Chapter One

INTRODUCTION

The idea that humans might someday be cloned—created from a single somatic cell without sexual reproduction—moved further away from science fiction and closer to a genuine scientific possibility on February 23, 1997. On that date, *The Observer* broke the news that Ian Wilmut, a Scottish scientist, and his colleagues at the Roslin Institute were about to announce the successful cloning of a sheep by a new technique. The technique involved transplanting the genetic material of an adult sheep, apparently obtained from a differentiated somatic[2] cell, into an egg from which the nucleus had been removed. The resulting birth of the sheep, named Dolly, on July 5, 1996 appears to mark yet another milestone in our ability to control, refine, and amplify the forces of nature.

The Scottish sheep experiment was different from prior attempts to create identical offspring from a pair of adult animals. It used a cloning technique to produce an animal that was a genetic twin of an adult sheep. Put another way, Dolly contained the genetic material of only one parent. This technique of transferring a nucleus from a somatic cell into an egg is an extension of research that had been ongoing for over 40 years using nuclei derived from non-human embryonic and fetal cells. The demonstration that nuclei from cells derived from an adult animal could be "reprogrammed," or that the full genetic complement of such a cell could be reactivated well into the chronological life of the cell, is what sets the results of this experiment apart from prior work. In this report the technique, first reported by Wilmut, of nuclear transplantation using nuclei derived from somatic cells other than those of an embryo or fetus is referred to as “somatic cell nuclear transfer.”

For some time, scientific evidence has suggested that the genetic material contained in differentiated somatic cells may retain the potential to direct the development of healthy fertile adult animals, but its capacity to do so remained unproved (Di Bernadino, 1997). The Roslin experiment, therefore, was a significant scientific event with potentially profound implications since it brings us closer to the possibility of developing a capacity to create clone human beings in an asexual manner. Although for the past ten years scientists have routinely cloned sheep and cows from embryo cells, this was the first successful experiment using the nucleus of a somatic cell from an adult animal to clone an animal that matured to a fully developed state.

The issues surrounding the cloning of human beings have long been the subject of periodic concern and debate among philosophers, scientists, ethicists, and others, particularly following the publication of Joshua Lederberg's 1966 article on cloning in the *American Naturalist* (Lederberg, 1966). Nevertheless, the impact of these most recent developments on our national psyche has been quite remarkable. Some commentators have suggested that the furor aroused by the new possibility for cloning is out of proportion to most of the ethical, legal, and moral issues it raises, since these same issues have been raised by previous developments and are simply emerging again in a novel and striking form. Nevertheless, it is important to acknowledge that the possibilities raised by this new technique certainly would be unprecedented and that some would consider its use to be a truly radical step. This type of cloning would involve three novel developments: the replacement of sexual procreation with asexual replication of an existing set of genes; the ability to predetermine the genes of a child; and the ability to create many genetically identical offspring.

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[2] A somatic cell is any cell of the embryo, fetus, child, or adult which contains a full complement of two sets of chromosomes; in contrast with a germ cell, i.e., an egg or a sperm, which contains only one set of chromosomes.

Some scientists were surprised that the technical barriers of cell differentiation and development seemingly could be so easily overcome when using somatic cells as the source for nuclear transfer. The public—including many members of the scientific community—responded to Dolly with a combination of fascination, hope for useful new understandings of human biology, and profound concern—even alarm—about the prospect of being able to create whole humans from a single somatic cell via nuclear transfer cloning techniques. Although much of the initial public reaction was one of fear, concern, and serious moral reservations about the potential use or abuse of this new technological capacity, a few voices were heard cautiously suggesting that a better understanding of cell dynamics in humans and animals might enable us to develop new cures for various diseases. Thus, it is important to reflect not only on the dangers and ethical reservations but also on the potential human benefits from the use of this type of cloning that might arise in such areas as treating particular infertility problems, transplanting cells or tissues, or preventing certain genetically transmitted harms to offspring.

A few of the initial objections to this new type of cloning were either speculative or based on simple misunderstandings, such as, that cloning would allow for the instantaneous creation of a fully grown adult from the cells of an individual. Other fears stemmed from the incorrect idea that an exact copy, although much younger, of an existing person could be made. This fear reflects an erroneous belief that one's genes bear a simple relationship to the physical and psychological traits that make up a person. Although genes provide the building blocks for each individual, it is the interaction among a person's genetic inheritance, the physical and cultural environment, and the process of learning that result in the uniqueness of each individual human. Thus, the idea that nuclear transplantation cloning could be used to re-create exemplary or evil people has no scientific basis and is simply false.

Other objections to nuclear transplantation cloning, however, are based on carefully articulated philosophical ideals, deep cultural commitments, or religious beliefs, and these deserve continuing and careful consideration. These objections reflect deeply held beliefs about the value of human individuality and personal autonomy, the meaning of family and the value of a child, respect for human life and the natural world, and the preservation of the integrity of the human species.

Many public leaders in the United States responded to the announcement about Dolly with immediate and strong condemnation of any attempt to clone human beings in this new manner. The reasons ranged from frightening science fiction imagery to the judgment that cloning of human beings is a serious violation of basic human rights and human dignity. The reaction abroad was similar, with many nations seemingly ready—indirectly or directly—to prohibit cloning human beings in this fashion. Indeed, many international organizations such as UNESCO and the Council of Europe have a long-established and well-articulated concern that research and clinical applications in biology and genetics remain consistent with a fundamental commitment to human dignity and human rights. To date, at least Argentina, Australia, Great Britain, Denmark, Germany, and Spain have enacted laws banning cloning human beings. Unfortunately, some of the deep concerns supporting such views and associated legislation are stated in vague or overly broad terms. The widespread public discomfort, even revulsion, about cloning human beings deserves the best articulation possible, a task that takes time and requires the considered reflections of diverse groups within American society and abroad.

Within days of the published report of the apparently successful cloning of a sheep in this new manner, President Clinton instituted a ban on federal funding for research related to cloning of human beings. In addition, the President asked the recently appointed National Bioethics Advisory Commission (NBAC) to address within ninety days the ethical and legal issues that surround the subject of cloning human beings. This provided a welcome opportunity for initiating a thoughtful analysis of the many dimensions of the issue, including a careful consideration of the potential risks and benefits. It also presented an occasion to review the current legal status of cloning and the potential constitutional challenges that might be raised if new legislation were enacted to restrict the creation of a child through somatic cell nuclear transfer.

The Commission began its discussions fully recognizing that any effort in humans to transfer a somatic cell nucleus into an enucleated egg involves the creation of an embryo, with the apparent potential to be implanted *in utero* and developed to term. Ethical concerns surrounding issues of embryo research have recently received extensive analysis and deliberation in our country. Indeed, federal funding for human embryo research is severely restricted, although there are few restrictions on human embryo research carried out in the private sector. Thus, under current law, the use of somatic cell nuclear transfer to create an embryo solely for research purposes is already restricted in cases involving federal funds. There are, however, no current regulations on the use of private funds for this purpose.

The unique prospect, vividly raised by Dolly, is the creation of a new individual genetically identical to an existing (or previously existing) person—a “delayed” genetic twin. This prospect has been the source of the overwhelming public concern about such cloning.
While the creation of embryos for research purposes alone always raises serious ethical questions, the use of somatic cell nuclear transfer to create embryos raises no new issues in this respect. The unique and distinctive ethical issues raised by the use of somatic cell nuclear

transfer to create children relate to, for example, serious safety concerns, individuality, family integrity, and treating children as objects. Consequently, the Commission focused its attention on the use of such techniques for the purpose of creating an embryo which would then be implanted in a woman's uterus and brought to term. It also expanded its analysis of this particular issue to encompass activities in both the public and private sector.

Controlling Nature

Humankind's efforts to control nature date back as far as recorded history. In particular, domesticated plants and animals have been the mainstay of our agricultural heritage. Over time human mastery over nature often has been met, quite understandably, with opposition and concern, and frequently has been considered by some to be an affront to the natural order of things or by others to be at odds with interpretations of God's revealed word. Indeed many myths and legends, ancient as well as modern, deal directly with humankind's on-going struggle to ensure that the benefits of our new technological capacities clearly outweigh the harms—both expected and unexpected. The idea that our growing technological mastery is filled with moral ambiguity and capable of both vast good and catastrophic evil is deeply embedded in many cultural traditions.

A prime example is the mythology of the Argo, the first ship, in classical Greek culture. The Greeks see the initial act of shipbuilding as both the origin of culture and the origin of decline. While sailing enables one to encounter other persons and other possibilities, it also brings marauders and war, and its very existence bespeaks the danger of unlimited human desire. Thus, the ability to build and sail boats is both a boon and a curse. Euripides' Medea starts with a lament about the trees that were cut down to build the Argo and the other troubles that followed:

> Would that the Argo had never winged its way to the land of Colchis....
> Would that pine trees had never been felled in the glens of Mount Pelion and furnished oars for the hands of the heroes who at Pelias' command set forth in quest of the Golden Fleece.

Concern about our tools and technology has been greatly accelerated with the coming of modern industrialized societies. Is it possible, some now wonder, that our confidence in human competence and technology may be just another myth? How, some are now asking, can we find some moral compass or moral limit to our desire to master everything and possess all? Only such limits, many would say, can save us from the moral ambiguity of our own cleverness.

In recent years, concern about humankind's control over nature has been particularly acute in relation to the new moral choices created by the stunning developments in the biomedical sciences, especially in the area of human reproduction. Although personal reproductive health is considered to be, in most cases, a private matter, ongoing controversies regarding the moral standing of human genetic material and particular human interventions in procreation have focused public attention on the ethical and legal implications of new reproductive techniques. In many cases, initial fears give way to cautious acceptance, but a wariness lingers that is easily reawakened with each new advance.

Artificial insemination by donor, for example, was considered a form of adultery when first introduced in the 1940s. It is now a widely used and accepted practice in the treatment of infertility, although some continue to have serious reservations. When prenatal diagnosis was introduced in the late 1960s, the public simultaneously welcomed the opportunity to prevent lethal disease in newborns but worried about the use of such techniques to select "vanity" characteristics or nonmedical traits in offspring. The birth of Louise Brown, conceived via *in vitro* fertilization, in 1978 was another dramatic event, providing a new and controversial means to parenthood. With all of these technical advances, there has been a continuing debate about safety, legality, ethical acceptability, and the government's right to intervene in private matters.

Research itself, not just its clinical application, has often sparked debate. For example, research involving human fetuses has been a subject of intense national debate and disagreement for over two decades (Institute of Medicine, 1994). Federal research in this area continues to be restricted to that which has potential therapeutic benefit to the fetus, or involves no more than minimum risk to the fetus even if potential benefit to the mother can be demonstrated. Restrictions also remain regarding embryo research. Despite the recommendations of the National Institutes of Health Human Embryo Research Panel (1994), that certain targeted and carefully regulated research using early human embryos be eligible for federal funds, in December 1994 the President directed NIH not to allocate federal funds for research programs that involved the creation of human embryos solely for research purposes. This issue was also addressed by Congress, which inserted language in the FY96 and FY97 appropriations bills that widened the presidential ban to prohibit virtually all human embryo research conducted with federal funds. Work in this area continues in the United States, but it is largely limited to the private sector, and thus takes place without any federal regulation.

Recombinant DNA research represents another example of controversy and intense debate. In the 1970s, concerns about the safety of unintended release of recombinant organisms led to a voluntary research moratorium in the scientific community and the development of guidelines (Fredrickson, 1991). Similarly, all experiments involving gene therapy (treatment of specific diseases by inserting human genes into human patients) are subject to review and approval by a federal body.

As segments of human DNA or human cells became the focus of study and the objects of manipulation, their use as research materials raised increasingly important ethical issues about how these materials are obtained, transformed, and, in some cases, used to develop commercial products (Office of Technology Assessment, 1987). Such research with human genetic material generates questions about respect for persons and the human body, and the value and moral status to be placed on cells and tissues.

Genetic and reproductive technologies also cause concern because of the specter of eugenics and of real or imagined social control through manipulation of human genes. Genetic control suggests broken taboos, and, in the words of Henry David Thoreau, implies that “men have become the tools of their tools”(Blank, 1981). While these concerns are often set against and partly attributable to a backdrop of fiction, fantasy, and misunderstanding, they are, more importantly, related to profound concerns regarding the nature of humankind and its relationship to other aspects of the natural world.[3] When the bizarre and fantastic scenarios are removed, we are left with a myriad of reactions: sincere expressions of opposition; serious moral concerns; new hope for a better understanding of human biology and the prospect of combating currently untreatable afflictions; calls for more study; and guarded statements about the need for some measure of control (Macklin, 1994; 1997).

Controlling Science

With some notable exceptions, the scientific community has enjoyed for centuries a great deal of autonomy in directing and regulating its research agenda. Since mid-century, however, demands for external regulation have increased, in part because much research, particularly in the biological sciences, is publicly funded and therefore requires some additional measure of accountability. More importantly, society has become more sensitive to concerns about the dangers—particularly to human participants—of the research itself and its future consequences. Thus, our evolving moral sensibilities together with the spectacular advances in biomedical science have generated new ethical concerns. As Bernard Davis of Harvard Medical School and others have noted, society sometimes seeks to regulate or restrict research when it poses the specters of dangerous or unfamiliar products, powers, or ideas (Davis, 1980).

The regulation of science has thus become part of the landscape, particularly for those who receive federal funds (Office of Technology Assessment, 1986). In addition to environmental, health, occupational, and safety regulations, scientists must also comply with animal welfare and human subjects protections and abide by restrictions and moratoria on specific types of research. Because science is both a public and social enterprise and its application can have profound impact, society recognizes that the freedom of scientific inquiry is not an absolute right and scientists are expected to conduct their research according to widely held ethical principles. There are times when limits on scientific freedom must be imposed, even if such limits are perceived as an impediment by an individual scientist. Moreover, appropriate ethical constraints are a matter for both scientists and the broader public to formulate and implement. At the same time, limits on freedom of inquiry must be justified, and impositions on such freedom should satisfy certain conditions—for example, that the limits are not arbitrary, that they emerge from the thoughtful balancing of costs and benefits, that they are not unnecessarily oppressive, that they do not lightly impinge on long established rights and freedoms, that there is some continuing public discourse with those affected by the ban, and that such limitations be open to reconsideration in the light of new information and new understanding.

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[3] With respect to interesting fiction consider Aldous Huxley's Brave New World (1932), David Rorvik's unsubstantiated claim of successful human cloning in In His Image (1978), and popular films such as The Boys from Brazil (1978) and Jurassic Park (1993) in which cloning leads to dire, doomsday consequences.

Consideration of Ethical and Religious Perspectives

When the President asked NBAC to take up the issue of the cloning of human beings he admonished that "any discovery that touches upon human creation is not simply a matter of scientific inquiry, it is a matter of morality and spirituality as well." Although well aware that the United States Constitution prohibits the establishment of policies that are *solely* motivated by religious beliefs, NBAC shared the President's concern and sought out testimony about the cloning of human beings from leading scholars from a variety of religious traditions. In the same spirit NBAC also commissioned a background paper on the positions a number of religious traditions have taken or are considering on the cloning of human beings.

NBAC felt this was especially important because religious traditions influence and shape the moral views of many U.S. citizens and religious teachings over the centuries have provided an important source of ideas and inspiration. Although in a pluralistic society particular religious views cannot be determinative for public policy decisions that bind everyone, policy makers should understand and show respect for diverse moral ideas regarding the acceptability of cloning of human beings in this new manner.

Although some religious responses to the cloning of human beings through somatic cell nuclear transfer are tied tightly to particular scriptural texts or other faith commitments, often these ideas can be stated forcefully in terms understandable and persuasive to all persons, irrespective of specific religious beliefs. For example, appeal may be made to a view of human nature or of human reason, rather than exclusively to a religious source of knowledge such as scripture or revelation.

NBAC also wanted to determine whether various religious traditions, despite their distinctive sources of authority and argumentation, reach similar conclusions about this type of human cloning. A convergence of views across these traditions, as well as across secular traditions, would be instructive, even if not necessarily determinative, for public policy.

While many Americans look to their religious faiths for moral guidance on issues, other sources of moral knowledge and insight are also important. Many moral considerations that would be widely acknowledged as legitimate do not depend for their force on particular religious commitments or a specific philosophical outlook. For example, the conviction that it is wrong to harm a child is broadly shared among Americans. If you inquire why it is wrong to harm a child, people may give different answers. Some may refer to their religious convictions that a child is a gift from God. Others may say that it is always wrong to harm an innocent person without some compelling reason. To many people, this is a bedrock principle of ethics, even if it has no single, universally acknowledged foundation in a specific religious or philosophical tradition. Rather, it finds its foundation in many different understandings of morality, some religious, some secular. Moral ideas such as the obligation not to inflict harm on others are accessible to all Americans and, therefore, can provide a robust foundation for public policy.

America has a vibrant tradition of ethical dialogue in which all are invited to participate. What moral considerations deserve our attention and which are the most important in responding to a particular issue? These are questions that arise with every new controversy. Whether one's ethical beliefs come from theological commitments, philosophical arguments, or from hard-won life experience, all voices should be welcome to the conversation, and all thoughtful views are entitled to a respectful hearing. While tolerance is a widely accepted virtue in American it is important to remind ourselves that it is built on the idea of mutual respect and the capacity to accept, whenever possible, the moral worth of others with whom one may disagree. Tolerance, therefore, means both agreeing to disagree and accepting the challenge of sustaining a community where moral authority will, to some extent, always be contested.

Policy makers, therefore, need to consider a range of moral views when they try to determine whether a particular policy is ethically justifiable as well as politically feasible. A particular policy may not be politically feasible, for instance, if it evokes thoughtful, widespread and vigorous moral opposition. In such circumstances its social costs may outweigh its putative benefits, and additional education and deliberation may be required before new policies are put in place.

Consideration of Law and Public Policy

The public policy chosen with respect to the cloning of human beings via somatic cell nuclear transfer should reflect a keen knowledge of the science, our best judgments about the ethics of attempting such an experiment, and our traditions regarding limitations on individual actions in the name of the common good. Americans in this era, relative to earlier generations, have a wide interest in and substantial knowledge of science. Nevertheless, in the weeks following the report of Dolly, the public, the media, and even some scientists demonstrated a surprising lack of understanding of the science involved in cloning. NBAC believes that public debate about issues such as human cloning requires an even more educated populace. Science policy has become public policy, which can be decided wisely only by an informed nation.

American tradition has been to avoid prohibiting or regulating personal activities, absent a compelling reason related to effects on others or society as a whole. Where the individual actions are expressions of fundamental rights, such as the right to free speech or the right to privacy, the reasons for limitation must be compelling, and the limitations made as minimal as possible.

The possibility of cloning human beings in this new fashion appears to raise concerns about direct physical harms to the children who may result. This in itself is sufficient to justify a prohibition on such attempts at this time, even if such efforts were to be characterized as the exercise of a fundamental right to procreate. More speculative psychological harms to the child, and effects on the moral, religious, and cultural values of society may be enough to justify continued prohibitions in the future, but more time is needed for discussion and evaluation of these concerns.

In its discussion of potential policy options, NBAC considered the relative benefits of achieving an immediate prohibition through federal legislation on cloning human beings using somatic cell nuclear transfer techniques. It also considered more indirect means to deter such experiments.

Indirect, non-legislative options considered by NBAC include cooperation by the private sector, both research and clinical, in a moratorium on such experiments and/or clinical practice, and the continued prohibition of the use of federal funds to support such experiments. The American Medical Association, the World Medical Association, and the World Health Organization, for example, have already called for such a moratorium on clinical activities.

NBAC also weighed, in terms of nuclear transplantation cloning, the potential impact of a possible legislative measure to extend basic human subjects protections to all research conducted in the United States. This would insure that any research efforts to clone a human in this manner would, along with all other research using human subjects, be covered by the twin protections of informed consent and appropriate scientific review to insure an ethically acceptable balance between risks and benefits. In light of the early state of animal research in this area, such protections should prevent such cloning research from going forward at this time.

Finally, NBAC recognized that cooperation with other governments in the enforcement of any common elements of our respective policies could strengthen any of the measures adopted by the United States. Because science is a global endeavor, international cooperation would ensure consistency across borders and enhance public confidence in scientific research generally.

Process of NBAC and Organization of the Report

The results of NBAC's 90-day analysis are presented in this report. In its deliberations, NBAC focused its discussion on the science of the cloning of human beings using the somatic cell nuclear transfer technique, and the ethical, religious, legal, and regulatory implications of cloning human beings in this manner. To aid in these tasks NBAC invited testimony from an array of scientists, scientific societies, ethicists, theologians, and legal experts, and heard from a wide variety of interested parties during the public comment session at each meeting. In addition, it commissioned numerous background papers from recognized experts to inform its work.

This report consists of five chapters in addition to this one. Chapter Two describes the scientific developments that preceded and made possible the cloning of Dolly and speculates on potential applications of this and related technologies. Chapter Three presents some of the key themes in religious interpretations and evaluations of human cloning. Chapter Four outlines the numerous ethical concerns raised by the prospect of cloning human beings via somatic cell nuclear transfer. Chapter Five discusses the legal and policy issues considered by the NBAC as it pondered various recommendations. The final section, Chapter Six, presents the recommendations made by NBAC in response to the President's request.

In many instances, NBAC found itself moving at a rapid pace in only partly charted waters. In those times it relied on its individual and collective wisdom, judgment, and moral foundations, and the advice of others. NBAC argued and debated the issues as it searched for appropriate formulations of the problem and for the wisdom to suggest useful policy options. While the members of NBAC learned a great deal during its deliberations, we could not reach a resolution on all of the issues before us. Nevertheless, it was able to accomplish two things. First, it developed a set of recommendations, which are set out in Chapter Six. Second, it agreed that it was important to take a number of steps to ensure the continuation of an informed national discussion of these issues and other developments in the biomedical sciences and clinical practices that have an impact on our moral lives and cultural traditions.

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