Current Creation Questions

The Test of Human Cloning

By Anthony J. Zuccarelli and Gerald Winslow

Introduction

California Rebels about Stem-Cell Research," an *Economist* headline said in September 2002. The story reported on a bill signed into law by California's governor, Gray Davis, that expanded stem cell research by providing state funding despite federal limits set by President George W. Bush in an executive order signed in 2001.

Although other issues have presently overshadowed debates about biotechnology, the discovery of new techniques for manipulating the basic building blocks of human biology has launched a field of accelerating research. These discoveries have aroused soaring hopes and deepening concerns about what humans can do with human life. No area of human biology has more clearly revealed the rift between these hopes and fears than the prospect of cloning.

It may come as a surprise to some that the Seventh-day Adventist Church gave serious attention to the ethics of human cloning years before the debate reached its recent, national crescendo. In 1998, at the Annual Council of the General Conference, the Church formally adopted a "Statement of Ethical Considerations Regarding Human Cloning."[1] That statement, nearly four years ahead of the recent report of President George W. Bush's Council on Bioethics on the same topic, has served our church well. However, as with all attempts to address ethical issues in quickly changing fields, our church's statement needs to be revisited regularly in light of new developments and in view of our settled principles. In the statement's own words, "The rapid pace of progress in this field will require periodic review."[2]

As two who were responsible for the initial drafting of the Church's 1998 statement, we feel a responsibility to continue the discussion of what

it means to live responsibly and faithfully in a time when both the promises and the threats of the new genetic biology are so powerful. We do not offer here an analysis or proposal for revisions of the 1998 statement, which is reprinted on pages 44–46, below. We wish rather to extend the discussion by pointing to further ethical considerations in view of recent developments in human cloning.

We begin with reproductive human cloning. Then we turn to what has been called "therapeutic human cloning." Throughout, we offer our reflections of the meaning of Christian responsibility, and we seek to present reasons why Christians should respond in a principled manner rather than simply reacting in conventional ways. We conclude with a plea for the Church to return to the practice of fostering careful study and offering balanced moral guidance in a timely and systematic way. The prospect of human cloning provides an instructive test of our faith for the purpose of shared moral reflection.

Reproductive Human Cloning

At its root, the word *clone* means a replica. "Cloning" has been applied to diverse biological manipulations, so it is helpful to distinguish among them. Gene cloning—isolating and making multiple copies of particular DNA segments—has been a scientific reality since the early 1970s. Embryo cloning, through blastomere separation, has been used by animal breeders for decades. This is accomplished by artificially splitting an early embryo and coaxing the separated clumps to become multiple, fully formed offspring. It was first used on a human embryo in 1993.

Reproductive cloning is a form of asexual reproduction. We have been accomplishing the same result for millennia with plants. An example is the rooting of cuttings from prized rose bushes in order to create new plants. Asexual reproduction is also the means of propagation used by many microorganisms, and it occurs occasionally among invertebrates. Therapeutic cloning is the newest addition to the family. By exchanging the genetic material in a mammalian egg, it generates tissues that are the source of embryonic stem cells.

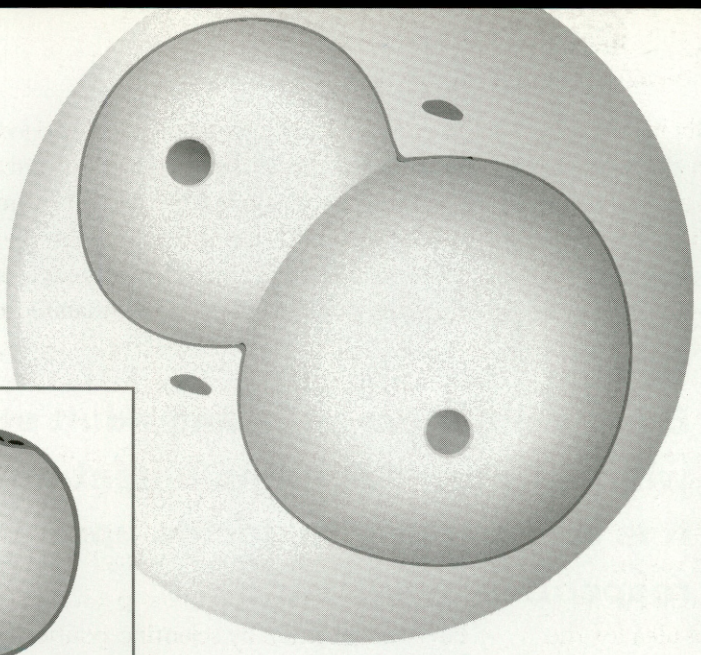
The birth of Dolly, the first cloned sheep, focused public attention on reproductive cloning, more precisely, somatic cell nuclear transplantation. This process creates a genetic replica of a living animal by reprogramming the nucleus from an adult cell to behave like a fertilized egg. In current practice it involves introducing the nucleus from an adult donor cell into an egg from which the original egg DNA was previously removed. Under ideal circumstances, the egg with its new nucleus divides and becomes an early embryo. When implanted into the uterus of a hormonally prepared female animal, the embryo may continue its development into a normal offspring. Our world is now inhabited by hundreds of cloned animals: sheep, mice, pigs, goats, cattle, one domestic cat, a guar (Asian ox) and a mouflon (wild sheep). All of them have three biological "parents"—a nuclear donor, an egg mother, and a birth mother.

The possibility of using nuclear transfer to make genetic duplicates of living humans has challenged public sensibilities. The response to Dolly's birth announcement in 1997 was intense, almost panicked. Countless pages have been written by scientific, political, religious, and social commentators concerning the application of the technique to human beings. Now the President's Council on Bioethics has added to the heft of this literature.

Though the public reaction to Dolly suggested that the world was unprepared for asexual human reproduction, it was not the first time that society had confronted purposeful interventions in our reproductive processes. In the 1960's, there was vigorous discussion of the religious, social, and moral consequences of using birth control pills to control reproduction. In 1978, there was a wide-ranging discourse after the birth of Baby Louise Brown, the first child conceived by in vitro fertilization rather than intercourse, and commonly referred to as a "test tube baby." (Since then, tens of thousands of children have been born using similar methods.)

In His Image, a book published the same year, falsely purported to describe the first human cloning.[3] It fueled the debate and provoked a detailed examination of human "clonal reproduction." In 1993, the first human embryo was artificially divided with the potential to generate twins. That event stimulated another discussion of the religious principles and philosophical traditions regarding the meaning of personhood, individuality, wholeness, and the sanctity of human life.

The science that created Dolly is a technology that emerged without precedents or antecedents. Nuclear transplantation had a long history dating back to experiments with frogs in the late 1950s. The methods improved steadily through the years. Ian Wilmut's contribution, in cloning Dolly, was technically modest. Indeed, there is a legal challenge to the Roslin Institute's original patent that protected the method of Dolly's creation, filed by another company that also generated live animals using nuclei from embryonic cells. Nevertheless, Dolly established, for the first time, that nuclear transfer from adult cells could be used to create



Day 1.5-2
Pre-embryo development of a fertalized egg at the two-cell stage

Day 1

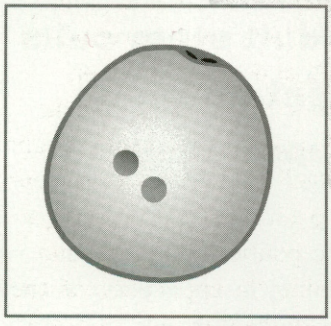


Illustration: Jennie Auman

We should notice that the creation texts answer one existential question only to raise others.

genetically identical animals.

If neither the concept nor the technology were new, why were we so surprised? One possibility is that before the event, the prospect of human clones was still deniable—a technique not applicable to mammals, sequestered harmlessly in laboratories, a subject for science fiction and abstract debates. The birth of Dolly—with her indelicate name—put the matter right under our noses, and the odor awakened dark fears.

Christian Views

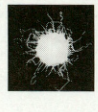
How should people of faith respond to the prospect of human cloning? Some Christians consider creation a completed act, a chapter of earth's history that was closed on the "seventh day" of Genesis 1. They regard God's original ordering of nature the perfect fulfillment of a divine design. Human intervention, in this view, could only be irreverent, disruptive, undiluted hubris.

Other Christians see their role in creation as one of cooperation with God in an ongoing process of creativity and caring for the earth. Though the creation story of Genesis 1:26-28 makes clear that we are dependent creatures, the Scriptures also indicate that in some respects we resemble the Creator. Much has been written about our God-image. For the present discussion, it is sufficient to notice that God's image in humans is multifaceted. When one observes that a child resembles its parents, one does not usually mean only the child's nose or other physical characteristic, or some mannerism or personality trait, but all of those taken together.

Creation in the image of God is fundamental in the Judeo-Christian and Islamic traditions. There is wide agreement that God's image is not about anatomy or physiology, but encompasses human intellect, moral agency, individuality, creativity, the capacity for altruistic love, the capacity to will, to apprehend God, and to find fulfillment in relationships. It may have even broader meanings within the framework of the cosmic conflict, as understood in Adventism. In the well-known words of Ellen White: "Every human being, created in the image of God, is endowed with a power akin to that of the Creator—individuality, power to think and to do."[4]

But we should notice that the creation texts answer one existential question only to raise others. God made the first humans, but why? Did the Master of the Universe have a specific purpose? Does humanity have a role distinctive from that of God's earlier creations? Why make a new order of beings in a universe that already had many others?

The setting of creation points to at least one divine purpose (without suggesting that it was God's only one). God stepped back from a cosmic conflict to design a ball of life in a small corner of the universe. He said something significant about himself when he shared the creative function of biological reproduction. "Be fruitful and increase in number; fill the earth and subdue it. Rule over the fish of the sea and the birds of the air and over every living creature that moves



on the ground"[5] (Gen: 1:28 NIV).

Exercising creative power through the reproductive process appears to be an important part of God's plan for humanity. The evidence suggests that humans were made to exercise this power to expand the Garden, to care for the earth and to improve it. Reproduction extends creation. It should reflect God's creative activity and be as consciously controlled as painting a landscape, composing a symphony, or building a bridge. It entails the sustained effort of nurturing and educating—replicating eternal values in new beings.

Embryonic stem cells and adult stem cells will likely provide complementary tools; it is far too early to decide upon their respective benefits.

Some wonder if producing biological offspring is essential to the health and wholeness of the human psyche. Continuing the family bloodline through childbearing no longer carries the weighty significance it did in Old Testament cultures. Many now enjoy rich, satisfying lives without children. We all know couples or individuals who are content with occupations and creative avocations to the extent that they willingly forego childbearing. In cases of infertility, some find joy in the adoption of children.

Nevertheless, some who experience reproductive failure in the twenty-first century consider it a heart-wrenching disability, as painful as a Michelangelo losing his sight or a Beethoven his hearing. The "womb ache of loneliness" was evident in an essay written by a forty-two-year-old woman who had spent five years trying to produce a child with her husband using "every high-tech and low-tech procedure then available."[5] The anguish of her "baby-longing" was real.

Just as surely as people have the right to pursue their spiritual and material longings, they have a claim to reproductive fulfillment. The concept of careful human reproduction as an extension of creation, when added to the injunction to multiply, invests human reproduction with moral value and provides ethical justification for the techniques of assisted reproduction, when such means are in harmony with Christian principles.[6] But the application of this line of thought to human cloning raises a number of additional considerations, of which we mention the following five:

1. **Safety**. The time-honored directive of health care's ethical tradition is *primum non nocere*—"First of all, do not harm." Nuclear transfer cloning is associated with a high rate of spontaneous abortion and newborn death.[7] Dolly was the only animal that survived to birth from 277 treated oocytes transferred to surrogate mothers—a success rate of about 0.4 percent. A modified technique called pronuclear microinjection produced Cumulina, the first cloned mouse, and raised the success rate to about 3 percent—30 embryos died for each live birth.[8]

Subsequently, transplanting nuclei from adult cells in cattle produced long-lived offspring at rates exceeding 4 percent.[9] But there were heavy losses at every stage of embryonic and fetal development. Every laboratory reported high rates of late term death, still birth, and serious congenital malformations in the rare survivors. Newborns suffered from lung abnormalities, cardiovascular defects, impaired immunity and high rates of perinatal death.[10] The late gestational losses represent a significant health threat to the birth-mother.[11] Some reproductive experts surmise that all cloned animals have physiological defects, obvious or subtle.[12] Even Dolly, the "poster child" for cloning, suffers from midlife arthritis and morbid obesity.[13]

Though there seems to be a trend of increasing efficiency, take note of the fact that the numbers are from different mammalian species and that repeated attempts to transfer nuclei from the adult cells of nonhuman primates have been uniformly unsuccessful.[14] These facts account for the inhospitable receptions given several unconventional proponents who have declared their intent to clone human beings.[15]

Representative Vernon Ehlers from Michigan expressed the concerns of many observers: "What if in the cloning process you produce someone with two heads and three arms? Are you simply going to euthanize and dispose of that person?"[16] The National Research Council and earlier, the National Bioethics Advisory Commission, rejected human cloning specifically because it would expose the fetus, the developing child, and the birth-mother to unacceptable risks.[17] From the Christian perspective, Scripture is clear in its call to protect human life, especially the lives of the most vulnerable.[18] At present, somatic cell nuclear transfer fails to meet minimum standards of safety for an elective medical procedure. Cloning is morally precarious because it is medically hazardous.

If safety were the only significant moral consider-

ation in human reproductive cloning, the discussion could end here. For the time being, human cloning would be banned as too dangerous. But nuclear transfer cloning is under intensive development. Since Dolly, the success rate in animals appears to have improved more than ten-fold. Another five-fold improvement might yield newborn clones at rates comparable to that of in vitro fertilization. Should the ban be lifted at that point, or are there other persuasive reasons to avoid human cloning?

2. **Individual uniqueness**. In its recent report, the President's Council on Bioethics opined that "Cloned children may experience serious problems of identity both because each will be genetically virtually identical to a human being who has already lived and because the expectations for their lives may be shadowed by constant comparisons to the life of the 'original.'"[19] Such a reaction suggests that cloning challenges pervasive beliefs about personal identity.

But this response may not be entirely rational. Several commentators have pointed out that the public understanding of what it means for a person to be a clone may be fanciful nonsense. In an attempt to explain the words *cloning* and *clone*, Lee Silver, a professor molecular biology and public affairs at Yale University, proposed that there were already millions of human clones walking around—we typically call them identical twins.

On the occasion of a public lecture to the well-educated residents of Princeton, New Jersey, Silver described a variety of techniques that are used to aid the infertile. Then he outlined a hypothetical situation of a man with severe infertility, unable to produce sperm or its precursors. The protocol under consideration was to obtain a small amount of testicular tissue by biopsy. The cells in this tissue would contain the full diploid complement of the man's chromosomes, rather than the haploid number found in mature sperm (or eggs).

The proposal was to inject one of the man's testicular nuclei into an egg cell from his wife from which the egg nucleus had been previously removed. If all went well, the egg would develop into an embryo that would be implanted in the wife's uterus. With continued luck, a healthy baby boy would be born nine months later. As he grew, the boy would probably look a lot like old pictures of his father at the same age. He might even have some of his dad's mannerisms or personality traits. Since this is not uncommon in children born without reproductive aids, unless they were told people would never suspect that the boy had been conceived through advanced reproductive technology. Then, Silver asked his audience a simple question: "Would you consider this boy to be a clone of his father?" Two-thirds of the group raised their hands to say "No."[20]

Scientists and the public may be using the same word for different concepts. Apparently, in the popular conception, a clone is an exact or near-exact replica of an individual that not only looks like the original, but also has the personality, memories, and even thoughts of the original. That is how clones are portrayed in the cinema and in fiction. In the entertainment media, a clone represents a second version of a person, usually having diminished spiritual and moral capacities, or none at all. Clearly, this conception has no basis in reality, but it seems to explain the revulsion some experience when they contemplate cloning.

We intuitively expect individuals to look different and we instinctively feel that physical distinctness is required for personhood. There is a related notion that every individual must have unique genetic material. This idea may stem, in part, from the belief that the genes determine the total physical and psychic nature of a human being. The European Parliament reflected the same belief in its 1997 resolution on cloning, claiming, in part, that "each individual has a right to his or her own genetic identity."[21]

As powerful as these convictions may seem, they have no factual basis. Monozygous twins are clearly individuals, even if we sometimes perpetuate myths about them. Natural twins develop distinct personalities and temperaments as a consequence of their independent experiences, environments, and choices. In spite of their identical genes and similar appearance, twins become fully individual "souls." Genetic uniqueness is not an essential component of personhood.

Unlike a twin, a clone would have a different birth mother, would grow up in a different family, and would live at different times from those of its nuclear donor. Even physical resemblances would be obscured by the different ages of the clone and the donor. At the genetic level, there would likely be differences in mitochondrial DNA. For these reasons, cloned persons would mature into individuals who would be distinct from their nuclear donors and as free to make their way in the world as any other person. Clones of Albert Einstein or Michael Jordan would be just as likely to become accountants and shoe salesmen as theoreticians and basketball superstars.

Some popular conceptions about the requirement of genetic uniqueness might be attributed, in part, to

successes in molecular genetics. We hear almost daily reports of new human genes that, according to the lay press, control traits as different as reading disabilities, schizophrenia, obsessive-compulsive disorders, addictive behaviors, and criminality. There was even a report that hyped a gene for musical talent.

The constant barrage has fostered a "Genes-R-Us" mentality—the belief that our faults lie, not in our stars or our choices, but in our DNA. This misunderstanding is exacerbated by a few evolutionary scientists who, like Richard Dawkins, deliberately broadcast the message of genetic determinism. Edward O. Wilson reduced it to absurdity with his aphorism, "An organism is DNA's way of making more DNA."[22] Overwhelming evidence, however, indicates that genotype accounts for no more than half of the variability between individuals. The rest of human distinctness comes from other sources—be they nurture, chance, or choice. Erik Parens of the Hasting Center summarized the matter eloquently. "As everyone in this room knows," he said, "you can't clone a self, because a self is a function of infinitely more than one's genetic material."[23]

3. **Autonomy.** Some express concern that there may be attempts to limit the freedom and choices of cloned persons. The time-worn caution of C. S. Lewis regarding human domination of nature is still apt: "What we call Man's power over Nature turns out to be a power exercised by some men over other men with Nature as its instrument."[24] There might be a temptation to use clones expediently, assigning their value primarily on the basis of their utility in some predetermined role. As a specific example, some have suggested that clones might be used as sources of transplantable tissues.

These are reasonable fears that deserve examination. The spare-body-parts scenario, however, can be dismissed, since no one has yet proposed that essential organs be taken from a newborn to patch up its nuclear donor. That would be a horror that is already prohibited by law. The more likely use of renewable or dispensable tissues, such as bone marrow or cord blood obtained from clones, does call for appropriate ethical cautions.

However, a reality check makes it clear that this practice already occurs without cloning. Andrew Kimbrell, author of *The Human Body Shop*, claims that 50 to 100 couples produced babies by conventional means to supply tissues for an older child in the few years preceding the publication of his book.[25] It is difficult to condemn such decisions categorically. Much would depend upon the situation into which the child would be born, including evidence that she or he would be nurtured, cherished, and loved.

There is wide agreement that God's image is not about anatomy or physiology, but encompasses human intellect, moral agency, individuality, creativity, the capacity for altruistic love, the capacity to will, to apprehend God, and to find fulfillment in relationships.

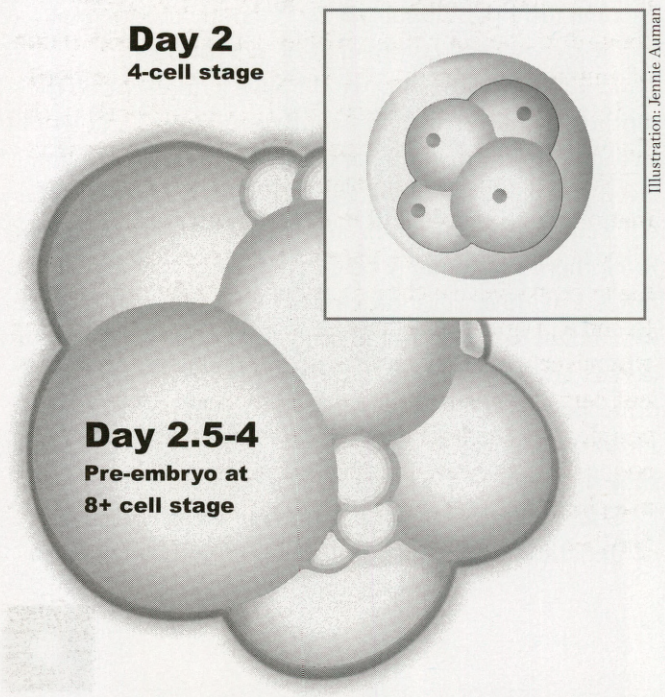


Illustration: Jennie Auman

There is another concern that clones might be produced to gratify the vanity of their "originals." Egotists might be inclined to duplicate themselves in more than just physical resemblance. The effects could be oppressive. "To aspire to genius is laudable," observed one commentator. "To be a child of genius can be difficult," he continues. "But to be expected to develop into a genius because you are its identical twin, could be crushing."

This problem, however, predates cloning. We already know that people sometimes have children by natural means for the wrong reasons, or for no reasons at all. How many youngsters have been driven into particular

pursuits by controlling parents? Zealous fathers admit to enrolling toddlers into particular nursery schools to put them on the fast track to an Ivy League college. Clearly, one does not have to be a clone to be an unfortunate extension of someone else's ego. The negative take-home lessons in this human foible are not intrinsic to cloning.

Another common hypothetical application of cloning is that of an infertile couple at the point of losing their only child. They want, literally, to replace a child.[26] At a time when childbearing in the United States has declined to 2.13 offspring per woman and when more than 98 percent of children survive to their twenty-fifth birthday, the death of a young person is both unexpected and devastating. In such situations, nuclear transplantation could serve as an advanced form of assisted reproduction.[27]

However, such proposals should comport with our best reflections on the will of God for human procreation. God's plan is for children to be nurtured within the context of a loving family with the presence, participation, and support of both parents. If nuclear transplantation is used to achieve human reproduction when other methods are ineffective, such attempts should be within the setting of a faithful marriage and in support of a stable family. Furthermore, we would be wise to avoid the moral complications that arise when a third party acts either as the gestational surrogate or the source of the genetic material.[28]

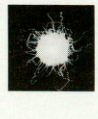
4. **Eugenics**. Many have expressed fear that the practice of reproductive cloning would undermine important social values by opening the door to a form of eugenics. The fear is that individuals free of disabling genetic defects and possessing subjectively valued skills would be selected preferentially for cloning, in an attempt to produce a superior cohort of human beings.

There is already ample evidence that people often find the goals of eugenics attractive. Walter Anderson provides an interesting example—an attempt to prevent deleterious genes from being expressed in the next generation—in the story of a genetic testing program in an Orthodox Jewish community.[29] The goal was simple: to reduce the occurrence of Tay-Sachs and cystic fibrosis, two devastating diseases common in their ethnic group. Tay-Sachs is fatal; it blinds, paralyzes, and kills in the first few years of life. Cystic fibrosis causes chronic lung infections, breathing problems, digestive insufficiency, and premature death due to lung failure. Among Ashkenazi Jews, the carrier frequency for each disease is one in twenty-five. When two carriers marry, there is a one-in-four chance that a pregnancy will produce an affected child.

The program offered genetic testing to students in Orthodox Jewish high schools with the results filed by identification number in a central office. When a boy and a girl seemed likely prospects for marriage, the matchmaker called the office hotline with their identification numbers. The office responded either that the pair was compatible or that they both carried the same recessive defect. (Clearly, bioinformatics had overtaken the venerable tradition of matchmaking!) This "lifeguard at the gene pool" approach produced remarkable results. New cases of Tay-Sachs were virtually eliminated, and the program was expanded to include other diseases. Similarly, a fetal screening program in Brittany, France, where the incidence of cystic fibrosis is higher than in the United States, has produced a marked reduction in new cases.[30]

This is obviously eugenics. And eugenics has often been considered the equivalent of a four-letter word in bioethics. There are important, historical reasons for such antipathy. Eugenics was proposed by Francis Galton, Charles Darwin's cousin, as a practical application of Darwin's new theory of evolution. By 1900, eugenics was wildly popular in Britain on both ends of the political spectrum. Then it flowered in the United States, where it bred compulsory sterilization programs, restrictions on immigration, and laws to prevent interracial marriages. Later, in most horrific ways, it was attempted by the Nazis. So the association between the word *eugenics* and the worst kinds of injustice, all the way to genocide, should not surprise us. This association is so powerful in contemporary thought that it sometimes inhibits rational consideration of important reproductive issues. We may even need to invent a new expression that is not burdened with the weight of the Holocaust. We could try *progenics*.

With the increasing availability of genetic information more people will make progenic decisions. Whenever prospective parents use genetic tests to make reproductive choices, whenever a family decides to end a pregnancy because of a severe fetal abnormality, whenever a fertility clinic selects an embryo that does not carry a catastrophic familial disease, whenever a couple that has borne a disabled child seeks genetic counseling, they are practicing progenics. A decision to use cloning under appropriate circumstances would be another example of personal reproductive choice.



Progenics is short-term and small-scale. It is a personal choice based on full disclosure of the best available information. Progenic decisions are made by individuals with the intent to avoid real suffering—conception of children with severe diseases in their own families. These are not the public breeding programs envisioned by Galton or implemented by the Third Reich.

Honest observation tells us that selective human procreation of one sort or another has been happening for a very long time, though it often had the satisfying innocence of chance about it. If progenics is about attempting to protect the genetic heritage of the unborn, we may be doing more of it today than when eugenics was public policy. The best safeguards against the failures of the past are to avoid coercive genetic policies, reject attempts to eliminate vaguely defined conditions, and forbid national programs to breed super humans, geniuses, or warriors. When genetic screening is done, it should be for clearly recognized diseases. Genetic test results should be reported through nondirective counseling, conforming to the concept that medical professionals have no license to control reproductive decisions. All of this remains true whether or not nuclear transfer is contemplated.

5. **Aesthetics and the "Natural."** The initial public response to Dolly's birth announcement was overwhelmingly negative. Polls performed in 1997 reported that three out of four Americans believed that human cloning should not be done. Justifying their judgments, some held that it was "playing God" or "unnatural," but many described their reaction as loathing, a revulsion. It violated an emotional boundary. Ethicists have observed such visceral reactions before, and some have even given them a name—the "yuck factor." The vital question is, how reliable is the "yuck factor" as a guide in making moral decisions? Is everything that makes people feel squeamish wrong or unethical? An essay by ethicist Leon Kass of the University of Chicago, now chair of the President's Council on Bioethics, argues that a gut response "is the emotional expression of deep wisdom" representing our intuitive ethical sensitivity and that it should be trusted.[31]

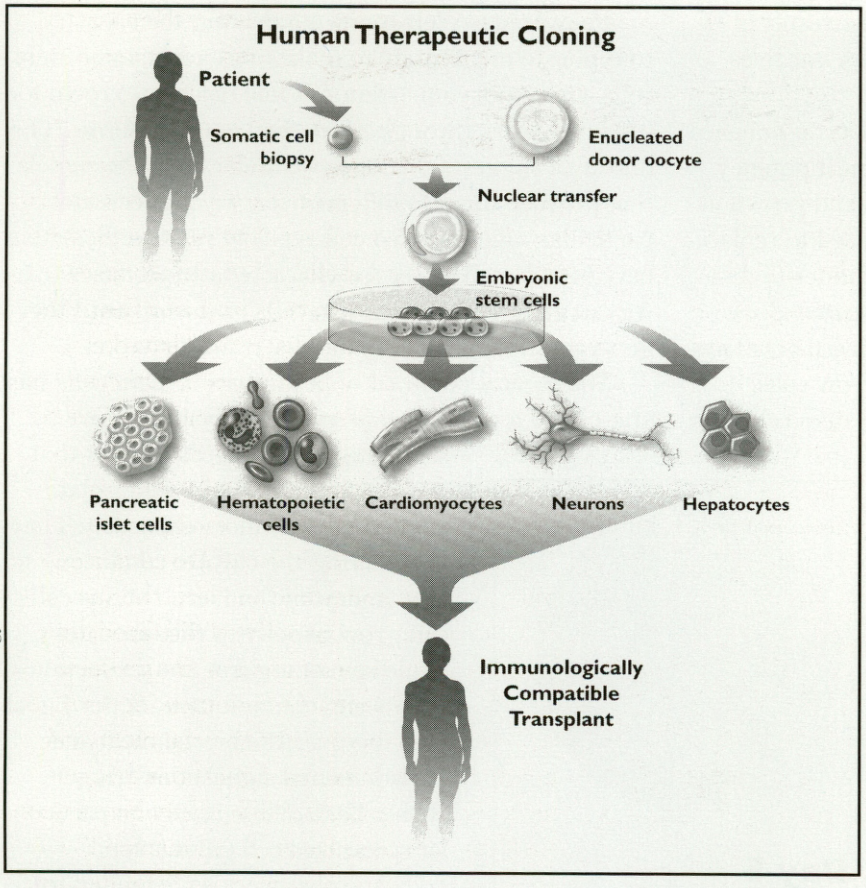
It is difficult to make a logical argument against this position since it is based on intuition, emotion, or aesthetic sensibilities. It can be balanced by the observation that society has reacted negatively to many major medical advances—immunizations, blood transfusions, x-rays, antibiotics, organ transplants, even fluoridated water—innovations that helped to contribute to increasing life expectancy from fifty to eighty years. And we may notice that not many feel deep repugnance to such measures today.

Related to concerns about what is natural for human beings is an uneasiness about overstepping our appointed bounds. Theologian Stanley Hauerwas has questioned the motives for cloning. Yes, it would be promoted because of its usefulness as an advanced technique in assisted reproduction and as a means for avoiding genetic disease. But he sees a "drive behind this to force us to be our own creators."[32] Others express the view that reproductive cloning would be "playing God," violating our standing as creatures.

These charges take us back to the theme of humanity's purpose. Is creation a finished product that will bear no further modification? Do advances in knowledge and power demean the sanctity of human life? Is the value of life eroded by an increased understanding of the processes of life? Are we better off not knowing and not using answers to fundamental biological questions? These are hard questions that individuals may answer differently based upon their foundational beliefs about mankind's role in the world. And we should not forget another caution given by C. S. Lewis: "Each new power won *by* man is a power *over* man as well."[33] Without the guidance of secure moral convictions, all new technologies are dangerous and have the potential to diminish the meaning and quality of human life.

However, we should also be cautious about allowing traditional but unfounded limitations to be placed on human creativity in cooperation with the divine will. "Even within religious communities," wrote the National Bioethics Advisory Commission, "the warning against 'playing God' is too indiscriminate to provide ethical guidance." Furthermore, "it overlooks moral invitations to play God."[34] Even if the image of God in humans has been tarnished and deformed by abuse or disuse, we still exhibit a measure of the curiosity and creativity that is part of God's nature. As no other creatures on earth, we persist in probing and questioning creation, attempting to understand it and make it accountable. It is a divinely intended heritage.

In sum, reproductive cloning raises a host of ethical issues. It forces us to balance competing values—a child's rights to safety, individuality, and dignity against the donors' rights to procreate and to have children free of genetic disease. Humanity's God-given stewardship of planetary life should take into account both the risks of genetic bondage and commodification of human life.



Source: Advanced Cell Technology

With respect to potential losses of uniqueness and the possibility that cloned individuals might be objectified rather than respected as persons, there is justification for serious caution.

But such risks are not unprecedented, nor are they refractory to carefully drawn principles, based on faith in the Creator. At present, the inability of nuclear transplantation technology to meet reasonable standards of safety and unanswered ethical questions lead to the simple conclusion: "Not yet." Some, possibly most, will want to add, "And not ever." But we urge caution about setting absolute limits on future possibilities for cooperating creatively with the divine will.

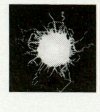
Therapeutic Cloning

A discussion of what has come to be called "therapeutic cloning" must begin with at least a minimal understanding of stem cell biology, a subject that has stimulated its own considerable debate. First, a review of some basic biology and terminology.

Our bodies are primarily composed of "differentiated" cells that can perform only the limited functions required for specific tissues. Cytologists have identified several hundred differentiated cell types—myocytes (muscle cells), neurons (nerve cells), erythrocytes (red blood cells), and so on. Highly specialized cell types, like those just mentioned, cannot divide to make more of their kind. Other cell types may divide a prescribed number of times, after which they enter a nondividing, senescent state. In either case, differentiated cells cannot transform themselves into other types. A neuron, for example, cannot become a myocyte. Under natural conditions, differentiation is usually a one-way street.

Fortunately, most tissues contain a few undifferentiated stem cells. Whether they are isolated from a fetus, newborn, or adult, such cells are called "adult stem cells." They are the energetic, but raw recruits of the body. They have not yet been "trained" to perform specific tasks. The training process is called "differentiation," an orderly program that turns on specific genes while switching off others. Some adult stem cells may remain unspecialized for the life of the organism. Furthermore, they can divide repeatedly to make more stem cells, a property called "self-renewal."

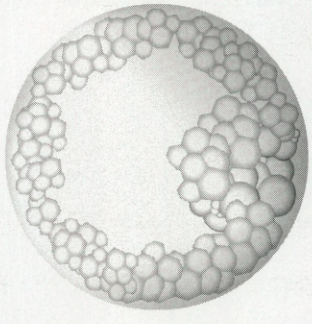
Multipotency. Adult stem cells from a particular tissue have the ability to differentiate into the various cell types found in that tissue. In contrast to the fixed fates of differentiated cells, adult stem cells are "multipotent." This means they can become any of several differentiated cell types. Hematopoietic stem cells from bone marrow, for instance, can mature into more than a dozen cell types found in the blood and immune systems. Neural stem cells can develop into neurons, glial cells, and oligodendrocytes—all cell types found in nerve tissue. This flexibility accounts for their alternative name, "multipotent stem cells." The normal role of adult stem cells is to generate



replacements for body cells that die as the result of damage, infection, or aging. Without them our lives would be short.

The enormous interest in stem cells is a consequence of their two distinctive characteristics: multipotency and self-renewal. If they could be isolated and grown in the laboratory, adult stem cells might be used to replace damaged human tissues. Two obstacles hinder that achievement. First, adult stem cells are scarce. Bone marrow, a well-known source of adult stem cells, contains about one stem cell per 10,000 bone marrow cells.

Other tissues may contain more adult stem cells, but never exceed one per several hundred body cells. The low numbers mean that one must have a large mass of normal tissue to obtain enough adult stem cells for most purposes. Such large quantities of human tissue are not commonly available. Furthermore, separating adult stem cells from the numerous differentiated body cells is not a simple matter.



Day 5

Pre-embryo development of a fertalized egg at the early blastocyst stage

Illustration: Jennie Auman

The second limitation of adult stem cells rests on the fact that their multipotency is restricted. Typically, an adult stem cell may become one of the cell types found in the tissue from which it came. For example, a nerve stem cell may become a neuron, a glial cell, or an oligodendrocyte. But it cannot become a pancreatic cell or a bone cell. Recent results have shown that multipotency sometimes exceeds expectations. Adult stem cells from one tissue have been observed to develop into cell types characteristic of other tissues.

For example, neural stem cells mature into mature neurons, but they can also become muscle cells, certain kidney cells, or cells lining the digestive tract. One research group found that stem cells isolated from fat—a slurry obtained by liposuction—could generate cartilage, bone, and muscle cells, as well as new fat cells. Nevertheless, there is no evidence for an adult stem cell that can produce all the various specialized cell types. Adult stem cells have limited flexibility.

Embryonic Stem Cells. The small numbers and circumscribed capabilities of adult stem cells have led to the enormous interest in human embryonic stem cells, first isolated in 1998.[35] In contrast to their more mature cousins, embryonic stem cells are "pluripotent"—they have unlimited flexibility; they can become *any* cell type. (Significantly, they are not "totipotent," because they cannot recreate a viable embryo.)

They are also self-renewing, having the capacity to replicate indefinitely to make more embryonic stem cells. One embryonic stem cell line has been grown for over two years through more than 300 doublings. The first trait suggests that once we understand the signals that provoke them to differentiate, we can recreate particular differentiated cell types to replace those that have been lost. The second characteristic promises that we can grow embryonic stem cells in culture until they generate a mass large enough for transplantation.

The clinical potential of both types of stem cells has stimulated a whirlwind of research. Scientists are searching for external features that will help them identify and isolate adult stem cells more efficiently. They are refining the culture conditions so that embryonic and adult stems cells can grow happily in the laboratory, while remaining free from infectious agents and contaminants. A third goal is to discover the biochemical and environmental signals that trigger stem cells to differentiate into particular specialized cell types.

Some observers have tended to overstate the usefulness of adult stem cells at the expense of embryonic stem cells in order to accommodate their belief in the personhood of preimplantation embryos. However, most scientists working in the field agree that, in light of their therapeutic potential, too little is known to limit research to one or the other. Embryonic stem cells and adult stem cells will likely provide complementary tools; it is far too early to decide upon their respective benefits.

About sixty embryonic stem cell lines derived before President Bush's August 9, 2001, address are now available for study with federal support. (His decision was an obvious political compromise because there is no meaningful ethical difference between the act of obtaining cells from early embryos, which is now prohibited if federal funds are used, and the act of studying those cells.) Though less than a dozen of those cell lines may be usable, the ball is now in the court of the research community to produce evidence that there is actual—as opposed to theoretical—benefit to be derived from embryonic stem cell research. That evidence will be the most persuasive argument for continuing the development and use of embryonic stem cells.

The move from knowledge about stem cells to useful medical treatments is likely to be long and difficult.

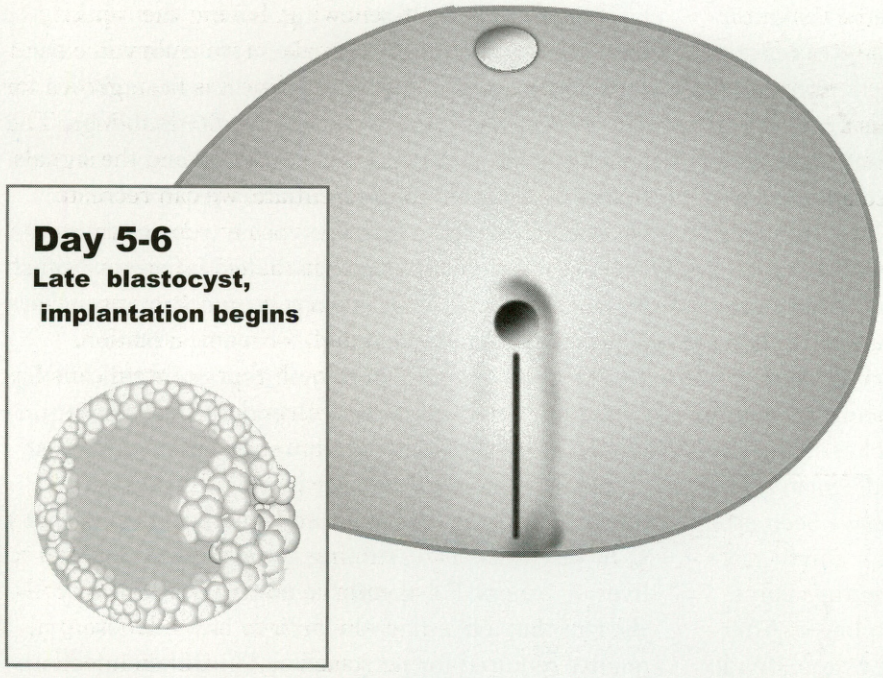


Illustration: Jennie Auman

Exercising creative power through the reproductive process appears to be an important part of God's plan for humanity.

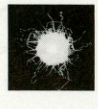
Novel stem cell therapies that go beyond the long-standing use of bone marrow and its constituents may be decades in the future. Nevertheless, the list of potential medical applications is impressive. Any condition that causes the death or depletion of a specific cell population may benefit from stem cell therapy.

A few promising targets include type I diabetes (loss of pancreatic islet cells), Parkinson's disease (loss of dopamine-producing neurons), Alzheimer's disease (loss of cerebral neurons), rheumatoid arthritis (destruction of cartilage and chondrocytes), multiple sclerosis (loss of myelin and myelin-producing cells), macular degeneration (loss of retinal visual receptors), hepatitis and cirrhosis (loss of liver cells), osteoporosis (loss of bone and bone-forming cells), heart attacks (loss of myocardiocytes), spinal cord injuries (lost of spinal neurons), leukemia (cancer of blood cells), and many other cancer types. By some estimates, more than 100 million Americans have conditions that might some day be treated with stem cells.

Stem Cells and Cloning. Biologists admit that if they had a diverse collection of embryonic stem cell lines and the knowledge to convert them into differentiated cells, there would still be a crippling barrier to using them. All stem cells are marked with distinctive surface features that make them potentially incompatible with the immune systems of some prospective recipients. The only means currently available for avoiding rejection of stem cell implants is lifelong treatment with immune suppressing drugs. Such drugs have multiple disadvantages, including increasing the patients' susceptibility to infections. But immune suppression would be essential after stem cell transplants until other options become available.

Cloning has been linked to embryonic stem cells because it offers the hope of overcoming the persistent problem of transplant rejection. The proposed alternative to immune suppression is to create patient-specific embryonic stem cells by a process alternatively called "nuclear transfer" or "therapeutic cloning." In this procedure the nucleus from a patient's cell would be transplanted into an enucleated egg. The resulting embryo would be used to generate embryonic stem cells. Tissue transplants derived from such stem cells would be perfectly compatible with the patient who provided the nucleus. The concept has already been tested successfully in cows. Much of the recent commotion was due to the report of Advanced Cell Technology, a for-profit company, indicating that it had succeeded in creating human embryos using this method.[36]

However, therapeutic cloning is not even close to a reality, and it may never become a practical remedy for transplant rejection, even after the technical difficulties are overcome. At present, the procedure requires an unrealistically high number of eggs. In a recent series



of experiments with mice, for example, investigators used 202 mouse eggs transplanted with skin cell nuclei to create one embryo for stem cell production.[37] The price of scores of human eggs (currently about $4,000 each) would represent only a fraction of the total cost. The time and technical effort required to derive individual embryonic stem cell lines for patients suffering from various targeted diseases would be outrageously expensive and cumbersome. Furthermore, for those who attribute personhood to zygotes, therapeutic cloning would be subject to the same ethical prohibitions as reproductive cloning.

Beginning of Human Life. The value of stem cell therapy is not debated. Bone marrow and hematopoietic stem cells isolated from bone marrow have been used to treat blood disorders and leukemia for thirty years. Rather, the current debate converges on the source of embryonic stem cells—very early embryos. After a human egg is fertilized, the resulting zygote divides repeatedly. As development continues, the cluster typically arrives at the blastocyst stage on the fifth day. At this point, it consists of 100 to 200 cells that form a hollow, fluid-filled sphere, smaller than a pinhead. Stuck to the inner surface of the sphere is a cluster of about thirty cells called the "inner cell mass." All existing embryonic stem cell lines were derived from the inner cell mass of such embryos.

The debates that swirl around stem cell therapy typically focus on the moral status of preimplantation embryos. The five-day old embryo, known as a blastocyst, is a tiny sphere of cells with no human features, no nerve cells, no organs, indeed, no differentiated tissues of any kind. It is, at this point, an undifferentiated cluster. Under natural conditions, a human embryo might implant in the uterine wall about eight or nine days after fertilization. The blastocysts used to establish stem cell lines have not yet reached this stage.

It is generally agreed that it is neither necessary nor desirable to make embryos specifically for stem cell derivation since embryos are available from other sources. In vitro fertilization is used in about 360 U.S. clinics as an aid to couples that are unable to conceive by natural methods. In 1998, for example, about 28,000 babies were born in the United States as the result of in vitro fertilization.[38] Doctors fertilize six to fourteen eggs from each woman. Perhaps two or three are implanted in the patient's uterus to achieve a reasonable probability of a single pregnancy. The healthiest of those that remain may be frozen—some women may not become pregnant in the first attempt, and couples may later elect to use additional embryos to have more children. If we accept in vitro fertilization as a treatment for infertility, then excess embryos will exist.

By various estimates, 100,000 to 200,000 embryos are currently stored frozen in the United States.[39] When patients decide not to implant certain embryos, they may offer them to other couples, they may require that they be destroyed, or they may allow them to be used for research as long development is halted before a specified stage. Outside a uterus, an embryo cannot long survive. The isolated embryo can never become a person.[40] Nearly all of the existing embryonic stem cell lines, including those approved by President Bush for continued research, were derived from such "extra" embryos.[41]

Is such research ethically justified? Many find it difficult to argue that it would be better for embryos to be discarded as waste than to be used to save the lives of others. For some, the matter is decided by the fact that a five-day-old embryo lacks an essential quality required for personhood. Until the fourteenth day of development, it is possible for an embryo to split into two or more monozygotic offspring (an event that occurs naturally about once in 370 pregnancies), and for those to recombine again into a single embryo. Consequently, before day fourteen, the embryo does not correspond to one and only one individual. Since the embryo might still split or merge, its individual identity has not yet been established, and there can be no individuality or personhood without identity.

Others have noted that natural reproduction is quite ruthless in its destruction of embryos. The union of sperm and egg in natural conception fails more often than it succeeds in producing a new being. Between 50 and 75 percent of embryos formed by sexual intercourse do not survive long enough to produce a baby. This fact has prompted some to argue that it is paradoxical to attribute great moral value to an entity with such a high likelihood of failure under natural circumstances.[42]

However, the fact that, given the proper circumstances, embryos might become human beings requires careful thought about their moral status. The degree of protection they deserve is the crux of the debate. Are the many thousands of frozen human embryos, currently stored in infertility clinics, in need of rescue? If they are no longer needed for infertility treatment, must they be stored indefinitely? May they be adopted? May they be used for purposes as mundane as testing of laundry detergents and kitchen cleaners? Or must preimplantation embryos be assigned full human status with the full array of human rights? Is it evident that the product of the nucleus of a skin cell, taken from the arm of a

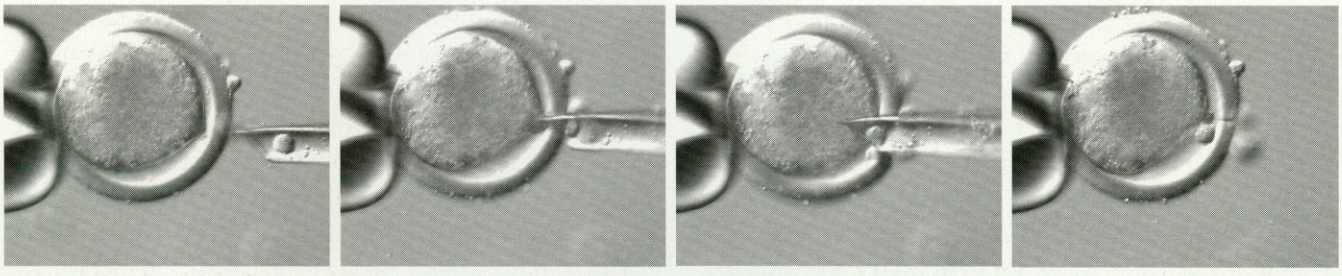
patient, transferred to an ovum, and cultured in a petri dish, should be accorded the rights of a citizen?

The obvious and knotty question is, of course, the same one that has been central to the debates about the morality of abortion: When does human life begin? Or better put, when does morally relevant personhood begin? Some Christians, basing their views on the creation story, believe that human life begins at birth. The text says that God "breathed into [Adam's] nostrils the breath of life, and man became a living being" (Gen 2:7 NIV). Other Christians believe that a new and unique person comes into existence at the moment of conception. They point to passages that describe Jeremiah's prenatal call and the Psalmist's wonder at being "knit together in [his] mother's womb" as evidence that the biblical writers were aware of and valued prenatal life. (Jer. 1:5; Ps. 139:13 NIV) This view generally leads to the conclusion that no benefit to others can justify the purposeful destruction of preimplantation embryos.

Still other principled Christians hold that moral value of prenatal life develops gradually through many important stages, in a crescendo building to birth. On this view, implantation is of crucial importance because progress toward birth is impossible if an embryo does not become implanted in a uterus. Another important time, in the developmental view, is the onset of organized neurological activity, or brain waves.

How could we accept the notion of "brain death," after which a human body is considered a corpse, even though its heart continues to beat, if we do not also accept the idea of "brain birth"? The time of quickening, when fetal movement is first detected, and viability, when the fetus is capable of sustained life outside the womb, are other significant steps in the crescendo of prenatal development. This view may include the belief that early embryos have human potential and possess symbolic moral value that is worthy of respect.[43] However, it may also allow embryo research after having taken into account both the stage of embryo development and the objective of the research.

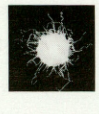
The "Guidelines on Abortion" and their accompanying "Principles for a Christian View of Life" summarize important principles for respecting prenatal life and the personal conscience of believers.[44] Notable in these statements is a deliberate openness regarding the precise "moment" when protectable human life begins. In an important footnote, the "Guidelines on Abortions," state: "Abortion, as understood in these guidelines, is defined as any action aimed at the termination of a pregnancy already established. This is distinguished from contraception, which is intended to prevent a pregnancy."[45]



A cell containing the genetic material from the donor is placed inside the Zona Pelluca. Source: Advanced Cell Technology

The reason for this distinction is important. Acknowledging honest differences among Adventists about the beginning of human life, the drafters of the "Guidelines" were able to achieve consensus that once implantation has occurred and gestation has begun, only the weightiest moral reasons could possibly justify ending prenatal life. At the same it was recognized that some of the most widely used birth control measures, including birth control pills, probably do not prevent conception but rather implantation and gestation.

Because Adventists do not subscribe to the concept of the soul as an immaterial entity that takes up temporary residence in a physical body, there is, for Adventists, no precise moment of ensoulment. Rather, the soul represents the entire human being, the whole person energized by life. For this reason, the instant of fertilization, though an essential step in the developmental process that will eventually produce a person, cannot be equated with ensoulment. In some respects, the argument that a human soul begins with the new genotype that is formed during the process of conception is similar to the traditional doctrine of



ensoulment. Instead of the infusion of an immaterial soul, there is the constitution of a new genotype.

But, as we already pointed out, a new genotype is not the same as a new person. The very possibility of twinning proves this. No one argues that monozygotic twins share one soul. They are clearly two different persons, even thought they began as one embryo. Because Adventists believe that the soul is the whole person, and because the person arrives through multiple stages, there are good Adventist reasons to view the establishment of human life developmentally. This deprives us of the neatness of some traditional views. But the gains in terms of honesty about the biblical texts and the biological facts make the developmental view, with all its complexity, the preferable position.

There are other reasons for Adventists to be carefully interested in what might otherwise seem arcane matters of genetic medicine. A central principle of Christianity is the obligation to alleviate suffering and to preserve life. The Christian doctrine of salvation is much more than "heaven in the sky bye-and-bye." It encompasses healing the whole person, body, mind, spirit, and even social relationships, here and now. The Scriptures portray God as endlessly concerned with the moral and physical restoration of his creatures. "And he sent them to preach the kingdom of God, and to heal the sick" (Luke 9:22 KJV). Christ gave explicit instructions to continue his healing ministry.

Adventists, in particular, appreciate the ministry of healing as part of God's work on earth. The duty of beneficence requires that Christian medical professionals provide those in need with the means for healing that they would seek if they were themselves in need. To the extent that we can help to prevent disease and restore health, and do so ethically, we are obliged to investigate the potential of genetic therapies that may become some of the most effective tools for doctors of the future.

Conclusion

God endowed human beings with intelligence and creativity, and gave us responsibility to cooperate with him in the care of the planet and all its creatures. He intends for us to grow in our understanding of the principles of life, including the function of our bodies. Ethical research and examination can only increase our appreciation of God's wisdom and goodness.

Within the medical realm, we are powerfully driven to control disease—conditions that disrupt the order and harmony that God intended. We are invited to use the knowledge he gives us. Consequently, gene therapy need not be an expression of human pride or arrogance. As long as the aim is to alleviate suffering, and we use our creativity with purpose, courage, caution, contingency, and compassion, keeping in mind the protection of the defenseless and helpless, genetic medicine has the same moral justification as traditional medicine. On the other hand, an attempt to redesign ourselves into creatures with new and superlative powers would be perilous. A balanced view of our God-likeness should remind us that we tamper with fundamental human attributes at great risk.

Many caution that the use of genetic medicine puts us on a slippery slope, potentially blurring the value of personhood and undermining human uniqueness. In rebuttal, we do not prohibit every endeavor that, if pursued without restraint, might lead to undesirable consequences. Everything we attempt carries risk that we attempt to balance against the benefits of measured action. That is the domain of ethics. Our deliberation implies that we can prescribe limits for our behavior. The reflection of God's image that remains invites us to that responsible action.

In this essay, we have not tried to resolve all of the ethical questions associated with cloning. If we had tried, we would have failed. The questions are still emerging, with new developments almost daily. We are only two members of a faith community that we seek to serve and whose help we also need. It is our conviction that Seventh-day Adventists should return to the practice of gathering members with appropriate expertise in an attempt to address issues of vital interest to the Church at regular intervals.

The documents produced by the General Conference's Christian View of Human Life Committee during the 1990s have continued to serve our church, and they have elicited positive comments from many outside our church. But such statements typically do not have an endless shelf life. They can easily become stale as new discoveries are made both in science and in biblical understanding. Since 2000, when the decision was made not to continue the work of the Christian View of Human Life Committee, no comparable work has emerged. Thus, statements that once provided careful guidance to church members and institutions now run the risk of appearing quaint or even misinformed. This is no insignificant matter for a church that operates hundreds of health care institutions, educates thousands of health care professionals and scientists, and seeks to conduct innovative and path-breaking medical research.

We believe that we, as Adventists, have been given

the necessary inspired resources and the motivation to pursue the best medical science in an ethical manner. But doing so will continue to require our best efforts to engage each other in honest, vigorous discourse about the practical implications of our faith. In this regard, the ethical questions of cloning will, we predict, continue to test us.

Notes and References

1. General Conference, "Statement on Ethical Considerations Regarding Human Cloning," in *Statements, Guidelines, and Other Documents: A Compilation*, ed. Ray Dabrowski, (Nampa, Idaho: Pacific Press), 38-42. This statement is also available on the Web at <www.adventist.org/beliefs/statements.html> under the heading "Human Cloning."

2. Ibid., 40. For the President's report, see President's Council on Bioethics, *Human Cloning and Human Dignity: An Ethical Inquiry*, issued July 10, 2002, and available in prepublication version at <www.bioethics.gov/cloningreport>.

3. D. Rorvik, *In His Image: The Cloning of a Man* (Philadelphia: J. B. Lippincott, 1978).

4. Ellen White, *Education* (Mountain View, Calif.: Pacific Press, 1942), 17.

5. A. T. Fleming, "Why I can't use someone else's eggs," *Newsweek*, Apr. 12, 1999, 12.

6. For a statement of ethical principles regarding assisted human reproduction, see "Considerations on Assisted Human Reproduction," in *The Seventh-day Adventist Church Focuses on Ethical Issues*, General Conference Health Department (mimeographed), 7-10. This statement was produced by the Christian View of Human Life Committee and adopted by the Administrative Committee of the General Conference on July 26, 1994.

7. I. Wilmut et al., "Viable offspring derived from fetal and adult mammalian cells," *Nature* 810 (Feb. 20, 1997), 810.

8. T. Wakayama et al., "Full-term development of mice from enucleated oocytes injected with cumulus cell nuclei," *Nature* 394 (July 23, 1998), 369-74.

9. R. P. Lanza et al., "Cloned cattle can be healthy and normal" *Science* 294 (Nov. 30, 2001):1893-94; Gina Kolata, "24 Cow clones, all normal, are reported by scientists" *New York Times*, Nov. 23, 2001.

10. J. R. Hill et al., "Clinical and pathological features of cloned transgenic calves and fetuses (13 case studies)" *Theriogenology* 51 (1999), 1451-65R.

11. Committee on Science, Engineering, and Public Policy, and Global Affairs Division, Board on Life Sciences, Division on Earth and Life Studies, National Research Council, *Scientific and Medical Aspects of Human Reproductive Cloning* (Washington, D.C.: National Academic Press, 2002), 3.1-3.3, 6.1-6.2, B.4-B.8 (See www.nap.edu/books/030907637/4/html).

12. R. Jaenish and I. Wilmut, "Don't Clone Humans!" *Science* 291 (Mar. 30, 2001), 2552.

13. I. Wilmut, "Are there any normal cloned mammals?" *Nature Medicine* 8 (Mar. 2002), 215-16.

14. G. Kolata, "In cloning, failure far exceeds success," *New York Times*, Dec. 11, 2001, F-1.

15. A. Abbott, "Trepidation greets plan for cloning humans," *Nature* 410 (Mar. 15, 2001), 293; I. Bonetta, "Academies called to task over cloning debacle," ibid., 412 (Aug. 16, 2001), 667; E. Young and D. Carrington, "Cloning pregnancy claim prompts outrage," *New Scientist*, Apr. 5, 2002 <www.newscientist.com/news/print.jsp?id=ns99992133>; A. Zitner, "Clones, free love and UFOs: medical researchers fear the group that says space aliens have instructed them to start cloning humans will cause lawmakers to ban the technique," *Los Angeles Times*, Mar. 5, 2002, 1.

16. K. Q. Seelye, "G.O.P. Lawmaker proposes bill to ban human cloning," *New York Times*, Mar. 6, 1997.

17. *Cloning Human Beings, Report and Recommendations of the National Bioethics Advisory Commission* (Rockville, Md., 1997), ii, 64, 107-108 <http://bioethics.gov/pubs.html>; H. T. Shapiro, "Ethical and policy issues of human cloning," *Science* 277 (July 11, 1997), 195-96.

18. Isa. 1:16-17; Matt. 25:31-46; Matt. 18:4-6.

19. President's Council on Bioethics, *Human Cloning and Human Dignity*, xvii.

20. L. Silver, "Popular cloning versus scientific cloning in ethical debates" <http://www.princeton.edu/~wws320/Second%20Pages/06Reprotech/SilverWilmut.htm>.

21. European Communities, European Parliament, "Cloning animals and human beings; Resolution on cloning," B4-0209, 0213, 0214, 0225, and 0242/97, Mar. 12, 1997, Bernan Associates, 4611-F Assembly Drive, Lanham, Md.

22. E. O. Wilson, *Sociobiology: The New Synthesis* (Cambridge, Mass.: Harvard University Press, 1975).

23. D. Lutz, "Hello, hello, Dolly, Dolly," *The Sciences*, May/June, 1997, 10-11.

24. C. S. Lewis, *The Abolition of Man* (Oxford: Oxford University Press, 1943).

25. Andrew Kimbrell, *The Human Body Shop: The Engineering and Marketing of Life* (New York: HarperCollins, 1993).

26. J. Walters, "Is cloning moral?" *Signs of the Times*, Aug. 2001.

27. A. Trafford, "A sad case for cloning," *Washington Post*, June 4, 2002, HE01.

28. For a presentation of the principles of assisted reproduction, as adopted by Seventh-day Adventists, see "Considerations on Assisted Human Reproduction," cited in note 6, above.

29. W. Anderson, *Evolution Isn't What It Used to Be: The Augmented Animal and the Whole Wired World* (New York: W. H. Freeman, 1996), 104-9.

30. V. Scotet et al., "Neonatal screening for cystic fibrosis in Brittany, France: assessment of 10 years' experience and impact on prenatal diagnosis," *Lancet* 356 (Sept. 2, 2000), 789-94

31. L. Kass, "The wisdom of repugnance," in L.. R. Kass and J. Q. Wilson, *The Ethics of Human Cloning* (Washington, D.C.: AEI Press, 1998), 3-59.

32. Quoted in G. Kolata, " With cloning of a sheep, ethical ground shifts," *New York Times*, Feb. 24, 1997, A-1.

33. Lewis, *Abolition of Man.*

34. *Cloning of Human Beings*, 45.

35. J. A. Thomson et al., "Embryonic stem cell lines derived from human blastocysts," *Science* 282 (Nov. 6, 1998), 1145-47.

36. See for example Eric Cohen, "Should human cloning be allowed?" *Wall Street Journal*, Dec. 5, 2001.

37. W. M. Rideout et al., "Correction of a genetic defect by nuclear transplantation and combined cell and gene therapy," *Cell* 109 (April 2002), 17-27; N. Wade, "Therapeutic cloning shown to work, at least in mice," *New York Times*, Mar. 10, 2002; A. Coleman and A. Kind, "Therapeutic cloning: concepts and practicalities," *Trends in Biotechnology* 18 (2001), 192-96.

38. C. T. Hall, "The forgotten embryo: fertility clinics must store or destroy the surplus that is part of the process," *San Francisco Chronicle*, Aug. 20, 2001.

39. Ibid.

40. L. M. Guenin, "Morals and primordials," *Science* 292 (June 1, 2001),159-60.

41. In at least one case, an embryonic stem cell line was derived from an embryo that was created specifically for that purpose from donated gametes. S. E. Lazendorf et al., "Use of human gametes obtained from anonymous donors for the production of human embryonic stem cell lines," *Fertility and Sterility* 76 (2001), 132-37.

42. C. T. Hall, "The forgotten embryo: fertility clinics must store or destroy the surplus that is part of the process," *San Francisco Chronicle*, Aug. 20, 2001.

43. For a discussion of the possible meanings of respect during various stages in the development of human life, see Karen Lebacqz, "On the elusive nature of respect," in *The Human Embryonic Stem Cell Debate*, eds. Suzanne Holland et. al. (Cambridge, Mass.: MIT Press, 2001), 149-62.

44. Both of these statements are available in *Statements, Guidelines, and Other Documents: A Compilation*, ed. Dabrowski, and on the Web at <http://www.adventist.org/beliefs/statements.html>.

45. Ibid., 92.

Gerald Winslow is dean of the School of Religion at Loma Linda University.

Anthony J. Zuccarelli holds a Ph.D. in biophysics from California Institute of Technology. He is professor of microbiology and biochemistry at Loma Linda University School of Medicine.