, Davor Solter of Wistar Institute in Philadelphia concluded that cloning mammals is biologically impossible, after several experiments with mice. [12]

In 1986, Neal First, Randall Prather and Willard Eysestone of the University of Wisconsin used an early embryo cell to clone a cow. In July of 1995, Ian Wilmut and Keith Campbell of the Animal Breeding Station in Roslin, Scotland, cloned

identical lambs. These lambs, named "Megan" and "Morag", were cloned from 9 day old differentiated embryo cells. [12]

In July of 1996, Wilmut and Campbell cloned "Dolly". Frozen udder cells from an adult ewe were used to create the first animal cloned from an adult cell. Much controversy surrounded the experiment as it was given high press coverage. An example of this was the front page headline of the *Daily Mail* which read "Monsters or a miracle?" In February of 1997, the birth of Dolly was announced. The media coverage was again intense.

In the summer of 1997, researchers from the University of Massachusetts cloned cattle using fetal cells. [12]

In the spring of 1998, it became apparent that Dolly is her own chronological age and not that of the lamb she was cloned from. Dolly had given birth the natural way. [12]

In July of 1998, scientists from Japan announced that they had successfully used cells of adult cattle to produce cloned calves. [12]

In August of 1998, researchers from Hawaii announced that they had cloned dozens of mice. More than 50 healthy, female mice spanning three age groups were created. [14] Less than a month afterward, scientists in New Zealand had successfully cloned the lone surviving member of a rare breed of cow. This experiment provided the first tangible evidence that cloning can be used to keep endangered species from becoming extinct. Such endangered species can be "brought back from the brink" and preserved. [13]

In December of 1998, scientists from Kinki University in Nara, Japan, cloned 8 calves from a single adult cow. The 8 successes came from 10 attempts, an 80% success rate. "The efficiency is high enough to see it being used commercially," said James M. Robl, a professor from the University of Massachusetts Amherst. Five other groups in Japan also claimed to have successfully performed similar experiments, but the Kinki University researchers were the first to describe it in sufficient enough detail to get the results published in a scientific journal and accepted by the scientific community. [14]

In April of 1999, researchers from Massachusetts cloned 3 genetically enhanced goats. The Tufts University School of Veterinary Medicine and Genzyme Transgenics Corp. of Framingham reported that the goats, born during the fall of 1998, were genetically altered to produce fortified milk containing a protein that is beneficial to heart attack and stroke victims. A Tufts scientist, Eric Overstrom, said, "the results could revolutionize the biopharmaceutical industry." "We now have a method that is a faster, reliable and more cost-effective way to produce complex pharmaceuticals for humans and animals." The method used by the researches only required 92 eggs per goat, where as using an existing technique would have taken 140 eggs. The improved method involved using "active" eggs that were programmed to "think" they were fertilized. [16]

There are undoubtedly several ongoing experiments being conducted at present in various countries around the world. The most recent experiment in Massachusetts showed researches an improved and more efficient technique of cloning. As more ongoing experiments conclude, the technology should become

more advanced to a point where more active debate is opened up regarding the application of such a cloning technology to humans.

2.2 Techniques of Cloning

There are different techniques of cloning. [12] These include:

Modecular Cloning: This type of cloning is widely used in gene therapy, genetic tests, drugs and vaccines. Pieces of DNA containing genes are duplicated in a host bacterium.

Cellular Cloning: This technique of cloning duplicates a cell and results in cell lines of identical cells. This method is used primarily in medical research.

Embryo Twinning: This method of cloning splits an embryo into halves, resulting in twins. The main application of this technology is in cattle breeding. While medically and ethically controversial, it is possible to increase the chances of success in IVF by increasing the number of embryos. Although the U.S. Embryo Research Panel has approved this application of embryo twinning, it is not generally used at the present time.

Nuclear Somatic Transfer (NST): This is the type of cloning that was used to create Dolly. The nucleus of a cell from one individual is placed into the egg of another individual of which the nucleus has been removed. The nucleus could come from a living individual, cells sustained in a laboratory culture, or frozen tissue. An embryo, fetus or adult specimen could be used as the source of the nucleus. The egg that is used may come from the individual who will eventually give birth to the clone

or from another donor. In the case of Dolly, the cell came from dead ewe tissue that had been kept frozen for years.

It is not possible to use cells in NST from anywhere. Cells from cadavers, non-biological material, cells not frozen properly and incomplete cells such as isolated DNA strands currently may not be used.

Nuclear Fusion: A variation of NST. The enucleated egg is placed next to a donor cell and an electric current is used to fuse the cells together. This begins the embryo development. The mitochondria from both donor and egg become part of the embryo. This was the actual technique that created Dolly.

Nuclear Somatic Transfer is the cloning technique that is being used by most scientists in current experiments. It is also the technology that will most likely yield the first human clone. While there are several methods of implementing NST, the basic concept of cell from one individual being placed in the egg of another holds true. Current research is improving efficiently and methods of NST requiring less donor eggs and yielding a higher rate of success. [16]

3. SOCIAL AND ETHICAL IMPLICATIONS

There is a lot of debate surrounding the inevitable existence and application of human cloning. The implications of cloning are vast, especially when it is the existence of a human being that is being considered. The various bodies of researchers, legislators and others who are interested in human cloning can not agree if it is ethically acceptable, and if so to what extent. Different religions have opposing views, and there is even division within some. Various governments and legislative bodies are not in agreement on how to regulate or control the application of cloning technology. A strong case can be made for parents who wish to use the cloning technology and their reproductive rights. However, there is cause for concern when the potential abuse of cloning is considered. The areas in which the technology could be misused must be examined before cloning becomes readily available. Clearly further discussion on the topic is required until some sort of consensus is met. Meanwhile, however, the science is advancing and the reality of human cloning is quickly approaching.

3.1 Religious View

Religious groups do not stand united on the issue of human cloning. Most will condone it in certain situations, the notable exception being Catholicism. The view of the Catholic faith is that any means of reproduction that is not natural is not right. Natural Law theory (Thomas Aquinas) condemns any techniques of reproduction or birth control that do not occur naturally. The Catholic religion also strongly backs family values and strictly natural reproduction by married couples.

[12] John F. Kilner, director of the Center for Bioethics and Human Dignity in Bannockburn, Illinois, argues that human cloning would violate Christian ethics[1]. He states that, "human cloning research would be unethical because it would inevitably cause the deaths of human embryos. Further, cloning a human for a particular purpose would violate that person's God-given human dignity by subordinating his or her existence to the interests of others. Cloning research should not be permitted for any purpose." [1] Kilner goes on to point out that, "the Bible portrays children as the fruit of a one-flesh love relationship, and for good reason. It is a context in which children flourish – in which their full humanity, material and nonmaterial, is respected and nourished. Those who provide them with physical (genetic) life also care for their ongoing physical as well as nonphysical needs." He goes on to say that creating a child out of wedlock is bad for children, and that creating them artificially simply casts them as products. A child that is created artificially by a technique such as cloning would not receive love like that of a child conceived naturally and brought up in a standard family environment. [1]

Kilner stops short of declaring that an artificially created human would lack a soul. It is unclear if that is the stance of the Christian faith. Since cloning can occur in nature (such as when an egg splits), that would imply that identical twins are flawed or without souls. Since that is obviously not the case and not the view of the Christian faith, there seems to be a bit of a paradox in the condemnation of human cloning.

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[1] Argued in a paper submitted by Kilner to Cloning. [1]

The Protestant, or Puritan, religion is a bit more accepting of some applications of human cloning. Following a philosophy of being "co-creators with God," Protestants have traditionally believed in applying science that "God may have revealed to them." While the Protestant religion does not yet have a formal stance on cloning, it can be inferred that it would be condoned under at least some circumstances. Followers of the Judaism religion are also likely to accept human cloning. Jews, especially descents of the Holocaust, have a fundamental interest in having their family lines extended. Most members of the Judaism faith will likely condone human cloning as a solution to infertility. Followers of the Buddhist faith are more likely to support human cloning in all its forms. The religion is based on eternal change. That could be interpreted to mean the Buddhist faith would not condemn any such use of a technology geared towards enhancing humanity like cloning. [12]

There are other religions such as Islam and Confucianism where it is not so clear if the fundamentals of the faith would permit human cloning. With Islam, it may be shunned upon if a third party is used to assist in the creation of a child. This would mean embryos, sperm, or eggs would be forbidden from any means of reproduction if they were from a third party donor outside the family or marriage. With Confucianism, there is emphasis on having descendants that could perhaps allow for the use of human cloning as a solution to infertility. However, there is also emphasis on offspring being born in the traditional way, without artificial intervention. [12] So it is not clear if these religions will ultimately condone or condemn human cloning. Unfortunately, a lot of people may not come forward with

their views until human cloning is a reality. It is this "wait and see" approach that is going to cause much controversy when the first human clone is born. As with any organization, spirited discussion and debated is necessary to determine what the consensus of that group is, and it is unfortunate that such discussion is currently limited.

3.2 Government View

Since the cloning of Dolly, the United States government has attempted to develop a policy on human cloning. The main tool used by the government to understand the technology in question was the National Bioethics Advisory Committee. The United States had assembled the National Bioethics Advisory Committee (NBAC) on October 3rd, 1995. This was due to the actions of President Clinton, who issued Executive Order #12975, "PROTECTION OF HUMAN RESEARCH SUBJECTS AND CREATION OF NATIONAL BIOETHICS ADVISORY COMMISSION." In June of 1997, the NBAC reported on the topic of human cloning[2]. The committee reported that, "at this time it is morally unacceptable for anyone in the public or private sector, whether in a research or clinical setting, to attempt to create a child using somatic cell nuclear transfer cloning." They also advised that, "federal legislation should be enacted to prohibit anyone from attempting, whether in a research or clinical setting, to create a child through somatic cell nuclear transfer cloning." [7]

With such a new and developing technology such as cloning, any legislation must be very specific to accomplish only what is desired without allowing any

technical "loopholes." The committee was very wise and reported that a rush to ban such a technology could have undesirable effects. They warned that, "any regulatory or legislative actions undertaken to effect the foregoing prohibition on creating a child by somatic cell nuclear transfer should be carefully written so as not to interfere with other important areas of scientific research. In particular, no new regulations are required regarding the cloning of human DNA sequences and cell lines, since neither activity raises the scientific and ethical issues that arise from the attempt to create children through somatic cell nuclear transfer, and these fields of research have already provided important scientific and biomedical advances." [7] The BBC News reported that "President Bill Clinton backed a bill which would have outlawed human cloning but the legislation was drawn so loosely it would have outlawed all genetic research. Opponents tore it apart and it never saw the light of day ... Congress has struggled with cloning legislation." [15] As a compromise, the United States has instituted a policy of not backing any research that would attempt to clone a human being. The NBAC did advise that should a ban not be enacted, "clinical use of somatic cell nuclear transfer techniques to create a child should be preceded by research trials that are governed by the twin protections of independent review and informed consent, consistent with existing norms of human subjects protection." In other words, the NBAC would like to see a ban, but if that is not the case they advise in their report that the technology should be strictly regulated. The committee did go on though to encourage further debate about the issue by advising the president and legislative bodies that, "the federal government, and all interested

[2] The NBAC has not submitted a formal report regarding human cloning since 1997.

and concerned parties, encourage widespread and continuing deliberation on these issues in order to further our understanding of the ethical and social implications of this technology and to enable society to produce appropriate long-term policies regarding this technology should the time come when present concerns about safety have been addressed." The committee concluded its June 1997 report with the suggestion that, "federal departments and agencies concerned with science should cooperate in seeking out and supporting opportunities to provide information and education to the public in the area of genetics, and on other developments in the biomedical sciences, especially where these affect important cultural practices, values, and beliefs." While quick to advise a ban on cloning, the NBAC did thoroughly recommend that more research, debate, and education of the public should occur to get a better understanding of what legislation may ultimately be needed. The committee appeared to edge toward the side of caution in their recommendation for a ban on human cloning but did offer a window so that policy could be reevaluated in the future. [7]

Currently, there is no ban or significant regulation on human cloning that affects the private sector. This is not due to a lack of effort by some legislators, but a lack of a consensus and a number of technical problems. Any legislation that is drafted to regulate or ban human cloning experimentation needs to be written perfectly. If the wording of a proposed law is too vague, then it could have unintended effects on currently permissible research, such as DNA engineering. If the legislation is too strict and specific, then it could be easily made useless by a slight change in the techniques of cloning. Another perhaps less obvious reason why

there are currently no regulatory laws on cloning experimentation is the vested interest of many big medical centers and universities. As in any democracy, those that are elected to run the government are subject to lobbying of special interests. The biomedical industry is growing fast and is very lucrative, and if a legislator comes from an area where such an industry is strong, then they may be hesitant to consider any type of ban. It will not be until the public at large is made aware of the issues and dangers surrounding human cloning that any serious regulatory legislation will likely be passed.

While the United States has been slow to pass legislation on human cloning, some countries have banned it outright. Among those countries are France, Germany and the United Kingdom. The Council of Europe, a European treaty organization, has such legislation written. Article 1 states, "1. Any intervention seeking to create a human being genetically identical to another human being, whether living or dead, is prohibited. 2. For the purpose of this article, the term human being 'genetically identical' to another human being means a human being sharing with another the same nuclear gene set." That is the main point and clause of the legislation[3]. There are 7 additional articles that attempt to block any technicalities and address treaty details specific to the European Council. [17]

The NBAC has suggested, "the United States Government should cooperate with other nations and international organizations to enforce any common aspects of their respective policies on the cloning of human beings." Clearly for any legislation that bans or regulates human cloning to be successful it needs to be incorporated into

[3] Member states must approve the treaty and adopt it into their local law. [17]

some kind of treaty that other nations can agree to. Even so, though, cloning will undoubtedly occur elsewhere in the world such as Eastern Europe, Asia and the Near East. Since cloning does not require a very sophisticated laboratory, human cloning could take place in many countries where there are no laws or regulations in place to stop it. So while many countries may condemn human cloning and ban certain types of experiments, it will almost definitely occur in a foreign country where no such policy exists. An international treaty will at least limit the effect, though. [7]

In many of the countries and groups that have condemned human cloning there are many debates over the policy. Many scientists, scholars and other individuals in many of these groups were and still are divided over the issue. Much condemnation of human cloning has been brought about by political pressure, especially after the public announcement of Dolly's birth and the ensuing media frenzy. As time passes, more and more ethicists, scientists, and legal scholars are coming forward in support of human cloning. Among these individuals from the United States includes: Professors Ruth Macklin of Albert Einstein College of Medicine, New York, Dan Brock of Brown University, Providence, RI, John C. Fletcher of the University of Virginia, Charlottesville, Gregory Pence of the University of Alabama, Birmingham, and John Robertson, University of Texas. There are several other scholars and scientists who are just now making their positions known as the number of experiments and educational institutions conducting research increase. Debate is opening up, and discussion is beginning to be heard with regularity. [12]

3.3 Reproductive Rights

There is a question of reproductive rights when it comes to the subject of human cloning. Some very strong cases can be made in favor of allowing some parents to apply human cloning technology to create a child. It should be noted that all of these arguments and scenarios assume that the science of cloning humans has been developed to a high degree of accuracy as to prevent any potential loss of human life due to failed experiments. The first and most simple case is the one of two parents who cannot reproduce any other way. Human cloning could perhaps offer them an alternative method of artificial reproduction that could work. If the parents can afford to pay for a cloning attempt to be made, and they've exhausted all other solutions, then perhaps they should be allowed to try cloning to produce a child.

Perhaps the strongest case in support of human cloning would be to avoid a genetic disease common in a family line. Suppose that in one particular family line there is a risk of every type of common disease from breast cancer to heart disease. Furthermore, suppose that 7 out of 8 living members of that family line are afflicted with at least one devastating disease or disability of a genetic nature. Now consider if both a male and female coming from families such as this want to have a child. Their offspring would have a very good chance at being born with one of those genetic diseases. Now suppose that there is a member from one of the parent's families who is healthy with no genetic diseases, smart, talented, and the ripe old age of 90. Perhaps it would be a good thing for the parents to clone that 90-year-old relative instead of rolling the dice in a situation where their child could be born with

a terrible disease. With the wellbeing of the child in mind, human cloning could definitely be beneficial in this type of scenario.

There are several other cases in which human cloning may be justifiable. Suppose that a set of parents has lost their child to some tragic accident such as a car crash. The child that was lost was healthy, bright, and sorely missed. Now suppose that the parents can no longer have children for one reason or another (perhaps the father is now infertile, or the mother has had her ovaries removed). If the child had not died right away, then perhaps he or she was taken to the hospital where some cells were removed and frozen. The parents, not being able to reproduce any other natural way would have the choice of having their dead child cloned from the frozen cells. This would perhaps be an acceptable application of human cloning. The same could perhaps be said of gays and lesbians who wish to have a child that bears a likeness to one of the parents.

These cases all tread around what are known as reproductive rights. Should individuals be allowed to make use of human cloning technology can perhaps be answered by looking at a broader scenario. John Rawls, a Harvard Philosopher, discusses justice as it pertains to the basic fundamentals of society. Rawls states that, "I have assumed so far that the distribution of natural assets is a fact of nature and that no attempt is made to change it, or even to take it into account. But to some extent this distribution is bound to be affected by the social system....it is also in the interest of each to have greater natural assets. The enables him to pursue a preferred plan of life. In the original position, then, the parties want to insure for their descendants the best genetic endowment (assuming their own to be fixed). The

pursuit of reasonable policies in this regard is something that earlier generations owe to later ones, this being a question that arises between generations. Thus over time a society is to take steps to preserve the general level of natural abilities and to prevent the diffusion of serious defects. These measures are to be guided by principles that the parties would be willing to consent to for the sake of their successors. I mention this speculative and difficult matter to indicate once again the manner in which the difference principle is likely to transform problems of social justice. We might conjecture that in the long run, if there is an upper bound on ability, we would eventually reach a society with the greatest equal liberty the member of which enjoy the greatest equal talent." The philosophical nature of the argument perhaps makes it a stretch to apply directly to human cloning experimentation, but the connection can be made.[4]

3.4 Potential Problems and Abuses

There are many misconceptions about the possibility of human cloning that could lead to inadvertent misuses of the technology when it is available. The common stereotypes most likely come from science fiction where clones are not portrayed as normal human beings who simply have the same genetic makeup as another human being. Perhaps the most common misconception about cloning is the fact that clones are not "instantly" materialized to be the age of the individual who is being cloned. Suppose that a 30-year-old male clones himself. First he would need to find a female willing to carry the child for the typical 9 months of child bearing, assuming that the embryo had been successfully prepared and implanted in the

[4] Pence discusses this in his book. [4]

female. Then the clone would have to be cared for, nurtured, and educated just as a normal child should be. The child may have similar instincts as the person who he or she was cloned from, but they will certainly have their own mind and be their own individual. By the time the child ages to be 30 years old, the age of the father when he was cloned, the father would be either 60 or 61. So it's not possible to create a clone of the same age as the person being cloned unless a newborn baby is the individual being cloned.

There are other stereotypes about clones that are products of science fiction and not possible when it comes to the reality of cloning. The most common misunderstanding is that the clone will have the same mind as the person they were cloned from. This of course is not true. While they may have a similar intellectual capacity, the memories and mental experiences are unique to the individual. The important idea to remember is that a clone is just another human being that fully develops on his or her own. They are not zombies, robots, slaves, or in any other way different from normal human beings. Some misconceptions may have arisen from such pop culture movies as Blade Runner. Undoubtedly as the potential for human cloning becomes closer to reality, these types of misconceptions and stereotypes will vanish. [4] [12]

Another cause for concern regarding human cloning is the potential that an individual will be cloned without their permission. While the notion is perhaps a bit farfetched at this stage of the technological advancement, it is an issue that would inevitably need to be dealt with. Suppose that there is a particularly famous person, such as the President of the United States. Undoubtedly, some people would desire

to have their children resemble the president to give them some kind of advantage in life. Or perhaps a star athlete would be desirable to clone so that the child being created would grow up to be as physically fit and perhaps also go into an athletic career. If cloning technology becomes readily available and eventually affordable, then the demand for cloning of popular people could increase to the point where a black market surfaces. This black market could potentially make money by obtaining genetic samples of famous people to be used for cloning. All it would take is a lock of hair or flake of skin to provide enough genetic information for a cloning procedure to take place. When an individual is born, they are usually unique. This uniqueness should be owned by a person, and only given up by his or her own choice. To have their likeness "stolen" would be undesirable, so some kind of measures would have to be put in place to ensure that this does not happen. The government of any country where cloning is a practice should take steps to pass legislation about rights to ones own genetic makeup, and prohibit the unauthorized cloning of an individual[5].

Another cause for concern with the potential application of human cloning is a loss of diversity in the gene pool. Normally, the two parents of a newborn both contribute to the genetic makeup of that child. Traits are taken from each of the parents to make up a new unique individual. When cloning is used, the genetic makeup of the new individual is exactly that of another existing individual. If there were multiple clones made of someone, then each of those clones would be genetically identical. With each additional clone, the diversity among the human

[5] The NBAC mentions the importance of this in their 1997 report on human cloning.

race decreases. While this may be trivial when there are only a few clones of a single person, it becomes a matter for concern if there is potential for a large number of clones. It would be wise for the scientific and medical communities to determine how many clones of a single individual would be acceptable before gene pool diversity is compromised. The government of any countries where cloning takes place should pass legislation to ensure that excessive cloning of a single person does not take place[6].

[6] Currently, no nation has legislation that specifically condones human cloning.

4. THE CAUTIOUS APPROACH

There are valid arguments both for and against human cloning. Those for it cite examples where the technology can be used to do a lot of good. Such cases include reproductive rights for couples who cannot reproduce any other way and cloning to avoid genetically based diseases. Those who would argue against human cloning express concern about the possible abuse of the technology, especially before it has fully been developed. There is enough evidence that human cloning can do a lot of good to justify its use, but yet enough evidence that it could potentially be abused to cause much concern. Therefore, the correct approach would be a cautious adaptation of the technology once it has fully been developed. This would require agreement by the medical and scientific community, as well as national and international governments. After all, an agreement is only as good as long as it is enforced and followed universally. Therefore, a cautious approach should be used in the exploration of human cloning technology.

4.1 Cloning Technology Must Advance Further

The first and most important point of the cautious approach is that development should occur slowly, and that human testing should not occur until the technology has advanced significantly. Animal experimentation can lead to a lot of meaningful data and until that sort of experimentation has been absolutely exhausted, human experimentation should not take place. The main reason is that a failed animal experiment could yield a dead or sick animal, and a failed human experiment could yield a dead or sick human. Quite simply, it is wrong to test on humans when

it could lead to death that could otherwise be avoided by extensive testing on animals.

Another important point to consider is that animal cloning experimentation still yields new and useful data. It was just recently confirmed that Dolly does in fact have the ability to reproduce normally as it gave birth to healthy offspring. The question of whether or not a clone such as Dolly would be able to reproduce normally was never really in doubt, but it also had not been confirmed with enough experimentation. While scientists can make assumptions about the health of clones, testing is definitely required to confirm their beliefs. If human cloning takes place and one of the previously thought assumptions is false, it could be a tragedy. For instance, if a clone for some reason could not reproduce, then it would be unethical to bring a human clone into the world with that sort of condition. So while the technology seems to be building, many tests to confirm the results are still necessary. In another recent breakthrough in April of 1999, researchers from Massachusetts cloned 3 genetically altered goats. While this experiment may seem ordinary, the technique uses was more efficient than known methods because it required fewer donor eggs to be used. [17] Cloning technology should be researched slowly, and animal experimentation should be exhausted before the phase of human testing is even considered.

4.2 Experimentation

After the technology has been deemed sufficiently safe to use and that human cloning should take place, experimentation should proceed slowly and cautiously. In

the beginning stages it should be limited to certain various needs. For example, infertile parents for whom cloning is the only viable method for reproduction. This beginning step would provide a "proving ground" of sorts. This would allow cautious and safe, progression and collection of information on cloning of humans. Using this information, the technologies used in cloning could be verified for safety and accuracy. After repeatedly successful reproductive cloning for infertile parents, and debate upon the received data concluded, a progression to other kinds of cloning could occur. The next logical step would be limited cloning experimentation for parents with genetically passed disorders that wish to have children, but don't wish to have children with the disorders. Using the prior learned techniques, slowly, reproductive cloning could occur, during which genetic disorders and diseases could be eradicated allowing a healthy fetus to grow, and result in a healthy child. That next step would provide large amounts of information on genetic manipulation and reproduction within humans, and be a milestone event in the history of mankind.

The importance of ethical and moral debate, and those debates being heard, can not be stressed enough. It must first be decided whether or not the human race as a whole wants to embrace this technology. Cloning has many ramifications, and as the science matures it will greatly impact the way that people live, think, and feel. It can create whole new industries, jobs, "spin-off" technologies, and ultimately create a new type of genetically superior humans, depending on the extent that the technology is applied. These are the ramifications that need to be considered. Through lengthy ethical debate a consensus could be reached as to how much or little of cloning the world wishes to have. If society rushes into cloning then there

will most likely be extensive controversy and fighting between peoples of opposing views. Abortion is a good example of this. Abortion was brought into use before there was a great deal of discussion and education of the people as a whole about it. The result was a divide between people who are pro-abortion and people who are anti-abortion. With cloning reaching down to the very base of philosophical theologies and ideologies, various religions and peoples have greatly differing feelings about it. If not handled carefully without ethical debate being heard, the implementation of cloning technology could lead to violence and even death.

4.3 Regulation

Legislation for human cloning should be strictly based upon the consensus of varying ethical groups and scientists. Without the legislation being based upon a consensus, it will most likely lead to violence, and possibly an eventual development of cloning related crimes. Legislation is first and foremost required to be an expression of what people believe should be changed or happening. If the legislation does not result from the consensus of ethicists and scientists, exactly what the limit is will never be clear or concise. There will be continuing arguing, experimentation, and potential crime and violence. [3]

The legislation that results from the consensus of the varying groups with interest in cloning should be worded as exact as possible. Due to the delicate and experimental nature of human cloning, it is important that no ambiguity exists in the wording of regulatory laws. If not worded explicitly enough, the laws could open the door for deviation of accepted guidelines on the part of scientists. If loopholes

are present within the legislation, scientists could get away with unregulated experimentation. If this occurs, it could lead to serious mishaps and dangerous results. Legislation should be extremely strict and specific, such as is the case for biochemical hazardous substances. These substances are extremely regulated, and any suspicious activity that indicates a use or experimentation with these substances is investigated immediately. Similarly, cloning technologies should be limited and safeguarded so that someone who would misuse it does not obtain the technology.

As the technology grows and evolves, the legislation relating to human cloning should as well. This will prevent new ways to abuse and misuse the technology. New legislation also provides a platform for new discussion between scholars and scientists as new ethical and moral issues develop. The revised legislation could incorporate new restrictions on experimentation and application of developing technology. Swiftness of updating as new advances are made is crucial to maintaining regulation of cloning[7]. In something as experimental as human cloning, there is also a need to address copyrighting in legislation. Not only copyrights and patents on specific technologies would need to be looked at, but also of genetic patterns. There would be a great demand for genetic code of popular people in society, while most religious and scientific communities agree that stealing of a person's genetic code is wrong. This would result in a whole industry based upon the buying and selling of genetic patterns. Copyrighting would have to be strict and laws extremely specific about just what people may do with another's genetic pattern. What could potentially develop is a scenario in which famous people in

[7] The NBAC points out the importance of keeping legislation up to date in their human cloning report.

society sell their genetic patters for a large sum of money. Once the genetic code leaves the source, namely the person, records of who has rights to that source must be kept in some sort of database both for government and scientific use.

International agreement regarding human cloning regulation is imperative to any kind of cloning regulation at all. Without international agreement, any kind of cloning regulation by any country alone is worth next to nothing. If there is no agreement, then those who wish to bypass cloning regulation in one country could simply travel to another country that lacks such laws. This would cause a cascade effect that would make regulation of cloning in countries already with legislation extremely hard to enforce. That in turn would create a "black market" of sorts, where cloning could be performed in a country lacking legislation, then taken back to regulated countries, much like drug smuggling. The lack of international agreement on legislation would also allow easy access for genetic pattern trade and unauthorized reproduction, thereby violating an individual's rights. Some scientists may attempt to create a research facility on a separate island where there is no formidable government. That would allow for unregulated experimentation and cloning. For example, in the scenario presented in the book entitled "The Island of Dr. Moreau", a scientist creates a base on an island and performs an extremely large number of genetic cloning experiments, completely untold to any kind of authority[8]. This is the exact kind of scenario that could arise if international legislation is not reached.

Another important factor of international agreement is that of religious

concerns. A large number of countries consist of a single major religion. Therefore, each nation could be treated as an independent theological entity for the purposes of a theological discussion. International agreement in this sense is also very important, because it signifies an overall acceptance or finding of a "common ground" on the matter of human cloning. Without international agreement in this way, civil and international wars could occur. History has shown that with even a small amount of difference in ideology, peoples will fight each other. The subject of cloning is a controversial topic in any religion, and could provide a context for which violence between people with opposing viewpoints could occur. International agreement could only help but provide a context in which a universal understanding between most people can be achieved.

[8] Information on *The Island of Dr. Moreau* can be found in the IMDB. [18]

5. SUMMARY AND CONCLUSION

Over recent years the science of cloning has advanced quite a bit. With the first suggestion of nucleic cloning in 1938 by Spemann, he created the first cloning procedure. His cloning of a 16-cell salamander embryo was the first step in the process of eventual human cloning.

Some 14 years later, with the cloning of 27 tadpoles with nuclear transfer Briggs and King took the next large step, and further developed the ideas of Spemann. As time progressed more experiments were performed, and each time a further advance was made, as in the cases of Gurdon, Illmensee, Solter, and Prather. These trials all lead to a recent culmination of cloning experimentation. With the first cloning of identical sheep in 1995, the proverbial "ball" started rolling. What proceeded was the first animal cloned from an adult cell. Named "Dolly", the lamb provided crucial information relevant to the further development of cloning technology. Dolly showed that cloning from adult cells is viable, and that the resulting animal is of it's own chronological age, and not that of the originating animal. Due to the large amount of press coverage Dolly received, the majority of the public realized that cloning was soon to become reality, instead of mere science fiction. This provided a platform for the first major theological and ideological debate over the ethical and moral nature of human cloning.

The next major step in cloning technology was when New Zealand scientists cloned an endangered type of cattle. This provided the first true evidence that cloning could be used to help make sure endangered species were able to survive. This provided an avenue for practical use of cloning, the forced reproduction of

species. At this point, the practical usage of cloning for reproduction was considered. Couples not capable of reproduction by natural or existing artificial means would be eligible candidates for the attempted use of cloning to produce a child. In December of 1998 Japanese scientists achieved an 80% success rate in the cloning of cattle, a complex organism. With an 80% success percentage, many consider cloning technology to be viable and advanced enough for commercial use. The only roadblock, so to say, is the ethical and moral debate of the existence of human clones and what kind of a success rate is "high enough". It would need to be determined whether or not human cloning is acceptable by the majority of peoples, and if so under what circumstances.

Currently, there are five major cloning methods that have developed over the history of cloning: Modecular cloning, cellular cloning, embryo twinning, nuclear somatic transfer; and nuclear fusion.

Modecular cloning is the most widely used version of cloning, which duplicates host DNA in a bacterium culture. Cellular cloning is used primarily in medical research, and is a simple method of duplicating a cell. Embryo twinning is not typically used, except primarily for cattle breeding. Embryo twinning is a process in which an embryo is split into halves, which have identical genetic structure. Nuclear somatic transfer (NST) is a method in which a nucleus is placed in an egg that has had the nucleus removed. Nuclear somatic transfer is a very delicate procedure, which requires that the nuclei must be properly frozen and handled prior to transfer. Nuclear fusion is a method that is a branch of NST. This approach uses an enucleated egg and a donor cell, where current is applied and the

two fuse together to produce an embryo.

These five methods are the main procedures being examined for potential application to human beings. All these methods work to some extent and are being experimented with currently. The most widely used method for cloning is nuclear somatic transfer, which was the actual method used to create Dolly. This method promises an easy way of cloning as long as the nuclei are kept properly frozen.

The inevitable debate over the great controversy of human cloning has supporters both in the anti-cloning and pro-cloning camp. Many debates are done strictly in a religious sense, involving most major religions. The general feeling of the masses is that it is acceptable in certain situations, but what exactly are the limits of which cloning can be used? As the science of cloning continues to quickly develop, debate must come to a consensus soon, or we will have reached a point beyond what debate can achieve.

There is much disagreement between several major religious groups on the subject of human cloning. Most religions condone it when applied certain ways, except for the Catholic Church, which condemns any form of unnatural birth due to its strong family backing. The Protestant religion accepts cloning on the basis that we are simply using the science that God has given us to extend what is natural. The Buddhist faith is likely to accept human cloning in all forms, due to their view that they see it as a change and improvement upon mankind. Jewish communities are likely to accept cloning as a substitution for infertile families and other limited activities where procreation of their race and culture is supported.

The majority of religions stand close to a "middle ground" of sorts on the

subject of human cloning. Most would accept it for a means of reproduction for infertile parents. Whatever the stance a religion takes on the subject of human cloning, the debate is heavy and often quite outspoken. The importance of finding a common ground between religions on the topic of cloning is of utmost importance, since a vast majority of the world is part of some sort of religion. If no consensus is reached by the time cloning matures and is first applied to humans, then the resulting clash between religions could be disastrous, comparable to the current division surrounding abortion.

Meanwhile, agreement for government legislation has been a slow and grueling process. Early legislation attempts were not passed because of the inaccurate wording and design. The early legislation in the United States was written too literally yet not specific enough. It would have blocked a lot of legitimate use of genetic science that is currently acceptable, such as IVF. This resulted in the creation of the National Bioethics Advisory Committee in 1995, to report on the subject of human cloning and advise on legislation and regulation. In 1997 the committee concluded that it is morally and ethically unacceptable to clone any human, resulting in the creation of a human child, using nuclear somatic transfer. This was concluded about any usage of this method including clinical, research, public, or private. They also concluded that legislation should be immediately enacted to prohibit the creation or attempted creation of a human child, whether in clinical or research fields, using nuclear somatic transfer. The failure of the NBAC to rule on the other methods of cloning and to explain thoroughly why that nuclear somatic transfer was unethical led to cause for more debate in the scientific

community. Legislation should be enacted to regulate any usage of any method in attempt to create a human child by cloning, instead of just nuclear somatic transfer.

The report by the NBAC is a perfect example of the problems associated with a relatively new technology, as it is full of loopholes. Loopholes in a regulatory legislation basically make the law pointless, as it can simply be bypassed on some technicality. Any legislation passed also needs to be carefully revised several times before being finalized to ensure there is no unintentional loss of legitimate genetics experiments. The main concern for legislation crossover involves fields that deal with DNA sequences and cell lines, in which cloning techniques are sometimes applied. Since DNA sequences and cell lines do not raise the same theological, ideological, ethical, and moral concerns as cloning a human child does, it should not be included in regulatory legislation. Any legislation passed needs to be specific about cloning and its application to humans only, since that is where the proverbial "line" is drawn on ethical standards. If that is not specifically detailed, legislation could stray from its intended purpose and limit what is already deemed acceptable and ethical experimentation in DNA sequencing, which would be of a tremendous loss, as DNA sequencing is a field with many possibilities and uses. The NBAC advised that in the case that if a ban was enacted, research trials should precede any clinical use of nuclear somatic transfer as long as subject protection, independent review, and informed consent laws were strictly followed. The NBAC also encouraged debate between interested parties so that a consensus can be reached before any action is taken. The final stance of the NBAC seems to be a cautious acceptance of a ban on human cloning, but that related research (such as on animals)

should be carried out and a consensus between interested parties be reached, and the issue reviewed again in the future.

Many other countries besides the United States have taken on or are considering a stance on regulating human cloning. France, Germany, and the United Kingdom have all decided to outright ban human cloning. The importance of the United States legislation on the subject of cloning agreeing with other countries was greatly stressed by the NBAC. Unless an international treaty on regulating cloning technology is present, it is a simple matter to build the relatively unsophisticated cloning technology in third world countries without regulation, such as in various African, South American, and Asian nations. Clearly, unless a global treaty on cloning regulation can be established, human cloning will undoubtedly be performed in countries lacking such regulation.

Debate in the past over cloning technology has been typically towards banning it, though in recent years many scientists and philosophers are coming forward to support cloning. The new influx of support varies from acceptance of reproductive cloning only to full support of human cloning no matter the circumstances. One of the strongest cases made for human cloning is for infertile parents who have no other means of reproduction. Reproductive cloning could at least initially be used as a means of last resort as all other options have been exhausted.

The strongest case for human cloning is the application of reproductive cloning to avoid genetic and hereditary diseases. Reproductive cloning would allow the eradication of a genetic disease, so that a fully healthy and normal child could be

born. This could be the only choice for some parents with genetic diseases who would not want to bring a child into the world with such a high chance of a serious disorder.

Misconceptions about cloning are rampant throughout modern society. Most stereotypes were introduced through science fiction stories and then progressed over time as writers came up with new stories. One of the most rampant cloning misconceptions is that when you clone something, the resulting being is of the source's chronological age. In no type of cloning could the clone have the same chronological age as the host, it has its own chronological age that begins when the clone is born. Another misconception about the nature of cloning is that the resulting being will be exactly same in instinct, likes, and dislikes as the host. However, the clone will have its own set of personality traits, totally independent of the host. The personality will be result of the clones own experiences and thoughts, as is a normal child's. As human cloning becomes closer to a reality, the stereotypes will vanish as the masses become educated about the facts.

One of the major concerns and topics of debate over cloning is the rights to one's genetic code. A hazard of genetic cloning is that a person's rights will be violated if they are cloned without their permission. Since it takes extremely little source to clone an individual, it would be very easy to obtain a person's genetic code and then create a clone from it. Any legislation put forward for serious consideration should deal with this inevitability. This could become a serious problem, as many people would want to clone popular people in society. Legislation should either deal with the issue by giving "genetic copyrights" or altogether banning cloning of

another person.

Another major concern of human cloning is the potential decrease of genetic diversity. If too much cloning occurs, there could be a sharp reduction in the diversity of genetic code within the population as people use the same code over and over. This could also lead to a sort of genetic degradation, in which genetic code eventually becomes standard as the same qualities of genetic code are used continually. While only a problem with large amounts of clones, it should be debated and discussed thoroughly in the scientific community before testing begins.

There are major arguments both for and against human cloning. The best arguments that condone the advancement of human cloning technology consist of reproductive cloning and genetic disorder elimination. Though, there are also many arguments against cloning, especially while the technology is still in its early stages. The best approach to cloning should be a cautious and slow one, since mistakes could be costly and a position still needs to be determined. First and foremost, cloning should proceed extremely slowly, with actual human cloning not being performed for years to come. Experimentation with animal cloning is still yielding good information, so should be continued before moving on to the next phase. Failed animal experimentation produces sick and dead animals, where as on humans, could produce sick or dead humans. Therefore, any human cloning should wait until the technology has significantly advanced, since a dead human is vastly more important than a dead animal.

If cloning technology has progressed significantly, and it has been shown through animal cloning that cloning is safe, human cloning should be at first limited

to certain needs. The logical first step would be to allow early human cloning trails to take place for the reproductive needs of particular parents. This would provide a safe beginning platform for human cloning, in which the accuracy and hazards of human cloning could be verified and judged. After many repeated successful cloning trials have been performed, a progression towards cloning to eliminate genetic disorders could be tried. This could provide a further platform for advancement of cloning technology. Regardless of which stage the progression hits, each platform of study should be thoroughly examined and discussed before the science is allowed to move further along.

Before any kind of cloning legislation is passed, there should be a great deal of debate on the subject. The debate should be listened to closely, and anyone with an interest in human cloning should be allowed to participate. Legislation must be based on the consensus of the experts and the populace must educated before any hopes of a broader international agreement can be met. Without a complete consensus, some parties involved may choose to ignore the legislation due to their opinion being in the minority. This is bound to happen, but should be kept to a minimum.

Wording of laws is extremely important in having that legislation be a viable source of regulation. If the legislation is worded inaccurately, it could limit other acceptable sciences severely. This is a major concern of legislation because applications like DNA sequencing, which can be used to find cures to genetic diseases and disorders, could be inadvertently banned by poorly worded laws. On the other hand, if legislation is too narrow, it could present "loopholes" that scientists

and people in the private sector could exploit. In as constantly an evolving science as cloning, it is imperative to that the legislation be updated periodically. Without updated legislation, new technologies could develop resulting unregulated experimentation and abuse of cloning technologies that were originally designated for regulation. The updating of legislation should also include new changes in societal view towards legislation, which should ideally be a major driving force of legislation anyhow. During review of legislation, the reviewers also need to deal whatever new information has come up about copyrighting of one's genetic code and other such issues that may not be resolved right away.

For any legislation to truly be effective, there needs to be some sort of related international legislation to prevent local scientists from engaging in banned experimentation in foreign countries. A lack of international agreement to support local legislation would result in unregulated experimentation with human cloning, causing an outcry from the nations that have taken steps to control it. Additionally, it could open up a "black market" of genetic technology and cloning where people in countries with strict legislation could travel to other countries to get cloning done and return afterwards, thus bypassing the spirit of their local laws.

Cloning technology and its potential application on humans could offer a lot of beneficial breakthroughs for mankind. However, there is enough reason for concern with the many possible misapplications and dangers in the early stages of experimentation that extreme caution needs to be applied. Human cloning can and will be a reality in the near future. It should be embraced, analyzed, studied, and discussed before it becomes widely available in other countries. The global

community needs to come to a consensus regarding what is acceptable and set local laws accordingly. Human cloning can be successful and beneficial to the human race if it is approached slowly, with great caution.

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