

1

00:00:00,000 --> 00:00:11,252

This series presents information based in part on theory and conjecture.

2

00:00:11,252 --> 00:00:15,855

The producer's purpose is to suggest some possible explanations, but not necessarily

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00:00:15,855 --> 00:00:22,101

the only ones to the mysteries we will examine.

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00:00:22,101 --> 00:00:30,107

Biologists have patched together the genes of six mice to produce this single offspring.

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00:00:30,107 --> 00:00:35,511

More astonishing is the mouse created from only one parent.

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00:00:35,511 --> 00:00:48,522

One day, it may become possible to make exact replicas of human beings.

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00:00:48,523 --> 00:00:55,528

The chance of twins being born is about one in eighty.

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00:00:55,528 --> 00:01:00,532

The likelihood that they be identical is less than one in two hundred.

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00:01:00,532 --> 00:01:09,539

Wherever they appear, they are startling and fascinating.

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00:01:09,539 --> 00:01:19,547

But if twins are rare, the odds against identical triplets are astronomical.

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00:01:19,547 --> 00:01:25,552

These boys are lucky to have been born in the twentieth century.

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00:01:25,552 --> 00:01:34,559

Among primitive peoples, twins and triplets were feared and rejected.

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00:01:34,559 --> 00:01:41,565

Mother bearing such an animal like litter was thought to be a cursed.

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00:01:41,565 --> 00:01:45,568

One or all of the children were frequently killed.

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00:01:45,568 --> 00:01:54,575

Today, such children are nature's oddity, but in the near future they could become a familiar sight.

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00:01:54,575 --> 00:02:02,582

There's a good chance that science will learn how to create identical human beings, or clones, as they are called.

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00:02:02,582 --> 00:02:10,588

In both intrigues and alarms people, there's a feeling that people created by laboratory manipulation would be less than human.

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00:02:10,588 --> 00:02:14,592

A sense that something evil may be on the horizon.

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00:02:14,592 --> 00:02:22,598

Biologically, however, clones would be much like identical twins, triplets, or quadruplets.

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00:02:22,598 --> 00:02:32,606

These ten-year-olds form one of a dozen sets of identical quadruplets in the country.

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00:02:32,606 --> 00:02:42,614

The boys do look remarkably alike, though there are differences, and more will become apparent as they get older.

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00:02:43,615 --> 00:02:54,624

Their physical similarity and emotional closeness often blinds people to the fact that genetic idenciles are separate individuals.

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00:02:54,624 --> 00:03:01,630

They may look alike, but they do not necessarily think or act alike.

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00:03:01,630 --> 00:03:07,635

Well, it's very close, and there's a very, very strong bond.

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00:03:07,635 --> 00:03:16,642

And I just can't describe it to you very much alike, and then we also differ a great deal.

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00:03:16,642 --> 00:03:25,649

Our personalities are entirely different, and emotionally, possibly my sister is the stronger the two of us.

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00:03:25,649 --> 00:03:32,655

Physically, I say my sister is stronger than I am. She moves quicker.

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00:03:32,655 --> 00:03:44,665

My sister does it in a very big manner and much more action, maybe a little more noise.

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00:03:44,665 --> 00:03:52,671

This is Robin. He has a thinner face, and this is Ray. He has a wider jaws and wider face.

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00:03:52,671 --> 00:03:56,674

Rich has a rounder head.

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00:03:56,674 --> 00:04:06,682

They walk and run completely different, and then their body is different. It's three different kids.

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00:04:06,682 --> 00:04:13,688

The Bearing Twins are one of two pairs of identical twin gynecologists in the country.

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00:04:13,688 --> 00:04:21,695

I think I'm a little more sedate, a little more likely to let nature take its course, whereas my brother is a little more aggressive,

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00:04:21,695 --> 00:04:29,701

a little more likely to rock the boat and get a little upset a little more quickly than I do.

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00:04:29,701 --> 00:04:37,708

Perfocative, or maybe volatile, is the word that I like to use.

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00:04:37,708 --> 00:04:45,714

Twins are not clones, but they are living examples of what clones could be.

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00:04:45,714 --> 00:04:58,725

If we are to rise above the superstition of primitive tribes who killed twins, we must not think of clones as either less or more than human.

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00:04:58,725 --> 00:05:09,734

Genetically, a pair of human clones would be the same as a pair of identical twins. They would,

however, not originate in the same way.

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00:05:09,734 --> 00:05:22,744

The conception of a normal baby begins with an egg from the mother, which carries her genetic instructions and with sperm from the father, carrying his genetic makeup.

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00:05:22,744 --> 00:05:35,755

When the sperm fertilizes the egg, the genetic information from the father joins that from the mother, and the cell begins to divide.

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00:05:35,755 --> 00:05:53,769

Occasionally, the cell mass splits apart at an early stage. The separate halves continue dividing. They become identical twins, alike down to tiny details of face, hair, and teeth.

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00:05:53,769 --> 00:06:04,778

It is believed that a person's skin and other body cells carry all the genetic instructions needed to duplicate that person.

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00:06:04,778 --> 00:06:12,785

The process of cloning someone would begin with any one of their cells and any fertilized human egg.

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00:06:12,785 --> 00:06:21,792

The egg nucleus containing its genetic instructions would be removed, and the nucleus from the donor cell inserted.

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00:06:21,792 --> 00:06:29,798

After implantation in any woman's womb, the altered egg would divide and grow in the usual way.

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00:06:29,798 --> 00:06:43,810

It would become the younger identical twin of the original cell donor, his or her clone.

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00:06:43,810 --> 00:06:55,820

All of this is theoretically understood. Human cloning may be possible. But for lower forms of life, cloning is a reality.

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00:06:55,820 --> 00:07:05,828

Some orchids clone themselves naturally. Others need a little help from man.

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00:07:05,828 --> 00:07:15,836

At the Rod McClellan Company, south of San Francisco, growers are in the business of cloning beauty.

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00:07:15,836 --> 00:07:26,845

They cut a tiny sliver of cells from the shoot of a mature plant and put the pieces in nutrient.

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00:07:26,845 --> 00:07:32,850

After weeks of constant agitation, the cells grow into green clumps.

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00:07:32,850 --> 00:07:37,854

The clumps grow into orchid plants exactly like the original.

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00:07:37,854 --> 00:07:46,861

The process assures the growers that every orchid plant will be healthy and bear top quality flowers.

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00:07:46,861 --> 00:07:50,864

Cloning techniques are also being applied to trees.

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00:07:50,864 --> 00:07:57,870

In California, the original stands of the giant redwood are rapidly disappearing.

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00:07:57,870 --> 00:08:07,878

Researchers are helping reforest with a new breed of trees, faster growing, straighter redwoods with fewer branches than their ancestors.

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00:08:07,878 --> 00:08:17,886

The breeding of super trees begins with the selection of the best tree in a stand.

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00:08:17,886 --> 00:08:27,894

Twigs from the top of the tree are shot down and carefully gathered.

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00:08:27,894 --> 00:08:31,897

Carbon copy redwoods are then grown in test tubes.

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00:08:31,897 --> 00:08:39,904

Pieces of twig are planted in a special nutrient containing sugar, minerals, and growth-promoting hormones.

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00:08:39,904 --> 00:08:45,909

Within a few months, a batch of little cloned trees is ready for planting in the nursery.

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00:08:45,909 --> 00:08:54,916

In a year, reforestation can begin.

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00:08:54,916 --> 00:09:00,921

In the last decade, cloning research has made awesome strides.

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00:09:00,921 --> 00:09:12,931

Biologists use the cells of one axolotl, a large Mexican salamander, to create its clones.

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00:09:12,931 --> 00:09:15,933

Eggs are taken from a white axolotl.

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00:09:15,933 --> 00:09:21,938

Normally, they would be fertilized by different sperm and grown into different axolotls.

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00:09:21,938 --> 00:09:24,940

But a stranger fate awaits these eggs.

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00:09:24,940 --> 00:09:27,943

Their genetic information is destroyed.

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00:09:27,943 --> 00:09:37,951

They will become carriers for genetic instructions from other axolotl cells.

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00:09:37,951 --> 00:09:42,955

A spotted axolotl embryo becomes the source of these cells.

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00:09:42,955 --> 00:09:49,961

It is picked apart into individual cells.

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00:09:49,961 --> 00:09:53,964

What comes next is the very essence of animal cloning.

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00:09:53,964 --> 00:10:00,970

The genetic information carrying nucleus of a cell is drawn into the pipette.

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00:10:00,970 --> 00:10:07,975

The nucleus is transplanted into the unfertilized egg.

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00:10:07,975 --> 00:10:15,982

Other cells from the same embryo, each carrying identical genetic instructions, can also be

inserted in eggs.

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00:10:15,982 --> 00:10:21,987

The results will be clones.

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00:10:31,995 --> 00:10:34,997

The baby axolotls are born identical.

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00:10:34,997 --> 00:10:36,999

Spot for spot.

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00:10:36,999 --> 00:10:43,004

Man-made clones of a single parent.

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00:10:43,004 --> 00:10:50,009

If cloning were achieved for man, a single individual could create descendants in his own image.

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00:10:50,009 --> 00:10:57,015

Extraordinary people might be copied in hope of benefiting society.

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00:10:57,015 --> 00:11:01,018

The process raises a frightful specter of individuality lost.

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00:11:01,018 --> 00:11:06,022

It would be theoretically possible to produce an army of identical humans

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00:11:06,022 --> 00:11:13,028

who might synchronize their brains, thoughts, and actions to become a master race.

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00:11:20,034 --> 00:11:26,038

If human cloning became reality, a person could create his own younger identical twin.

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00:11:26,038 --> 00:11:31,042

The prospect conjures up visions of a dozen identical prize athletes

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00:11:31,042 --> 00:11:37,047

or a hundred facsimiles of some movie screen goddess.

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00:11:37,047 --> 00:11:41,051

Human cloning, however, is not yet upon us.

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00:11:41,051 --> 00:11:47,055

When biologists tried to use on mammals cloning methods developed for salamanders and frogs,

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00:11:47,055 --> 00:11:53,060

they encountered formidable obstacles.

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00:11:53,060 --> 00:11:59,065

Mouse or human eggs are delicate specks, much smaller than axolotl eggs.

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00:11:59,065 --> 00:12:06,071

The operations of microsurgery can easily damage them.

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00:12:06,071 --> 00:12:11,075

Dr. Clem Markert of Yale University is a pioneer in cloning research.

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00:12:11,075 --> 00:12:20,082

His latest achievement is the creation of a mouse which has six parents.

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00:12:20,082 --> 00:12:25,086

Starting with three pairs of normally mated mice, each with different coat color,

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00:12:25,086 --> 00:12:32,092

Dr. Markert produced a three-colored patchwork female.

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00:12:32,092 --> 00:12:42,100

This laboratory miracle was performed by putting together embryonic cells from the three matings.

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00:12:42,100 --> 00:12:47,104

After joining, the cell groups synchronize, develop normally,

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00:12:47,104 --> 00:12:52,108

and become one mouse instead of three.

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00:12:52,108 --> 00:12:57,112

No one has ever cloned a mammal, but a few individuals at least have tried.

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00:12:57,112 --> 00:13:01,115

And we're trying to develop the techniques for cloning mice right now,

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00:13:01,115 --> 00:13:05,119

and there are two different methods that we can use in attempting to clone mice,

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00:13:05,119 --> 00:13:10,123

both of which involve a kind of microsurgery on mouse eggs.

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00:13:10,123 --> 00:13:15,127

The process begins with a female whose eggs have been fertilized in the normal way.

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00:13:15,127 --> 00:13:23,133

Her eggs are collected and prepared for microsurgery.

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00:13:23,133 --> 00:13:29,138

At this early stage, genetic material from egg and sperm have not yet mixed.

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00:13:29,138 --> 00:13:35,143

The mothers and fathers genes are in two distinct sacs called pronuclei.

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00:13:35,143 --> 00:13:40,147

Dr. Markert deftly removes one of the pronuclei.

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00:13:45,151 --> 00:14:00,163

In the incubator, the remaining pronuclei replicates,

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00:14:00,163 --> 00:14:07,169

restoring the normal amount of genetic material to the egg.

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00:14:07,169 --> 00:14:10,171

It can now develop like any other mouse egg.

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00:14:10,171 --> 00:14:16,176

A technician inserts the egg into the womb of a mouse who will bring it to term.

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00:14:16,176 --> 00:14:20,180

When born, it will be a new type of animal.

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00:14:20,180 --> 00:14:26,184

A female mouse descended from only one parent.

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00:14:26,184 --> 00:14:30,188

But if the same steps were carried out for the next generation,

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00:14:30,188 --> 00:14:38,194

science would produce cloned mice.

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00:14:38,194 --> 00:14:42,197

If we repeat the procedure, then we would make clones of mice.

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00:14:42,197 --> 00:14:47,201

And there's no technical or biological barrier to doing that right now.

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00:14:47,201 --> 00:14:51,205

Experiments with single-parent mice are continuing.

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00:14:51,205 --> 00:15:01,213

Within a few years, Dr. Markert expects the first cloned female mice to be made by this indirect technique.

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00:15:01,213 --> 00:15:08,218

If cattle could be cloned by first making single-parent cows, the economic gain would be enormous.

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00:15:08,218 --> 00:15:13,223

Dairy farmers could build whole herds of identical prized cows.

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00:15:13,223 --> 00:15:21,229

Unlike humans, however, these animals have been bred to eliminate genetic defects.

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00:15:21,229 --> 00:15:27,234

Human beings all carry a substantial burden of what we call recessive lethal genes,

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00:15:27,234 --> 00:15:31,237

which if present in duplicate would cause us to die.

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00:15:31,237 --> 00:15:36,241

So that if you began with a human egg and treated it the way we do the mouse egg,

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00:15:36,241 --> 00:15:40,244

instead of it living and developing, it would surely die in nearly every case.

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00:15:40,244 --> 00:15:45,248

Scientists, however, are working on another way to clone mammals,

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00:15:45,248 --> 00:15:49,252

a method like that used to clone axolotl embryos.

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00:15:49,252 --> 00:15:54,256

The second method involves putting a nucleus into the egg after you've previously taken its own nucleus out.

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00:15:54,256 --> 00:15:59,260

This is more difficult. I can do this mechanically. I can insert the nucleus alright.

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00:15:59,260 --> 00:16:03,263

The egg seems to heal up, but none of these have ever developed.

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00:16:06,265 --> 00:16:13,271

What Dr. Markert is trying to do for the mouse has not yet been done for the axolotl.

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00:16:13,271 --> 00:16:19,276

To begin with body cells from an adult animal and make an adult clone.

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00:16:19,276 --> 00:16:26,282

The successful experiments with frogs and salamanders all begin with tadpoles and embryos, not adults.

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00:16:26,282 --> 00:16:29,284

No adult animal has ever been cloned.

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00:16:29,284 --> 00:16:35,289

But even if this barrier is hurtled, the road to human cloning presents obstacles of its own.

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00:16:37,291 --> 00:16:41,294

The technical and logistic problems would be enormously magnified.

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00:16:41,294 --> 00:16:46,298

I work with dozens or hundreds of mouse eggs, most of which are going to die.

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00:16:46,298 --> 00:16:50,301

To try to do anything like that with human beings would be very difficult.

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00:16:53,304 --> 00:16:58,308

The notion of cloning, especially cloning human beings, certainly agitates people.

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00:16:58,308 --> 00:17:06,314

If one were successful in cloning, say, an adult man, all you would in effect do would be to produce an identical twin of that man,

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00:17:06,314 --> 00:17:08,316

but of a very different age.

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00:17:08,316 --> 00:17:11,318

Now there are thousands of identical twins walking around on the surface of the earth.

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00:17:11,318 --> 00:17:13,320

They all constitute small clones.

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00:17:13,320 --> 00:17:21,326

And to produce another set of identical twins of different age doesn't seem to me to be anything that should agitate people.

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00:17:22,327 --> 00:17:26,330

Identicals, however, may be more special than we realize.

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00:17:26,330 --> 00:17:32,335

Even if we were thousands of miles apart, I could feel something coming on.

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00:17:32,335 --> 00:17:35,338

I'd pick up the phone and my answer would be right there.

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00:17:36,338 --> 00:17:43,344

And sister would have her, she'd be ill or in some kind of trouble.

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00:17:43,344 --> 00:17:47,347

And we can always feel this.

152

00:17:49,349 --> 00:17:51,351

We can read each other's minds.

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00:17:51,351 --> 00:17:54,353

It's very strong, very strong.

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00:17:55,354 --> 00:17:59,357

I think that they have the same brain thoughts, same ways.

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00:17:59,357 --> 00:18:01,359

They come up with the same answers.

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00:18:01,359 --> 00:18:05,362

I really believe that they think about each other the same thought at the same time.

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00:18:07,364 --> 00:18:17,372

If there were four or five or six of us seeing that we twins are double-power, it would have been just absolutely marvelous.

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00:18:19,373 --> 00:18:24,377

I think four or six would be a very good landslide.

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00:18:24,377 --> 00:18:31,383

We have a veritable clinic and we have the whole town to ourselves probably.

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00:18:31,383 --> 00:18:36,387

I'm not too worried about negative results from phoning.

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00:18:37,388 --> 00:18:44,394

I think it's a good thing that we are able to improve the human race, if you will,

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00:18:44,394 --> 00:18:57,404

and improve certain characteristics maybe that are desirable and eliminate undesirable individuals and characteristics,

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00:18:57,404 --> 00:19:04,410

even though it may sound a little dangerous, depending on who calls the shots.

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00:19:07,412 --> 00:19:11,415

Many people are afraid that if the phoning of human beings became possible,

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00:19:11,415 --> 00:19:16,420

that the government would direct the process and produce individuals to the government's taste.

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00:19:16,420 --> 00:19:20,423

What governments are interested in is the adult personality.

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00:19:20,423 --> 00:19:23,425

If you were to clone individuals, you'd still just begin with a group of children,

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00:19:23,425 --> 00:19:27,428

the same genetic makeup as some preceding generation of adults,

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00:19:27,428 --> 00:19:32,433

but you'd still have exactly the same problems of trying to discipline them, educate them,

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00:19:32,433 --> 00:19:36,436

change them, or make them into the kind of adults you wanted to make them into.

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00:19:37,437 --> 00:19:43,441

One of the reasons why many people are very worried about the possibility of cloning human beings

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00:19:43,441 --> 00:19:49,446

is that they suffer from the illusion that genes determine character, and that's just not true.

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00:19:52,449 --> 00:19:57,453

Dr. Markert and associates are continuing attempts to clone mice.

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00:19:57,453 --> 00:20:02,457

Their progress, manipulating eggs, has attracted new researchers to the field,

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00:20:02,457 --> 00:20:05,459

multiplying the chances of success.

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00:20:07,461 --> 00:20:11,464

The cloning of human beings could soon be within reach.

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00:20:11,464 --> 00:20:16,468

If human cloning comes, serious questions will have to be faced.

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00:20:16,468 --> 00:20:19,471

Who will be singled out for duplication?

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00:20:19,471 --> 00:20:22,473

Who will decide how many copies to make?

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00:20:24,475 --> 00:20:28,478

Geneticists believe that intelligence is in part inherited.

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00:20:29,479 --> 00:20:35,484

By cloning talented individuals, society could boost the mental power of the species.

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00:20:35,484 --> 00:20:39,487

It is a prospect at once frightening and tantalizing.

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00:20:39,487 --> 00:20:46,493

Whether used wisely or not, cloning could profoundly alter our destiny in the universe.

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00:20:47,493 --> 00:20:52,497

If achieved, cloning would create genetically identical individuals.

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00:20:52,497 --> 00:20:59,503

But if cloning became a common method of human reproduction, certain types might be overbred,

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00:20:59,503 --> 00:21:04,507

and variety is essential to the survival and evolution of a species.

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00:21:04,507 --> 00:21:10,512

Unless carefully controlled, cloning could potentially lead us toward evolutionary disease.

188

00:21:10,512 --> 00:21:17,518

Unless carefully controlled, cloning could potentially lead us toward evolutionary disaster.