

David Cavanah
October 3, 1997

Cloning -- A Way of Life

The scene opens as two jeeps cross green rolling hills. Both jeeps stop and Dr. Grant turns and, to his amazement, sees a fifty foot dinosaur. Within minutes he looks down over a lake where herds of dinosaurs have gathered. Perhaps only half believing what he is seeing, he asks simply of his host: "How did you do this?"

The question is directed to John Hammond, the owner of the prospective amusement park. Hammond has financed and developed everything you see. Somehow he has been responsible for putting these animals here and now he has brought Grant to the park, seeking his approval.

Hammond turns to Grant and says, "I'll show you."

The scene shifts to a small movie theater. John Hammond is standing in front of the screen and then appears on the screen. The two speak to one another, and then the on screen John Hammond wants to know how he got here. Real John Hammond volunteers to show him, but needs a drop of blood from the finger of screen John. When screen John complains about the pain of the needle prick, real John say, "Relax, John. It is all part of the miracle of cloning."

During the next few minutes, this miracle is explained to the learned guests. Dr. Ellie Sattler, Dr. Grant, and Dr. Malcolm watch and listen while Hammond explains how

the DNA is attained and how Hammond and his scientists turned it into the dinosaurs seen today.

Only a couple of years ago, we witnessed the miracle of *Jurassic Park* and in so doing witnessed the genius of Michael Crichton and Steven Spielberg. Only such a pair could take such a farfetched theory and make it so real, so powerful, so scary.

Now witness Dolly as produced and directed by Dr. Ian Wilmut at Roslin Institute in Edinburgh, Scotland. Dolly is not as imposing as a dinosaur nor is she roaming the countryside 65 million years after the extinction of her species, but to many, Dolly may be just as dangerous. You see, Dolly is a "true clone," the first of a kind, and she opens up the box to let all of the bad things out.

In February of 1997, Wilmut introduced Dolly to the world. Unlike any other mammal that has ever lived, Dolly is an identical copy of another adult and has no father. Wilmut, as well as others, had previously produced offspring from embryonic cells, but Dolly was produced from a cell derived from the mammary gland of a six year old ewe. The donor cell was fused with an unfertilized egg from which the cell nucleus had been removed. The fused cell was persuaded to divide to form an embryo that was then implanted into a surrogate mother where it matured into a healthy lamb. This lamb was then genetically identical to her biological mother -- her only parent. Her DNA came from the single cell taken from her mother.

Similar experiments have been carried out by other scientists, but without positive results. The key to Wilmut's success appears to be the quiescent state that he forced the cells into before he extracted their nuclei. This was done by starving the cells for five

days and appears to have made their chromosomes more susceptible to reprogramming to initiate the growth of a new organism after the nuclei were transferred into an egg.

Even using these techniques, it required 277 nuclear transfer to produce a single cloned lamb, but the magnitude of the accomplishment is immeasurable. Prior to Dolly, it was assumed that as animals aged and cells differentiated into their various types, that genes changed enough to prevent reproduction from such cells. We now know that adult cells contain enough workable versions of all the genes necessary to produce an entire organism.

This might be a good time to add official concurrence to a fact that you probably already understand. What we are talking about here is using the nucleus from an adult cell to ultimately produce an infant of whatever species we are dealing with. In the movie *Multiplicity*, Michael Keaton is cloned twice and one of his clones is cloned once. Each clone is the same size and age as the original. That is not currently possible, and unless James Garner is holding out on us in his Xerox commercials, there is no reason to think that it will ever be done.

Okay. So cloning is now a way of life. We can make a sheep or a bull and even a Rhesus monkey, and on screen we can make dinosaurs and a Michael Keaton or two. But why would we want to? Who do we help? How do we advance mankind by doing these things? Where's the money?

Perhaps the most immediate impact will be seen in agriculture and food production. It will be possible to produce a number of genetically identical offspring from a population of cells. A farmer could have a group of identical sheep each with the

same high level of performance. This kind of uniformity would offer advantages to the farmer, as the animals would mature at a very similar rate, advantages to the food processors, as they would have a more consistent product to sell, and advantages to the consumers since they could be more confident of purchasing a consistent product.

Changes can also be made in the composition of milk. Fat content can be altered to match the requirements of the public. The levels of certain proteins in milk could be increased. This would be done by inserting a foreign gene into the genetic material of an animal. That gene would direct the production of a desired protein. That animal would be cloned to produce herds of animals with the ability to produce that protein. The protein could then be used in the treatment of diseases in humans.

Molecular cloning has been used for the last several years and will be used more as more is learned. Here a DNA sequence is added to an organism (usually a bacteria). As the organism replicates, virtually endless clones of the sequence are produced. This is the basis of recombinant DNA technology. Most insulin now used is produced in this manner. Are you an insulin dependent diabetic? If so, you may remember being switched to Humulin Insulin during the last few years. This is Eli Lilly's recombinant insulin. A gene for the production of human insulin has been added to non-pathogenic Escherichia Coli. So instead of getting insulin from the pancreas of cows and pigs, insulin is produced in a laboratory by bacteria.

Are you interested in part-time work for full-time money? This ad entitled "The Missypticity Project" appeared on the Net.

Welcome to the home page for the Missyplicity Project, which seeks to clone a dog for the first time in history - a specific dog named Missy.

Missy is a beloved pet, getting on years, whose wealthy owners wish to reproduce her - or at least create a genetic duplicate (which we all know is not the same thing).

The purpose of this website is bi-directional communication. We'll keep you informed of developments in cloning of Missy, and we invite your feedback as well. We're especially interested in hearing from scientists with relevant expertise, who wish to work on the Missyplicity Project. We invite all scientists to review our RFP [Request for Proposal], which also contains more information on the project.

To the press: It's too early for us to discuss this project publicly - other than what's here. If you'd like to do a story on the Missyplicity project, we encourage you to tell us who you are and how to reach you.

When we're farther along, we promise we'll contact you.

Thanks for your interest in the Missyplicity Project.

Sincerely,

The Missyplicity Project Staff

The private sector may one day be able to finance this type of work as refinements are made and techniques are improved.

These are all wonderful advancements and lie at the heart of the cloning issue. But the real question that Dolly forces us to ask, the meat of the matter as it were, is how do

we clone a human, like, say, Charles Tilley. As you recall, the main lesson that Dolly taught us is that a cell may be taken from an adult and used to produce a clone. So, although Charles has been around for a few years and his cells have had time to differentiate, each of his nuclei has the DNA required to produce another Charles. In theory the procedure would be similar to the one that produced Dolly (cell to egg, to embryo, to female host to young Charles). One problem that must be encountered is related to how early an embryo turns on its own genetic factory. This happens much earlier with humans than with cattle and sheep. This must be slowed down in order for the embryo to thrive in the egg. Assuming that this hurdle can be eliminated, the byproduct would be a true clone of Charles. We could expect all features that are generally inherited to be virtually identical. When young Charles is 25 years old, he would look a little like John Charles does now -- John Charles being only half Charles. Young Charles would be a little shorter, have less power at the plate, and not throw as well from the hot corner. Height, power, and arm evidently are inherited from the mother.

This fantasy brings up yet another question. Who would want a clone of himself? The most obvious example would be a couple who cannot conceive. The cell could be taken from the man and the woman could carry and deliver the child. The act of carrying a fetus can be as important as being its biological mother. Also the mother would be contributing her mitochondria to the equation.

The movie *Clone*, which was aired on NBC last Sunday night, sends us two messages. First, the fact that this movie is mentioned in this paper at all points to some degree of procrastination on my part. That being acknowledged, let us hurry on to the

second point. In the movie a husband and wife who have lost the only child that they will ever be able to conceive are offered the chance to have that child cloned. (One embryo made from one of their son's cells is still viable.) The act would be illegal, but would almost certainly be successful. The temptation to reacquire something so precious that had been lost would be undeniable.

But what of the many voices who scream their opposition to any kind of human cloning? A substantial number of people belong to that group. In March of this year, CNN conducted a poll to find out just how Americans feel about cloning. When asked if it was morally wrong to clone humans, 89 percent said that it was. In fact, 66 percent said it was wrong to clone animals. Of the 1005 adult Americans polled, 74 percent said that cloning humans was against God's will. What are their fears? How reasonable are they? Some fear that clones could be produced to provide spare body parts for the parent clone that could be used without fear of tissue rejection. Of course, this could not be done until the clone's organs were mature enough to transplant and the clone would have to agree to the donation.

Another fear is that there would be inherent differences. For instance, would a clone have a soul? This is a really gray area for an Athenaeum paper. Too much talk about souls could lead members of the "rules adherence committee" to decide I was "talking religion." That's no good and could even lead to expulsion. So I will simply say that I am Methodist and am not willing to admit actual knowledge of anything. But if "test tube babies" have souls, then clones would probably come equipped with them as well.

Others have expressed concern that cloning would enable gay couples to produce offspring. Of course, if this were done, the child would be a copy of just one member of the couple, but it would be as possible as with a mixed couple that had been unable to conceive. Naturally if the gay couple were both men, they would need to find a woman to carry and deliver "their" child.

I don't really lend much credence to any of these objections. I don't feel that cloning for body parts would be very prevalent; the soul issue doesn't bother me. I don't feel threatened by the possibility of a gay individual being cloned; I'm not afraid that Hitler will resurface, and I don't think that Dr. Frankenstein will take advantage of this venue to create someone to terrorize the villagers.

However, I do have reservations. I wonder if the clone would not lose the possibility of individuality, the feeling that he is the first of a kind. Alex Kahn, who is director of the Inserm Laboratory of Research on Genetics and Molecular Pathology in Paris, says that part of the dignity of a person lies in the uniqueness and the unpredictability surrounding his development. The uncertainty of heredity protects humans against biological predetermination imposed by third parties, including parents. One of the blessings of the relationship between parents and their children is their inevitable difference which results in parents loving their children for what they are rather than trying to make them what they want.

For the most part, the legal stand on human cloning is more clear than ethical considerations. In the United Kingdom, where Wilmut produced Dolly, human cloning is illegal. Many other nations have also strictly forbidden this kind of research. The United

States does not have similar laws. In March of this year, shortly after the Dolly announcement, President Clinton asked the National Bioethics Advisory Commission to make recommendations on what controls should be placed on human cloning research. He also banned the use of federal funds on that work and asked private companies to honor a "voluntary moratorium" in this area. Also in March, Congressman Vernon J. Ehlers (R - Michigan), who is the first physicist in Congress, introduced two bills. The first was the Human Cloning Research Prohibition Act (H.R. 922), a bill designed to prohibit the expenditure of federal funds to conduct cloning of humans. The second bill was the Human Cloning Prohibition Act (H.R. 923). That would prohibit the cloning of humans in the United States. At about the same time, Senator Christopher Bond (R - Missouri) introduced legislation to prohibit the use of federal funds for research involving human cloning (S 368). None of these bills has been acted on.

On June 9th President Clinton, after receiving the report from the National Bioethics Advisory Commission, announced that he was sending to Congress the "Cloning Prohibition Act of 1997." This legislation would prohibit any attempt to create a human being using cell nuclear transfer technology. The proposal would also provide for further review of the ethical and scientific issues associated with the use of cell nuclear transfer in humans. Specifically, it mandates that the Advisory Commission spend the next four and a half years continuing the investigation that they have already begun. At that time, the additional information could be re-evaluated. To date, no legislation has been passed.

What is the status of cloning today? Worldwide experimentation has increased since Dolly. Excitement is high. Promises of additional breakthroughs seem very real. Closer to home, the fires are being fanned by the editorial in the *Kentucky New Era* in which Cecil Herndon practically alleged that he possessed the technology to retrieve tissue from the recently discovered dinosaur egg and clone a dinosaur and that he might do so to celebrate our bicentennial. On the pouring water on the coals side of the issue, there is still that Clinton moratorium to deal with, not to consider Joy Tilley's threat that "nobody better try to clone Charles."