Genetic Engineering & Cloning

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What is Genetic Engineering?

"Genetic engineering is the technology for modifying the genetic information in a plant, animal or human in order to produce some desired trait or characteristic"
A Brief History of Genetic Engineering

★ The name is new, the practice is not.
★ Plants and animals have been bred for thousands of years.
★ Human breeding has also been done now and then.
★ All of this has worked by trying to enhance desired characteristics, without knowing how they are transmitted.
Genetic Engineering in the 20th Century

- There have been great advances in our knowledge of genetics:
  - How genetic information is stored
  - How it is transmitted
  - How it is used
- The entire DNA sequence of several organisms is now known, with human DNA just about done.
- We are just beginning to decipher what each unit means and how it works.
Prospects for Genetic Engineering

- Designing plants & animals "from scratch"
  - This is not going to happen anytime soon
- Transgenic Engineering
  - Putting genetic information from one type of plant or animal into another
- Cloning
  - Making genetic copies of an existing plant or animal
- Let’s look at the latter two of these.
Transgenic Organisms

- An organism is called "transgenic" if it has genetic information added to it from a different type of organism.
- Viruses do something of this sort when they infect plants, animals or humans.
- Humans have begun to do this with plants and animals.
- We are not yet making flying pigs!
Transgenic Plants

- This is the work that is furthest along:
  - Corn with its own insecticide
  - Soybeans & cotton resistant to herbicides
  - Papayas resistant to viruses

- Transgenic crops are being grown in the Americas, South Africa, Europe, Australia and China
Transgenic Animals

- The work is less advanced here.
- Human genes have been inserted into:
  - Bacteria
  - Mice
- To produce various human proteins for treating diseases.
Making Transgenic Mice

CONSTRUCTION OF A TRANSGENIC MOUSE

Collection of Fertilized Eggs

Fertile

Implant Injected Embryos into Pseudopregnant females

Sterile

Transgene

Injection of Transgene into male Pronucleus

Founder Animal

Live Birth Test for Transgene
Advantages of Transgenic Engineering

**Plants:**
- More disease-resistant
- Larger yields
- More transportable
- More nutritious

**Animals:**
- Make proteins for medicinal purposes
- Make organs for transplant to humans
Concerns about Transgenic Engineering

★ Plants:
- Are they safe to eat?
- Will they harm wildlife?
- Will some become super-pest weeds?
- Replace or contaminate natural plants?

★ Animals:
- Will they be harmful?
- Replace or contaminate natural animals?
Cloning

- A "clone" is a copy of something.
- Computers that mimic IBMs are called "clones."
- In genetics, a clone is a genetic copy of another organism.
- Clones occur naturally:
  - Asexual breeding in plants & lower animals
  - Identical twins (triplets) in higher animals
A Brief History of Cloning

- For centuries it has been known that simple animals – worms & starfish – can be cloned by cutting them in half.
- This doesn't work for higher animals!
- Part of the problem is cell specialization:
  - Nerve
  - Bone
  - Muscle, etc.
Cloning in the 20th Century

- We now realize that each specialized cell has all the genetic information, but much of it is turned off.
- Problem – how to reset the "program" so this information is usable?
- Cloning of frogs successful in 1950s
- Cloning of livestock from fetal cells in 1970s
Dolly - 1996

- Clone from an adult sheep cell by Scots researchers under Ian Wilmut
- Had only one success in 300 tries.
- Dolly grew to maturity, and successfully had a lamb by natural means in 1998.
- But Dolly seems to be prematurely old.
Cloning Dolly

CLONING OF A EWE
(The Roslin Method)

1. An ewe provides the mammary cell to be cloned.
2. A mammary cell contains copies of all genes needed to produce a sheep, but only genes for proteins required by mammary cells are active.
3. Cells grow and divide, generating precise copies of themselves. Then the cells are deprived of nutrients, inducing them to dormancy. At this stage all of their genes can be activated.
4. Another (or even the same) ewe provides the egg.
5. The egg is preserved in a laboratory dish.
6. The nucleus is dislodged from the egg.
7. The mammary cell and the nucleus from the egg blend with a spark of electricity. Molecules in the egg then program genes in the mammary cell to engender the embryo.
8. Clusters of embryonic cells are grown.
9. Embryos are implanted into a surrogate mother.
10. The resulting lamb is a clone of the donor ewe.
Cloning since Dolly

- Cloning of this sort has now been done on cattle, pigs and mice also.
- The success rate has improved considerably.
- Cloning humans begins to show up in science fiction in 1970s.
- This is now a realistic possibility.
Advantages of Cloning

- With an adult plant or animal, the breeder knows what its traits are; this is not the case with fetal cell cloning.
- Cloning allows making a genetically identical copy of the desired plant or animal.
Concerns re/ Cloning

- The success rate from adult animal cells is still rather low.
- This would be unacceptable for cloning humans in most societies.
- The evidence suggests that the clones which survive are still not right.
- The genetic program has probably not been completely reset.
- We still don’t understand what we are doing in cloning from adult cells.
How Should Christians React?

How should we respond to:

- Food containing transgenic ingredients?
- Making mice which produce insulin?
- Making pigs to harvest for human organ replacements?

What does the Bible have to say about such things?
- Nothing directly, but important principles
God's Commandments in Eden

- **God's Purposes (Genesis 1:26):**
  - Mankind to be in God's image
  - Humans to rule over animals, etc.

- **God's Commands (Gen 1:28):**
  - Be fruitful, multiply, fill the earth.
  - Subdue the earth.
  - Rule over animals, fish, birds.
God's Commandments at Ararat

✦ Be fruitful, increase, fill the earth.
✦ Animals will fear you.
✦ Animals are given into your hands.
✦ They will be your food, but you must not eat their lifeblood.
✦ Neither you nor they may shed human blood. (Gen 9:1-7)
Treatment of Animals

"A righteous man cares for the needs of his animal, but the kindest acts of the wicked are cruel." (Proverbs 12:10)
God's Commands at Sinai

☆ Have no other gods but God.
☆ Make & worship no images.
☆ Don't misuse God's name.
☆ Remember to keep his Sabbath rest.
☆ Honor your parents.
☆ Don't murder, commit adultery, steal.
☆ Don't give false testimony.
☆ Don't desire what is not yours. (Ex 20:3-17)
What Should We Expect?

- Technology is good, because creation is.
- Mankind is fallen, "a ruin" (Buswell).
  - Not just a pile of shapeless stones, an artifact.
  - Not what it was designed to be.
- Man has always used the latest technology, for good or evil.
- This is bound to happen with genetic engineering, too.
What Should We Expect?

- By God's mercy, there has been less nuclear, chemical, biological warfare than we had any right to expect.
- Given the world situation, we can expect genetic engineering will be used for both good and evil.
- This will surely include human cloning unless it backfires terribly.
What Should We Do?

- We should act as Christians are supposed to, whatever the situation:
  - Salt – taste, preservative, thirst, stings
  - Light – visible, illuminating
- We should obey God’s commands ourselves & encourage others to righteousness as best we can.
- We should pray that God will be glorified and Jesus lifted up in whatever situation God puts us in.
What This Means

- Seek first God's rule and God's righteousness, and all these things (food, clothing, etc.) will be yours as well.
- We may have to take unpopular stands.
- Don't let short-term benefits outweigh doing what is right & compassionate.
Genetic Engineering & Cloning

Not The End!