

Rough Transcript of the Video: *Darwin's Dangerous Idea* (DDI)
Copyright 2001, 2009

Preliminary matters:

The on-line link to the Video is:

<http://video.google.com/videoplay?docid=-9073555471451092793#>

Students have been given the following link for related assignments:

<http://www.pbs.org/wgbh/evolution/index.html>

The Web site explains that DDI is the first of many other resources developed for teachers for use in public school classrooms.

Produced by public broadcaster WGBH Boston and documentary and feature film producer Clear Blue Sky Productions, the *Evolution* project aims to help biology teachers nationwide enhance and deepen their students' understanding of evolution and the nature of science.

Teachers may obtain and provide to students a set of 42 questions about the film at <http://www.slideshare.net/hohlert/darwins-dangerous-idea-movie-guide>. The questions reinforce points students should be expected to understand from watching the video.

Transcript of Video Taken from Close Captions

The title of the video that appears on the DVD Menu is:

"Evolution"
"A journey into where we're from and where we're going"
"Darwin's Dangerous Idea"

Chapter 1: Prologue

"South America 1833"

[The prologue opens with Darwin in South America in 1833 with Captain Robert FitzRoy as they discover a fossil jawbone of an extinct animal. Darwin is asking the natives who found the fossil how much they want for it. He wants to buy it.]

Darwin speaking to a South American native as they enter a village: "Me llamo, Charles Darwin." pointing to Fitzroy: "Captain Fitzroy. Me Naturalist. Do you have bones?"

Native: "Si, large bones."

Darwin: "Here? Fitzroy."

FitzRoy: "A Flood washed down part of a bank of the earth. It was perfect but the boys knocked out some of the teeth throwing stones at it."

Darwin asks the native: “How much?” and then says to FitzRoy: “I wonder why these creatures no longer exist.”

FitzRoy: “Perhaps the ark was too small to allow them entry and they perished in the flood.”

[Darwin just laughs.]

FitzRoy: “What is there to laugh at?”

Darwin: “Nothing, Nothing”

FitzRoy asks: “Do you mock me or the Bible?”

Darwin: “Neither.”

FitzRoy: “What sort of clergyman will you be Mr. Darwin?”

Darwin: “Dreadful, Dreadful” (smiling)

The scene then shifts to FitzRoy reading from Genesis 1 on the ship to the full ship’s compliment:

FitzRoy: “And God said let the waters bring forth the moving creatures that have life and fowl that may fly above the earth in the open firmament of heaven. And God created great whales and every living creature that moveth...”

[In the cabin below, Darwin is sitting and listening and rolling his eyes. As his eyes roll they spot a beautiful butterfly that appears in his cabin]

FitzRoy in the background: “And God saw that it was good.”

Darwin: “Hello, [Talking to the butterfly]

FitzRoy: “...which the waters brought forth...”

Darwin: “What are you doing here? Why such beauty *where no one can see*? You can’t have been blown here.”

FitzRoy: “And God saw that it was good.”

[Then we hear the voice of Daniel Dennett, and the camera moves to him sitting in a chair and describing Darwin’s idea]

Dennett: “If I were to give a prize to the single best idea anyone ever had I’d give it to Darwin for the idea of natural selection. Ahead of Newton, ahead of Einstein, because *his idea unites the two most disparate features of our universe, the world of purposeless, meaningless matter and motion on the one side, and the world of meaning and purpose and design on the other.* He understood that what he was proposing was a truly revolutionary idea.”

[Next we hear from the deceased Atheist¹, Stephen Jay Gould]

Gould: “The Darwinian revolution is about *who we are, its what were made of, its what our life means* in so far as science can answer that question. So it in many ways was the singularly deepest and most discombobulating of all discoveries that science has ever made.”

[Darwin’s Biographer James Moore finishes the prologue:]

Moore: “In Darwin’s Day the idea of evolution was regarded as highly unorthodox, because it went against all of natural history in Great Briton. It jeopardized the standing of science, *it did jeopardize the standing of a stable society, the bible and the Church as well.*”

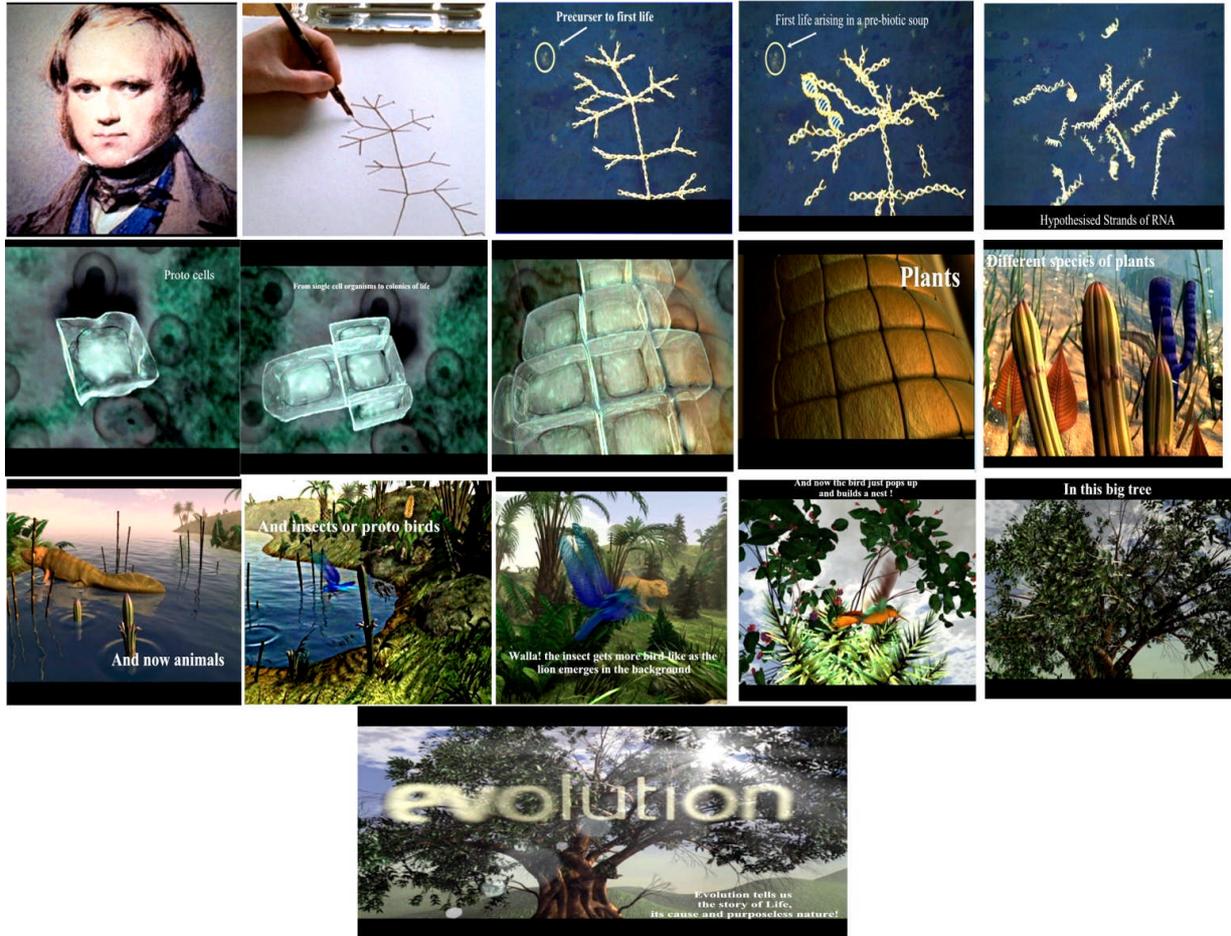
“Darwin kept his thoughts to himself for many years and agonized over the problem. If it ever got out that he was doing something that ran slap counter to an established science it would ruin his career, ruin his reputation. He was a respectable man with a dangerous theory.”

Chapter 2: Common Ancestry

[The opening scene in the movie after the prologue shows a speck of chemicals in the sea self-organizing into all biodiversity, ending up in a grand tree symbolizing the tree of life labeled “evolution.” The following collage shows a series of screen shots of the opening scenes in order, beginning at the top left:]

¹ See Stephen Jay Gould: Marxist and Atheist?

By David A. Noebel <http://www.worldviewweekend.com/worldview-times/article.php?articleid=1739>



[Following the Prologue, the movie opens with the caption “Darwin’s Dangerous Idea.”

“London, December 1836” upon Darwin’s return from the voyage of the Beagle

Erasmus, Darwin’s older brother, as he greets Darwin at the warf in London where the Beagle has docked after its long voyage: “Did you never get your sea legs?

Darwin: Not once in five years. Whenever the sea was up so was the contents of my stomach.

Erasmus: “What a delightful thought. We should be able to squeeze 400 a year out of the governor.

Darwin: Why, what has he said?

Erasmus: He hasn’t said anything, but I’ve seen it in his eyes --- the way he pored over your letters. A very proud father. I told him you were going to publish a journal of your travels. There was a definite flicker of interest.

Darwin: Publish?

Erasmus: Yes, of course. No country parsonage for you, my boy. You’re under my wing now.

I'll take charge of your affairs: introduce you to all my clever, witty friends. Trade on your celebrity.

Darwin: "Celebrity?"

Erasmus: "Certainly. Everyone wants to meet you --hear stories of naked Tahitian women and giant sloths or whatever.

Darwin, as he and Erasmus encounter Captain FitzRoy looking over some charts he introduces Erasmus to FitzRoy: "This is my brother, Erasmus."

FitzRoy: Mr. Darwin.

Erasmus: "Captain. [looking at all of the boxes of stuff Darwin brought back]: "Good God. A man can collect a lot of rubbish in five years. It's a wonder you didn't sink the ship, Charles."

FitzRoy: "Named, I take it, after your grandfather?"

Erasmus: "Yes and an uncle who drowned himself in the River Derwent."

FitzRoy: "And are you a *Free Thinker* like him?"

Erasmus: "I'm more of a free *drinker*, really."

[FitzRoy turns his back on Erasmus folding a chart with apparent disdain.]

Erasmus: "And how was the voyage for you?"

FitzRoy: "That's not for me to say."

Erasmus: No?

FitzRoy looking in a chest of charts as he replies: "40 views of the coast as seen from the sea, 80 plans of harbors and 82 coastal maps --- all for the Hydrographic Department of the Admiralty."

Erasmus [as FitzRoy walks off in obvious disdain]: "Bravo" [in a quiet mocking tone]

[After FitzRoy walks off Darwin walks up and Erasmus says to him, laughing]: "Dinner at sea must have been a marvelous affair."

Darwin [Ignoring the slur cast at FitzRoy. a committed Christian, Darwin shows Erasmus a sea turtle]: "Here..... from the Galapagos Islands."

[The video turns to a discussion at a formal dinner on Darwin's return.

Darwin: Puma roasted over an open fire rather like veal. Armadillo, roasted in its shell... a lot like duck. Tortoise, of course. Some of them weigh as much as 500 pounds. One of them I measured was 96 inches around the waist.

Erasmus: If one of them ever needs a suit of clothes we must send it to father's tailor.

Darwin: "What else, ah Llama, ostrich..."

Erasmus: "People wonder how some animals become extinct. Now we have the answer: eaten by Charlie Darwin."

[Scene shifts to Darwin getting ready to read a paper before a scientific audience.]

Erasmus resting in his bed as Darwin practices the delivery of a lecture to a meeting of naturalists: "You look as though you're going to the scaffold! Dignity, Poise, Smile, Remember all eyes are on you. The judging has begun. "

Darwin practicing: "Mr. President...., my lords, ladies and gentlemen

Erasmus: "No, NO, no, Start with a bang. Men of Athens.

Darwin: "What

Erasmus: Friends, Romans, Countrymen, That sort of thing.

Darwin: "Right. I can't do this.

Erasmus: Yes, you can. You must not let the fact that every leading geologist in the land will be there put you off.

Darwin: "Oh |God.

Erasmus: "Now, let me hear an interesting bit.

Darwin: "There aren't any."

[Scene shifts to the assembly and Darwin is reading from his paper:]

"The earth quakes ran 400 miles accompanied by the simultaneous eruption of a line of volcanoes. We found fresh mussel beds lying above high tide the shellfish all dead. The land had risen eight feet. Mountains must be the product of thousands and thousands of such rises occurring again and again throughout history. Even at the very crest of the Andes we found marine remains ...the fossilized shells of creatures that once crawled about at the bottom of the sea elevated nearly 14,000 feet above its level.

"Time, unimaginable tracts of time is the key."

[This argument for unlimited time is met with applause from Erasmus, and then the rest of the room joins.]

"Bravo, Bravo, Bravo"

[Next scene is in a lab where they are talking about finches. Each finch is unique, never described before. There is a separate species for each Galapagos island. It shows how Darwin began to theorize about the origin of species based on finches being on different islands. Darwin's problem is that he did not label the birds he collected by island. So he needed information from FitzRoy as to which bird came from which island.]

Man to Darwin following the lecture as they are leaving: "Mr. Darwin, splendid. "

Darwin: Thank you, thank you very much.

Professor Richard Owen to Darwin "Interesting paper."

Darwin: "Thank you. "

Owen: "Where have you placed your fossil specimens?"

Darwin: "I was thinking of the British Museum.

Owen: Ah, your happy to have them languish in some dusty Bloomsbury cellar?"

Darwin: "No, not at all.

Owen: "You'd better let me look over them for you then.

Erasmus: "We'll let you know.

Darwin being pulled away by Erasmus: "Yes, thank you."

Erasmus to Darwin as they walk off: "Pompous oaf. Who does he think he is?"

"He thinks he's the most brilliant anatomist in Europe. And you're Erasmus Darwin's little brother. Darwin of the Beagle Darwin! Lord it while you can.

Darwin: "I don't want to lord it."

Erasmus: "Liar."

[As seen later, Darwin ultimately turns his collection over to Owen.]

[Next scene is in a lab where Darwin and a scientist named John Gould are talking about finches collected by Darwin on his voyage.]

Darwin to Gould as he looks at his drawings of finches brought back by Darwin: "What a brilliant red!

Gould; I try to allow for the loss of color that comes with death. I haven't finished identifying your galapagos birds yet, Mr. Darwin. I don't know that your "wren" is a finch. Your "grosbeak" is a finch. Even your blackbird is a finch. And they're unique --- all new, never described before. There's even evidence that there are separate species for each Galapagos island."

Darwin: “But I didn’t label mine by island.”

Gould: “You didn’t label them by island?”

[Scene shifts to Darwin talking with Fitzroy at his home in the evening following his meeting with Gould]

FitzRoy asks Darwin: “Why do you want them? No, I mean, why are the birds I collected suddenly of such interest to you?”

Darwin: “The vice governor of the Galapagos told me he could identify which island a tortoise came from by its markings.”

FitzRoy: “Yes, yes... small variations are possible from island to island. Adaptations to climate and so on.”

Darwin: “Yes, but the islands all have the same climate. My expert, John Gould, tells me he’s found different species of finches. What if these finches were blown to the Galapagos from South America and then began to change, adapt, if you will become more and more different from their ancestors generation after generation? First into varieties and then into new species each new species marooned on its own island.”

FitzRoy: “What are you talking about? What if the finches were blown to the Galapagos! *God put those creatures there.*”

Darwin: “But that makes no sense. Why would God put different birds on almost identical islands .”

FitzRoy: “I have no idea. It’s not a question that requires an answer. Species were commanded into existence by God. They are perfect forms and they’ve been perfect since the day of Creation. It’s divine law, God’s will.”

[Darwin does not respond. The silence is pregnant. It implicitly conveys to the viewer, Darwin’s disagreement.]

FitzRoy After the silence: “I’ll see to it that your expert receives my birds.”

Darwin: “Thank you.”

FitzRoy replies: “Its God you should give thanks to.”

[Darwin remains silent.]

[Scene shifts to Erasmus and Darwin going together to a meeting in a hurry as they are apparently late]

Erasmus talking to Darwin as they walk together to a lecture by Richard Owen about fossils Darwin collected: “Tonight, and for one night only, ladies and gentlemen a guided tour of Charles Darwin’s Boneyard.”

Darwin replies; “Shhhhhh. And for goodness sake, hurry up!

[After they arrive we are shown a lecture in progress]

Professor Richard Owen (a highly regarded anatomist and naturalist) speaking in a pompous tone: “This is a large, extinct llamalike creature and this is a giant ground sloth discovered by Mr. Darwin at Punta Alta.

Erasmus to Darwin in a whisper as he mocks Owen’s presentation: “The remains of Mr. Darwin’s breakfast.

Owen: This skull belongs to a huge rodenta relative of the South American capybara.”

Darwin [whispering to Erasmus]: “If that is a rat, imagine how big the cats must have been.” (laughing at Owen’s ignorant pomposity)

Owen: “I have named it Toxodon.”

Host: “Thank you, thank you, Professor Owen for identifying and describing the extraordinary array of fossils discovered by Mr. Darwin on his voyage to South America.”

[Scene shifts to a cocktail party after the meeting]:

Darwin: “We allow the planets and the sun to be *governed by natural laws*, but the smallest of the insects *we wish* to be created by a special act of God. Surely the creation of life has to be explained in the same way as geology, *using natural ordinary everyday causes.*”

Owen [in response to Darwin’s assertion]: “Well, in theory yes, but in practice there can be no question about the prime cause, Divine will.”

Darwin: “But shouldn’t men of science be free to investigate each and every means by which new species come into being.”

Owen: “If by that you mean wild accusations about man’s ancestry, the answer is no. To destroy man’s status is to open the floodgates to anarchy. You might just as well throw muskets to the rabble.”

The scene now shifts:

Erasmus: “People like Owen think that if there was no Church of England cucumbers wouldn’t grow.”

Darwin: “If the globe has undergone such profound changes in its history geologically then surely all living creatures must have changed with it to adapt to their new conditions. Otherwise they would have perished.

Erasmus: “Some did perish it seems.

Darwin: “Yes, but the continued existence of life on Earth can only be explained by the assumption that a creature like this was replaced by the modern-day armadillo. *There must be a law* which causes new species to appear in place of the extinct ones. “

Erasmus: “Oh, that, my boy, is the mystery of mysteries. The person who can solve that riddle will take all of the scientific prizes. ”

[The scene now shifts to a billiard room and a billiard table where balls are scattered across the green top.]

[Darwin has an idea and he wakes up Erasmus from an apparently drugged stupor to tell him about it.] and says:

Darwin: “The Galapagos Islands are almost identical – the same geology, the same climate. So why should different finches inhabit identical islands? Small changes over ages and ages can throw up mountain ranges and sink continents. If mountains can move and rivers can move then why can’t animals?

Darwin: “Finches. Tortoises. Iguanas. If you trace the animals across the surface of the earth or dig down and trace them back through time you come face to face with the same truth.”

Erasmus: “Which is?

Darwin: “New beings can appear on the earth.

[Looking at a series of balls on the billiard table arranged in a straight line.] “Perhaps everything is part of one ancestral chain. Man... mouse...armadillo....”

“No.” [he says to himself as he scatters the line of balls on the table]

“Its nonsense to think of animals or man climbing some ladder ...to talk of one animal being higher than another . No. I think its more like a tree. A tree of life. Each new species springs from the parent tree like a shoot. These shoots branch and divide in their turn and so on and so on. Some branches die out, others keep developing. The trunk--- the ancient common ancestor. The stalk. The stalk, the stalk from which all animals plants sprang.”

Erasmus: “Nursed by warm sun-beams in primeval caves Organic life began beneath the waves. Hence, *without a parent* by spontaneous birth rise the first steps of animated Earth. [Pulling a book off the mantel and opening it] Grandfather’s Zoonomia. Would it be too bold to imagine that all warm-blooded animals have arisen from one living filament? Its in out blood Charles.”

Darwin [reading from the book]: “Grandfather was vilified for it. “

[Picture shifts to Darwin drawing a tree of life.]

Narrator: “What Charles Darwin glimpsed over 150 years ago is now the bedrock of biology. All forms of life on earth *have evolved* from a single branching tree of life.”

Chapter 3: Ecuador and The Tree of Life

The video takes you to a rain forest and an investigation of different varieties of finches based on beak sizes.

Narrator: “Darwin applied his thinking about finches – that all of the varieties of finches came from a single species that flew over from the mainland. He then *extrapolated that to explain all of life*. If beak sizes can change then all other changes can be accounted for the same way. Everything arises from one common ancestor.

Tiputini, Ecuador, November 2000

Chris Schneider, Boston University: “One of the most important ideas that Darwin had was that *all living things on Earth were related*. How can you realize that you are part of this single tree of life and not be *fundamentally moved* by that? It’s something that *stirs the soul*. ”

Narrator: “Following in Darwin’s path biologist Chris Schneider and his colleagues have come to South America to a remote region of Ecuador near the base of the Andes Mountains. The rain forest may be home to more species of animals than anywhere else on Earth. Darwin had been awestruck by its endless variety of life. He wrote that he felt like a blind man being given sight and that the sounds of the rain forest were like a great cathedral at Evensong.

“pbs.org Read Darwin’s Diary”

“For biologists today the lowland rain forest and the nearby Andes Mountains are laboratories for exploring Darwin’s ideas.”

[Scene shifts to Schneider holding a finch or bird of some kind]

Narrator: “Over the next several days Schneider’s team will track down rats and frogs, bats, birds and lizards through the day and night, both here in the rain forest and high up in the mountains. By comparing the two groups of animals they hope to better understand how changing environments might trigger the evolution of new species. “

Schneider: “You just can’t help but be awestruck by the fact that there are so many different kinds of things here. There are 12 species of primates. There are 550 species of birds that have been identified here. There are 100 species of frogs right here in this little area.

“Why is there such diversity here?”

[Schneider returns to his campsite]

Narrator: “Ornithologist Tom Smith wants to compare the size of birds’ beaks from the rain forest with those he hopes to find in the mountains. Even subtle differences may offer clues about how and why new species arise just as it was the beaks of finches from the nearby Galapagos Islands that spurred Darwin’s thinking in the 1830’s. Darwin saw that the finches he brought back had uniquely shaped beaks that had adapted to the different foods on the islands. He envisioned that these different species of finch had all descended with modifications --- from a common ancestral population that had flown over from the mainland. *Darwin’s bold insight was to apply this vision to all of life to see that the great variety of life on Earth, including*

leopards and lichens, minnows and whales flowering plants and flatworms, apes and human beings all descended from one root, one common ancestor.”

Stephen Jay Gould: “It was indeed one of his radical proposals. Not only to say that evolution happened but that there was a root of common ancestry to everything that lived on this planet, including us. You could construe it in other ways, that, as I like to say, are more user friendly. You could have thought well, God had several independent lineages and they were all moving in certain preordained directions which pleased His sense of how a uniform and harmonious world ought to be put together. And Darwin says ‘No, its just history, all coming from descent with modification from a single common ancestry“

Moore: “The key to Darwin’s thought in every realm is that *given enough time* and innumerable small events anything *can take place by the laws of nature*. So, whether it’s the raising of mountains or the evolution of new species all of these things happen through time and change.”

Narrator: “The rainforest holds striking examples.

Schneider: “Take a look at this [green praying mantis that looks like a leaf resting on a green leaf] here. This thing is almost perfectly disguised as a leaf but you can see if you look at the underside that it’s a praying mantis just like you’d find in a garden in North America. But this one is highly modified. Its thorax is flattened out to look like a leaf and its wings are modified to look like leaves. You can even see the veins. If you imagined a population of mantises and some looked more like leaves than others those ones that look like leaves may tend to survive and reproduce more than others. And so a series of modifications could build up over time to result in an almost perfectly leaflike mantis. But if you put it on a background on which it doesn’t belong, I mean it just sticks out like a sore thumb. It would almost certainly get eaten by something.”

Narrator: “Before heading into the mountains Smith collects more birds to add to what he’s learned in the rain forest.

Schneider: “Bill length, [measuring the length of a bill] ... is 9.2. Common is 10.

Narrator: “[He’s looking to see if individuals are] different enough to be considered new species branching off in a new direction on the tree of life?”

[Flying over the rainforest.]

Schneider: “When the Andes were uplifted it created a whole variety of new habitats. The animals that were in the lowland rain forest had an enormous opportunity to colonize these new habitats and they did so.

“The real question is whether adaptation to these new environments can lead to the formation of new species.”

Narrator: “Flying less than one hour Schneider and Smith move from the steamy lowlands to the windswept Andean peaks. Animal populations made the same journey, but gradually over many generations. And as the environment changed from the rain forest to the high, cool grasslands animal populations were forced to adapt. These grasslands lie nearly two miles above

sea level. Seasons never change here, so close to the equator, but it is said that winter visits every night. Temperatures often drop below freezing. Animals not well adapted will not survive.

Smith: “Hummingbirds are amazing. It turns out that they can drop their body temperatures 50 degrees and go into a state of hibernation to withstand the frigid nights here.

“*You can imagine* a small-billed hummingbird living in cloud forest some thousand meters down slope from us. And if those individuals were to expand their range up into this habitat where *perhaps* flowers are much longer [requiring a longer beak] you *could expect* that individuals with slightly longer bills *might* survive better. And in fact, there are many examples in hummingbirds where we know that small changes in bill length can make important differences in how that bird extracts nectar and how well it survives. We’re seeing that changes in the environment can be very important in changing the characteristics of those animals as they move between environments. And we *believe very strongly* that, in many cases, anyway that this can be very important in the progression to new species.”

Narrator: “From one species of bird, the common ancestor hummingbirds with beaks of different lengths evolve over many generations. And if these populations change so much that they can no longer reproduce with one another they are considered separate species on the tree of life.

“Smith and Schneider want to see how closely related the highland birds are to the birds they examined in the lowland rain forest. They compare color, beak length, and wingspan just as Darwin would have done. But they have another tool that Darwin never dreamed ofDNA.

“Darwin was convinced that traits were passed on from generation to generation but he didn’t understand how. *We now know that the sequence of the four chemical building blocks of DNA determines the traits of all living things.* Each generation passes on this *text* of As, Ts, Cs, and Gs to its offspring. But occasional *mistakes in copying* – mutations – can result in new traits.

Schneider: “By comparing DNA we can determine who is most closely related to whom, we can determine when they had a common ancestor, and when they diverged from that common ancestor.”

Narrator: “Laboratory analysis reveals the DNA from the rain forest hummingbirds differs only very slightly from that of the highland hummingbirds. They must have diverged from a common ancestor relatively recently in the history of life on Earth, about 3 million years ago.

Schneider: “Were examining the genetic material that makes organisms what they are. And written in that DNA is the history of their evolution.”

Narrator: “The fact that the *blueprints* for all living things are in the same *language* the genetic *code* of DNA – is powerful evidence that they all evolved on a single tree of life.”

Schneider: “How is it that organisms that are so different can be related? That we are related to a flatworm or a bacteria? Darwin emphasized that small changes would accrue every generation and these changes *could* build up to amount to enormous changes. Its not really hard to understand how major transition *could* come about given that life has been around for *3.5 billion years. Darwin really had it right.*”

Scene shifts to Maer Hall, Staffordshire, 1837

Chapter 4 Natural Selection.

Darwin is courting Emma Wedgwood, his cousin. They are practicing their archery. Emma shoots an arrow into the center of the target. After being congratulated for her marksmanship she then picks up her dog named Squibb, from the arms of a servant.

Darwin: “Well, Emma, you’re a remarkably good shot!

Emma [putting down the bow and taking her dog Squibb from an attendant. She then greets a friend who comes up who has a dog with him as well]: “Hello Parker”

Parker (a dog breeder): Miss Wedgwood.”

Emma: “You’ve met my cousin, Mr. Darwin, before.”

Parker: “Sir.”

Darwin: referring to Parker’s dog: “He’s fast?”

Parker: “The fastest in the country.”

Darwin: “Did you breed him yourself?”

Parker: “I mated him with a bitch who was pretty swift.

Darwin: “And how would you breed a fellow like Squibb here?”

Parker: “From the runts, I suppose.”

(The men laugh)

Emma [holding poor Squibb in her arms]: “How dare you. Squibb is quite as nice as any of your rotten dogs.”

Darwin: “Its true. Its from the runts and monsters that breeders can produce hairless cats or pygmies like squib.

Emma: “I’m not listening to any more of this. Take me back to the house at once and stop saying horrid things.”

Darwin (as they walk back): “From wolves to greyhounds, from bulldogs to fellows like Squibb, in what, a matter of a few hundred years.

I take it you don’t find talk of dogs all that interesting.”

Emma: “I can think of more interesting topics of conversation.”

Darwin: “Such as?”

Emma: “The novels of Miss Austen.”

Darwin: “And what does she have to say about selective breeding?”

Emma: “Nothing, as I recall.”

Darwin: “Well that’s a great pity. Why shouldn’t nature produce such differences, these different breeds of dog?”

Emma: “Why should it? What would be the point?”

Darwin: “Survival.”

Emma: “In nature a little puppy like Squibb who was the smallest in her litter would die.”
[Saying to Squibb]: “You nearly did die didn’t you.”

Darwin: “Yes, that’s true. But what about the one with a little more vigor or a head start because of some peculiarity?”

Emma: “Such as?”

Darwin: “A puppy born with an extra-thick coat in a hot climate would be a monstrosity, but in a cold climate that would be a good adaptation.” “That puppy would have an advantage.”

Emma [Darwin playfully blocks Emma’s passage through a gate, and she objects] “Charles. “Let me go.”

Darwin: “Not until you’ve paid the toll.”

Emma: “Which is?”

Darwin: “A kiss for me rather than the dog.”

Emma: “You can make a big dog or a small dog, but you can’t produce feathers on a dog nor can you create organs as miraculous as the heart and the eyes. “That can only be the work of God.”

Darwin: [responds by kissing Emma, thereby avoiding a rejoinder]

Scene shifts to home

Darwin [Dressing to go out]: “These blasted ties.”

Erasmus [reading from Darwin’s Diary]: “Marry. Not marry? Mary. Children if it pleases God.

Darwin: “Give me that. Its private.”

Erasmus: “I’m your brother; you’ve no secrets from me.”

Darwin: “Yes, I do; I have secrets from everybody. Give it to me.”

Erasmus – holding behind his back Darwin’s note book

“Thank you, Garmon.” [telling the butler to leave so they can talk in private]

Reading from Darwin’s writings: “Constant companion and friend in old age.”

Darwin: “Ras. (sighs)

Erasmus: “Object to be loved and played with better than a dog anyhow. (laughing) You old romantic.”

Drawn: “Well its intolerable to think of oneself spending ones life like a neuter bee, working, working, working.

Erasmus: “And all this is a response to your trip to Cousin Emma’s?”

Darwin: “Not necessarily.”

Erasmus: “Well you don’t know anyone else.”

[both chuckle]

Erasmus: “Now it’s true, your collection won’t be complete without that most interesting specimen in the whole series of vertebrate mammals. And why haven’t you married if it’s such an enviable state.”

Darwin: “Oh, I’m too lazy to take on anything requiring as much effort as a wife and family.”

Erasmus: “But you’re the marrying kind.”

Scene shifts to Darwin and Erasmus riding in a carriage in a bad part of London.

[Glass breaking in the carriage from a rock thrown by someone in the crowd.]

Darwin: “Good lord, what is that?”

Erasmus: [yelling as a mob surrounds the carriage from outside] “Were being mobbed.”

“They probably think we’re Poor Law Commissioners.”

Darwin: “Why would they think that?”

Erasmus: “Its enough that we’re top-hatted toffs in a smart carriage, and they’re scavenging on rubbish heaps, starving to death. Too many people, not enough food!”

Thank god we’ll always have food on our plates. Speaking of which, *I think I’ll have turbot in the white sauce.* “

Scene shifts to the restaurant where Darwin and Erasmus are having dinner sitting across one another and talking:

Darwin: “Cabbage, sprout, cauliflower – all bred from the same ancestor. Cabbage, the leaves, sprouts, the side buds; cauliflower, the flower head. All monstrously enlarged.”

Erasmus: “Sitting opposite me is that strange creature, Homo Thesis; half man, half theory.”

“A word of advice. In my entire life I have known only three women who were skeptics and two of them were not permitted in polite society. Keep your theory from Emma.”

Darwin: “Its too late. I told her...sort of...not a theory. I don't have a theory, just thoughts.

Erasmus: “How did she take it?”

Darwin: “She asked me to read her favorite part of the New Testament.....

(Erasmus laughs)

“our Savior's farewell to his disciples.

Erasmus: “You see what I mean?”

Darwin: “I am the vine, and ye are the branches. If man abide not in me”

[Bishop Wiberforce walks into the restaurant]

Erasmus: “Wilberforce's ears have pricked up!”

Darwin (softly): “If man abide not in me, he is cast forth as a branch and is withered; and men shall gather them and they shall be cast into the fire and they are burned.”

Erasmus: “And how is your *sole*? [a joke not “soul”]

Darwin: “What?”

Erasmus: “Your fish?”

r

Darwin: “Ohdelicious.”

[Scene shifts to a club after dinner]

Voice: “I understand your carriage was stoned tonight.

Darwin: “We're meeting the threat on the streets head-on. We're drilling with the Honorable Artillery Company. Gentlemen, any volunteers. In the event of riots we will back the police. Every man as the law of the land should be free to pursue his own interest in his own way.

“Yes, of course. Charge what he likes for bread or anything else for that matter. Laissez-faire. Let individuals compete and struggle for their advantages.”

[Later that night Darwin walks over to a coffee table and looks at a book. The title on the spine reads: "Malthus Population Commerce and Agriculture." Darwin picks it up and starts to read it.]

Erasmus: "Whenever I can't sleep I reach for Malthus. Or, as I prefer to think of him the Reverend T.R. Morpheus.

Darwin reads: "The natural tendency of mankind is to reproduce. Humans can double their numbers every 25 years."

Erasmus: "But they don't. A struggle for resources slows growth, and death and disease, war and famine check the population. I know the argument.

Darwin: "Yes, but don't you see, exactly the same struggle takes place throughout nature?"

"I don't know why I didn't make the connection before. Why are we not overrun with insects and frogs given the rate at which they reproduce ---the number of eggs produced by each and every female? "

Erasmus: "Nature's broom sweeps away the ugly ducklings, the runts."

Darwin: "But its not that simple. Sometimes it's the ugly ducklings that are better adapted to the situations of life. They have longer legs and can run faster. They have bigger beaks that can crack harder nuts and seeds in harsh winters. They survive, have more offspring.

"Nature selects them to pass on their traits to future generations.

Erasmus: "And where do we fit in?"

Darwin: "Hmmm. Well, the sun does not revolve around the earth Nature does not revolve around man. Man must fall into nature's cauldron. He's no deity, no exception.

"Once you accept that species can pass into one another the whole fabric totters and falls. "

Erasmus: "They'll burn you at the stake for this.

Darwin with a smile on his face: "Yes"

Erasmus: "But now you have a theory. So I said, "Don't come down the ladder, Mother; I've taken it away."

Moore: "Darwin's work began with the observation that individuals differ from each other. And these minute differences, Darwin believed might be advantageous. It might give each individual an edge when it came to getting food or finding a place to survive in nature. Darwin realized that in nature individual organisms compete for limited resources. Those with some kind of advantage in coloration, for example ...[showing black and orange beetles] or in speed [showing a gazelle] or in vision [an owl] are more likely to survive and reproduce and pass on these advantages to their off spring. Those who are less fit will not succeed.

Darwin called it “natural selection” because the forces of nature select which organisms will survive. [showing a tiger]

Stephen Jay Gould: “The survivors will be those whose variation *fortuitously* adapts them better to changing local environments. And then because they pass on those traits to their offspring the population changes. That’s natural selection; that’s all it is. It’s not a principle of progress. It’s just a principle of local adaptation. You don’t make better creatures in any cosmic sense; you make creatures that are better suited to the changing climates of their local habitats. That’s it.”

Narrator: “Darwin couldn’t actually see natural selection acting in real time but today, scientists can -----by observing the evolution of HIV, the virus that causes AIDS. “

Chapter 5: Mutation and HIV

[scene shifts to fellow bathing his face in a sink. Jeff Gustavson]

Narrator: “Jeff Gustavson has been infected with HIV for over a decade. He takes a host of medications, but to little avail: the virus keeps adapting evolving into new strains that evade the drugs.”

Gustavson: “There’s a pervasive feeling that all you have to do is take your medicine and you’ll be okay, and that really isn’t the case, you know. HIV has the capacity to evolve no matter what you give it. “

Clarence Johnson who has AIDs: “There are 19 HIV drugs on the market today, and of those 19 I’ve already been through 14 of them.

Narrator: “Clarence Johnson, too is locked in a daily struggle against the rapidly evolving virus.

Johnson: “Sometimes I feel like I’m fighting a losing battle. I haven’t given up yet but there have been times that I just want to lay down and give up, but, um I can’t leave my family behind.

Narrator: “Clarence Johnson’s doctor, Michael Saag has seen HIV evolve into new varieties over the last dozen years. The virus is constantly changing subject to the *forces* of natural selection. In the environment of patient’s body. “

Saag: “Imagine we didn’t have the concept of evolution and we started giving drugs to a patient that in the test tube looked great and all of a sudden the virus starts coming back and its not susceptible to the drugs anymore. What a mystery. How in the world did that happen? There is only one way that it happened: through evolution.

Narrator: “Once inside a patient’s white blood cells HIV replicates at an alarming rate. Billions of new viruses are spawned every day and each time it reproduces random genetic copying mistakes – mutations –result in slightly different varieties of the virus bursting forth into the blood stream. Some of these new varieties, just by chance will have traits that make them resistant to certain drugs. So when drugs enter the bloodstream natural selection favors the drug-resistant forms; they survive and reproduce. Before long, drug resistant viruses dominate in the patient’s body.

SAAG: “Evolution seems pretty easy to understand when we look at big animals. We can kind of see it, in a sense. But that’s evolution that took centuries to develop. When your talking about something like a virus that you can’t see in everyday life it’s hard to imagine how it changes. In the case of HIV, we’re talking about minutes to hours to move from one species to another. It’s mind-boggling in terms of the speed with which HIV can replicate. “

[Scene switches to nurse]

SAAG: “Clarence? How are you feeling today.”

Clarence: “I’m doing okay.

SAAG: “Great. Every time I see a patient in the back of my mind I’m thinking “What is the virus doing in the environment of that patient?”

The virus is producing itself on the order of billions of copies a day. Those few that happen to be able to work in the presence of drug say, “Hey, this is my chance,” and they emerge. So it creates the appearance that the virus has thought this through but in fact it’s just a matter of chance. It’s a matter of a virus being there that’s not susceptible to the drugs. It emerges, and the virus begins to win the war.

Narrator: “That’s just what happened to Jeff Gustavson. Each time he tried a new drug, the virus evolved to resist it. Even a cocktail of multiple drugs made little difference.

Gustavson: “Here’s this puny little virus that doesn’t have a brain and yet it can outwit some of the top scientists in the world.

All the virus has going for it is it can’t copy itself too well. I mean, that’s pretty awe-inspiring and scary.

Stephen Jay Gould: “All that’s happening at least under Darwinian natural selection ---is that organisms are struggling in some metaphorical and unconscious sense for reproductive success, however it happens.

Daniel Dennett: “The process of natural selection feeds on *randomness*. It feeds on *accident* and contingency and it gradually improves the fit between whatever organisms there are and the environment in which they’re being selected. But there’s no predictability about what particular accidents are going to be exploited in this process.”

Narrator: “For millions of HIV patients, evolution is the enemy. If only there were a way to take advantage of natural selection to make it work in a patient’s favor. In 1997 at Goethe University in Frankfurt, Germany a researcher may have discovered such a way.....quite accidentally.

Veronica Miller, Goethe University): We had a patient and even though he was being treated with five drugs his virus replication could not be controlled and at the same time he was suffering from a lot of side effects of the medications., So at that point he’s asked his physician if it wouldn’t make sense to just stop taking the drugs for a while since he was really having nothing much from them other than the toxicities he was experiencing.

Narrator: “After three months off drugs the patient’s virus population was tested for drug resistance. Dr. Miller could not believe the results.

Miller: “At first I thought a mistake had happened because the lab that did the resistance test was not able to detect any resistance whatsoever in this virus sample. We sent a second sample and this result was confirmed. Within a matter of three months his virus population had changed completely from being resistant to every single drug to appearing to be susceptible to every single drug that we currently have.

Narrator: “Here’s what had happened. With drugs present in the patients blood stream only the drug-resistant strains of the virus could replicate. But some of the non-resistant virus – the “wild type” ---still lingered in the white blood cells. Then the patient stopped taking drugs the environment changed and the wild type came back. It replicated extremely rapidly and soon outnumbered the drug-resistant strains. In Darwinian terms the wild type virus was more fit in this drug free environment.

Narrator: Dr. Miller’s findings have led to a new experimental treatment strategy ---take a patient off drugs for a time and if the virus reverts to the nonresistant wild type hit it hard with a combination of drugs.

Saag: “Clarence, How are you? The concept of a treatment interruption is a new strategy that we might be able to apply in Clarence’s case but we’ve just got to make sure that we aren’t putting him at too much risk if we choose that route. so one of the options is to take all the drugs away for a while, let the virus spring back into its natural state of not having any mutations and then pounce on it again with the regimen --- and it might even be the same regimen that we used before.

On first blush, the evolution back to wild type would seem to be a great thing: the drugs all of a sudden can work again. But it’s a double-edged sword: as the virus goes back to wild type, it becomes more dangerous for the host--- it’s a much more effective killer of cells.

And so we have to find a way to balance those two things out.

Narrator: Jeff Gustavson is also beginning a treatment interruption ---despite the risks.

Gustavson: I feel like I’ve played all the cards that I have in my hand with the medicines that are available. I feel like its worth the risk to try and take another card or a different strategy and just stop taking medicine altogether and hope that the next time that I do go on medicine that it will actually work.

Narrator: “After five weeks off drugs Clarence Johnson is enjoying being free – at least temporarily --- from their debilitating effects. If the wild type virus is staging a comeback it doesn’t it doesn’t et appear to be affecting his immune system.

SAAG: “We took a bit of a gamble. I think, so far, you know, it’s paid off. And the virus has gone from being resistant to certain drugs and now that population has shifted so that now they’re susceptible again. What I hope for Clarence is that we can find the right course ,,,find a way to stretch his survival out even further so that he’s healthy and happy until the next new approach to treatment is about to get him to a point where he can live to 80.

Johnson: “My greatest hope is that when I do go back on medications those drugs will bring my viral count down to an undetectable amount I don’t know what it feels like to be undetectable so that would be a great experience.

Narrator: “Six weeks into his treatment interruption Jeff Gustavson’s virus also has changed to the drug susceptible wild type. He’s now on a new course of medication, and responding well.

SASG: “From day one of this epidemic we were put into a Race with HIV. Over the last decade or so we’ve been catching up: we’ve learned a lot about it; we’ve scouted out the enemy; we’ve learned how it replicates; we’ve learned how it tries to survive; we learned how it evolves. And were now taking those principles that we’ve learned and applying them to putting the brakes on the virus in its race.”

Chapter 6: Complexity

Scene shifts back to Down House, Kent spring 1844, Darwin is visited by Erasmus after Darwin has moved into his new house in Kent:

Erasmus: “Thought I’d surprise you.”

Darwin: “Welcome to Down House. “

Erasmus: ”When is the moat to be dug?

Darwin: “When the drawbridge is in place.”

Erasmus: “Who are you trying to keep out, Charlie?”

Darwin: “Everyone – especially you.

Emma: “Ras, what a wonderful surprise!

Erasmus: “My dear, what a journey. Nature abhors a journey of 16 miles almost as much as a vacuum.”

[Darwin is married and holding in his arms his young daughter, Annie]

Hello, Annie.

[scene shifts to the parlor where games are being played with Darwin’s young son, William wearing a blindfold. William is playing blind-mans bluff.]

Darwin: “I’ve thought of a name for the new village – ‘Down in the mouth’”

Darwin’s son who is blindfolded is chasing after Erasmus:

William: I can find you really easily If you speak. “

Erasmus: “shhhhhh ...How’s your work progressing?”

Darwin: “I’ve sent the manuscript off to be copied. I’ve no idea what I’m going to do with it when it comes back.

William: Who is still blindfolded: “Everyone be quiet.”

Emma says: “Aren’t we glad we’re not blind? If you’re blind you can’t see the sky ...or the flowers.

Darwin: “Or anything else for that matter.”

William: “I can get any of you any time I want!

Erasmus: “Well, go on then!

Emma: “We feel sorry for moles, don’t we?

Darwin: “Moles don’t need to be able to see because they live underground. That’s why their eyes have got smaller and smaller and owls’ have got bigger and bigger.

William: “Everyone’s always talking about eyes all the time.

[Running out into the yard]

Darwin to Emma: “I’m going to talk to William, hmmm?”

Servant [Brodie carries Annie out into the yard yelling: “William, wait for us!”

Darwin: “She will soon talk him around. She has the knack.

Erasmus to Darwin: “You look pale.

Darwin: My stomach rejects food. I’m not strong anymore. I’ll never achieve anything in science now. “

Erasmus: “What rot!”

Erasmus: “Your coming back to London with me.

Darwin: “No, I’m not.”

Erasmus: “Yes, you are ---I’m not letting you stagnate down here while your rivals make all the progress. You must visit your publisher.”

Darwin: “You don’t understand, Ras. Even when I talk about my theory with you, I feel like I’m confessing a murder. No, I can’t publish.”

Erasmus: “Well, you’re coming back to London with me, Charlie whether you like it or not. If only to remind the opposition your still alive and kicking!

Emma to Charles as he gets in the coach for London: “Take care and make sure you get plenty of rest. Erasmus, he’s not to spend all night at the club with you. I mean it, or he’ll be utterly done for the next day.”

Erasmus: “Yes, Mother.” “Don’t worry, it’ll do him good.

[Scene shifts to institution of science]

Erasmus to Darwin in a hall as Darwin stoops to look at a picture on the wall: “Come on. Your sloth awaits you, sir.”

Darwin as they enter the laboratory of Richard Owen that has the fossil skeleton of the giant sloth Darwin collected in South America: “What a magnificent beast, eh, Ras? My word, Owen’s done a remarkable job. He really is a splendid specimen. “

Richard Owen: “Yes, I thought you’d be pleased. Come through, see what I’ve been working on. The chimpanzee being the highest organized four-handed ape every difference between its anatomy and a human’s is instructive. I’ve been studying for example [looking at the carcass of a great ape lying on an examining table] the irrational ape has doglike canines used as weapons of destruction quite unlike the masters of the animal kingdom.

Darwin: “Yes but how...

Owen: “And the human foot is of decisive taxonomic value. Our feet are made for walking upon, our hands for grasping. This brute’s hands and feet are made for nearly the same purpose. “There is a striking similarity. I’m writing a book on the subject.

Erasmus: “My brother is working on a new book, too.

Owen: “Come here let me show you what I mean.

[Looking at a paper showing the skeletal structure of all the major vertebrates including fish and birds:

“All the same pattern.”

DARWIN: “The bone structure in the hands and feet are all nearly identical.

Owen; “The blue print, if you will, THAT EXISTED FIRST IN THE CREATOR’S MIND. Of that there can be no doubt.”

DARWIN to Erasmus as they leave the lab: “Utter tosh! The similarity of structures indicates one thing and one thing only: an ancient common ancestor. Real, flesh and blood parents.”

Erasmus: “Why didn’t you say so then? You must publish your ideas. If only to establish your priority. What’s holding you back?”

[Darwin does not answer]

[Scene shifts to Emma playing an intricate classical piece on the piano. Darwin enters]

Emma: [stops playing]: “What is it?”

“I’ve completed a sketch of my species theory. I believe it’s a considerable step in science. If anything should happen to me....If I should diePlease, my love, its important. If anything should happen to me Id like you to see to it that it gets published. 400 pounds should be enough to see it printed and promoted.

Emma: “Nothings going to happen to you.

[Later Emma is reading a part of Darwin’s sketch and stops to ask a question]:

“You say here that the human eye “may *possibly* have been acquired by gradual selection of slight but, in each case, useful deviations. “

Darwin: “Yes”

Emma: “That’s a very great assumption, Charles.”

Darwin: “Well, if I’m wrong about that, I’m wrong about everything. My entire theory’s in ruins.”

Emma: “Can your theory account for the way my eyes and ears and hands and heart combine to reproduce the sounds that Chopin heard in his head? Isn’t that a God-given gift?”

Darwin: “Its given. But not, I think, by God.”

Emma: “You are a man of science. You don’t want to believe anything until it’s proved. But some things are beyond proof. It would be a nightmare to me if I thought we didn’t belong to each other forever in Heaven.”

Darwin: He looks at Emma and has no response.

Moore: “Emma was a sincere believer in the Christian plan of salvation. and that those who trusted in Jesus and his resurrection from the dead would spend eternity in Heaven. *She saw that her husband’s speculations about the origins of species and of humanity would jeopardize the Christian plan of salvation.* God was being made remote in her husband’s universe. Now, if nature by itself, unaided by God could *make* an eye, then what else couldn’t nature do?

Then what else couldn’t nature do? Nature could do anything – it could make everything.

Ken Miller: “In Darwin’s day, the very existence of an organ of extreme perfection like the eye was taken by many as proof of God, as proof of a designer. How else could all of the intricate organs and substructures of the eye have come together in just the right way to make vision so possible and so perfect? But it turns out the eye isn’t exactly perfect, after all.”

“In fact, the eye contains profound optical imperfections. And those imperfections are *proof, in a sense* of the evolutionary ancestry of the eye.

Narrator: “Eyes are imperfect because evolution *does not create things* the way a designer or an artist does. Natural selection simply favors random changes that make an organism more fit to survive, and imperfections in design often result from evolution’s constant tinkering. One such imperfection proved traumatic for artist Valerie Young.

Valerie Young: “We had just come home from a party and I saw a lot of lights flashing inside my eye ---especially on the outside edge of the right eye. And I thought, “We may be in trouble here.” And it took me a while to really see that it was my ...this was coming from inside my eye. Luckily, my husband was with me, because I wouldn’t have been able to drive to the hospital. So my vision was pretty obscured. The only way I can describe it is like a jellyfish with lots of little bubbles in it and it just kept turning and floating in front of my eyes.

Narrator: “Valerie had a retinal tear –not an uncommon problem due to the way human eyes evolved, from light-sensing patches of brain tissue in our ancient ancestors.

“In the human embryo eyes develop from bulges in the brain’s neural tube that pinch in to form cavities. This top layer, the retina ---which tore in Valerie Young’s eye – contains cells that collect light. It rests against a second, darker layer that lines the back of the eye. But the two layers are not attached to one another. And when the jelly that fills the eye liquefies as we age it can cause the retina to tear. The jelly can then seep into the space underneath the retina leading to a retinal detachment and, in some cases, blindness.

Physician: “When Valerie Yong came in her floaters were an immediate clue that she could have a retinal tear. We were able to successfully apply laser treatment in the office that day to seal it off, like applying sandbags around something to wall it off so that the vitreous jelly would not get in the break and detach her retina.

Narrator: Valerie Young’s retinal tear is just one example of imperfections in the design of human eyes.

Narrator: “Another occurs because nerve cells and blood vessels evolved to lie in front of the retina where they interfere with its ability to form sharp images. Its like trying to take a picture through a foggy piece of glass. And the optic nerve itself evolved to connect to the brain through a hole in the retina. So the eyes of all vertebrates have a small blind spot ---right near the middle of the visual field.

Kenneth Miller: “Evolution starts with what’s already there tinkers with it and modifies it but can never do a grand redesign. So even the eye, with all of its optical perfection has clues to the fact that its origin is of the blind process of natural selection. [showing the eye of a cephalopod and eye of a frog].

Narrator: “Darwin believed that what he called “an organ of extreme complexity,” like the eye could evolve by small steps, given enough time. Any trait that improved vision would aid in the search for food, or a mate or in the avoidance of predators so natural selection would most certainly favor those traits. ”

Stephen Jay Gould: “And what Darwin was able to do was to point out that you might think, in logic that its difficult to *imagine* a set of intermediary stages between the simplest little spot of nerve cells that can perceive light to a lens-forming eye that makes complex images. But, in fact, these intermediary forms do exist in nature.

Chapter 7: How the Eye Evolved

Narrator: “At the university of Lund in Sweden zoologist Dan-Eric *Nilsson* *has developed models to show* how a primitive eyespot *could* evolve through intermediate stages to become a complex humanlike eyes in less than a half a million years.

Nilsson: “I’ve been interested in eye evolution for a long time. In particular, I’ve been interested in the question of *how long* it would take for an eye to evolve.

Narrator: “Nilsson envisioned a sequence of stages by which a flat patch of light-sensitive cells on an animal’s skin *could* evolve into a camera-type eye. As a first step nature *would* favor any changes that made the flat patch more cuplike.

Nilsson: “As soon as you’ve *created* even the slightest depression in the center means that the edges of the cup will actually shade light from parts of the environment. And of course, all the light-sensitive cells in this little cup they won’t measure light in exactly the same direction so already this cup has some pictorial information.

Narrator: “Another *model* demonstrates what a primitive cup-eye can do. The brightly lighted skulls cast an image on a translucent screen *Nilsson installs* at the back of the cup to act like a retina. But the image is not at all well defined. The cup-eye can do little more than detect movement. This kind of eye can be found in nature today, in flatworms. *Their eyes evolved no further.* In their environment, that’s all they needed.”

Nilsson: “But if the animals need to move faster or evolve to become fast predators or to see other fast predators then the *construction* needs to be improved. And one way of doing that is to constrict the opening to make it smaller.

Narrator: “That’s just what happened to creatures like the chambered nautilus. Over thousands of generations natural selection favored those with slightly more constricted eye openings which focused light more sharply. This worked well up to a point.

Nilsson: “Since this *strategy* of making a sharp image also has the drawback of creating a very dim image its not very popular in the animal kingdom. And, there is an alternative solution , which has become very popular in the animal kingdom, the solution that we use in our own eyes and that is to put in a lens.

Narrator: “Nilsson’s model lens uses two thin layers of clear plastic. He can inject water in between them to make the plastic windows bulge out like a convex lens. This mimics what natural selection *might have* done over a few hundred thousand generations favoring animals with a rounded, transparent layer in their eyes that caused light to be focused more sharply on the retina.

Nilsson: “So *we can make it gradually from no lens* at all and just continue to inject more water making the lenses bulge more and more and the image becomes gradually sharper and sharper. So we can go all the way, *gradually, in very small steps* from a simple pigment cup-eye which has barely got the ability to determine the direction of a light source all the way to a complete camera-type eye of the same type as we have ourselves. And that is really exactly the way eye evolution *must* proceed.

Narrator: “The extreme complexity of the eye left Darwin “in a cold sweat” he wrote to a friend. But *still he was convinced* that an eye could be formed by natural selection. He later wrote that eyes *must* have evolved by “numerous gradations from an imperfect and simple eye to one perfect and complex with each grade being useful to its possessor.”

“Nature, unaided by a designer, *could* produce an organ of seemingly miraculous complexity.”

Chapter 8. God

Scene shifts to Down House 1850

Darwin’s in his lab looking in a microscope, when his daughter Annie comes in.

Darwin: “Annie. come and look; When I first started looking I thought lots of barnacles had tiny parasites - that’s an animal or plant that lives on another animal or plant and gets its food from it.----like mistletoe on an apple tree. But they’re not. Do you know what they are?

Annie: No

Darwin: “They’re little, tiny husbands. The females carry little, tiny males around with them clinging to their skirt tails.

Annie: “Just like you and Mama.

Darwin: “Just like me and Mama. I think it’s the most interesting barnacle in the whole wide world. What do you think we should call it?

Annie: “Barnabus.”

Darwin: “Barney for short.

[scene shifts to Darwin walking down the road with Erasmus talking about the barnacles]

Darwin: “The tiny parasitic males are rudimentary in a way that I believe can hardly be equaled in the whole of the animal kingdom. They have no mouth or stomach. They are really no more than a tiny head atop an enormous coiled penis.

Erasmus: “A bit like me, really. apart from the bit about the mouth and the stomach.

(both laughing)

Emma says when Darwin starts gasping: “Erasmus, take him home!

Erasmus at home: “Why must you work so hard at your horrid little mollusks?

Darwin: “They’re not horrid little mollusks they’re horrid little crustaceans. And I have horrid pigeons and horrid worms, too. They’re providing the evidence I need for my theory.

I don’t have the right to publish the idea unless I have the evidence.”

Erasmus: “We must do something about you.

Doctor: “Your stomach condition is nervous in origin, brought on as a result of excessive mental exertion. Cold water is used to stimulate the circulation and draw the blood supply away from the inflamed nerves of the stomach. No sugar, no salt, no bacon no alcohol, no tobacco. In fact, anything at all that’s good is forbidden.

[scene shifts to children playing in the yard with Darwin and family after an apparent cure of his illness.]

Darwin: “I don’t know how or why but I feel so much better. I look around me and I don’t care two hoots how any of this came to be created. Children! Last one back to the house is a rice pudding. Come on William, you’re last! Come on run, quick, quick, quick. Come on, Etty.

Darwin calls to Annie as they run home:
(laughing)

“Come here my darling. (gives her a big hug)

“Oh, Annie, my dear and good child!”

Scene shifts to People in Church singing Rock of Ages.

Congregation: “While I draw this fleeing breath

(Erasmus singing loudly, out of tune and out of sync. He is making an obvious spectacle of himself in Church.)

Erasmus: “When my eyelids close in death, When I soar through tracts unknown (children giggling at Erasmus)

“See Thee on they judgment throne, Rock of Ages, cleft for me Let me hide myself in thee.

(Erasmus hides his eyes and children giggle and laugh noisily.)

Erasmus and Congregation: “Amen.”

[Scene shifts to Darwin’s home at night. Annie is ill.]

William opening Darwin’s bed room door:

“Papa, Annie’s woke me up. Annie’s woke me up. Mum, wake up, wake up, Annie’s crying.”

[In Annies bed room. Annie is crying softly in bed]

Darwin: “Oh, now, what’s the matter, my darling?”

Emma: “What’s wrong darling. Does your head hurt.”

Darwin: “Ah, there’s no fever.”

Emma: “Does it hurt here? (Annie groans in pain)

Darwin: “That’s all right my darling. You’ll be all right.

Emma coming up the stairs: “The doctor’s coming. You go and get dressed. I’ll stay with her.

Darwin: “What if she’s inherited my wretched digestion?”

Emma: “She’ll be fine.

[Scene shifts to Darwin’s lab as doctor leaves the house]

Darwin: “What did he say?”

Emma: “It is her stomach, but he has no idea what’s wrong.

Darwin: “Perhaps I should take her to go see Dr. Gully. He cured me.”

Scene shifts to Doctors carriage:

Emma to Annie as they walk to the Doctor’s carriage: “You’ll be back soon and Papa will look after you. Soon there will be a new baby and I shall need your help. Say goodbye to Etty now.”

[Darwin lifts Annie and puts her in the carriage.

Darwin: “Now I want you to sit up. Now, come on, girl, take one big gulp of this. Come on that’s a good girl. Oh, quickly.

[Annie crying and vomiting the medicine]

Darwin: “Come on, lie back. That’s a good girl.

Darwin to the doctor: “She seems so weak. Isn’t there anything you can do?”

Doctor: “All you can do is pray.

Darwin [looking at the doctor vacantly] “It’s my fault. First-cousin marriages always produce weak children. Its my fault.”

Annie dies.

Emma [outside in the rain screaming and sobbing hysterically]:

“WHY?! WHY?!”

Doctor [trying to console Darwin in his grief]: “I give the cause of death as bilious fever with a typhoid character.

The Lord giveth and the Lord taketh away.”

Darwin [pushing him away] “Please ! Don’t”

[Erasmus opens the door for Darwin to enter his home. Erasmus’ wife comes down the stairs and says as she takes him in her arms:

“Oh, Charles, God grant us strength.

(weeping)

Scene shifts to Darwin walking to funeral service at church with family.

They get to the front door of the Church and Darwin looks up at its facade.

Emma: “Please, Charles, please.

Darwin refuses to go into the church with the rest of his family. He stays outside.

Emma: “Come along, children.”

(Church organ playing “All things Bright and Beautiful”

CONGREGATION (INSIDE CHURCH): “All things bright and beautiful. All creatures great and small. All things wise and wonderful The Lord God made them all.”

Moore: “What Amy’s death did to Darwin’s faith *was mainly to destroy Christianity*. He could no longer see that a good God ordered and superintended all the events of human life and of the universe. And he believed that she did not deserve punishment by God or by nature either. She had simply fallen victim to the struggle for existence. The amoral purposeless struggle that ran according to the laws of nature.”

Gould: Darwin certainly didn’t think that evolution spoke either for or against the unprovable existence of God or a form of God.

“He didn’t desire to cast disparagement on anyone’s religious convictions. He regarded it as a private matter which he was never able to hold with conventional zeal following the tragedy of his life.”

[Scene shifts from Annie’s grave stone back to children’s choir singing:

“All things bright and beautiful, All creatures great and small, All things wise and wonderful, The lord God made them all. The purple-headed mountains, the river running by”

Chapter 9: A Scientist Discusses Religion

Narrator: “Today scientists hold all conceivable views on religion: from Atheism, to agnosticism, to a general spirituality. And many, like biologist Ken Miller adhere to very traditional beliefs.”

Ken Miller sitting in church by himself: “I’m an orthodox Catholic and I’m an *orthodox Darwinist*. My idea of God is a supreme being who acts *in concert with* the principles and ideas that Darwin explained to us about the origin of species. My students often ask me: ‘You say you believe in God, but what kind of God?’ Is it a fashionable new age God, a pyramid-power kind of God? Do you think like some scientists do that God is the sum total of the laws of physics? And I shake those off and say my religious belief is entirely *conventional*.”

[Scene shows Miller praying in Church with his hands held out in supplication saying the Lord’s prayer along with the rest of the congregation.

PRIEST AND CONGREGATION: “Our Father who art in heaven, Hallowed be thy name, Thy Kingdom come .

Miller: “It surprises students very often that anyone could say that kind of very *conventional religious belief* could be compatible with evolution, *but it is*.

PRIEST: ... peace and unity of your Kingdom where you live forever and ever.”

CONGREGATION AND MILLER: “Amen”

“I find this absolutely wonderful consistency with what I understand about the universe from science and what I find about the universe from faith.”

ANNOUNCER (on radio): “Tennessee’s premier morning radio talk show.”

“The Haller in Hilton Hill Morning Show [in Knoxville] on News Talk 99, WNOX- AM/Fm, Loudon/ Knoxville.

“12 past the hour of 6:00 am. Its my pleasure to welcome to the braodcast this morning Dr. Kenneth Miller. Hes a professor of biolgoy at Brown University. His book is entitled Finding Darwin’s God: A scientists search for Common Ground between God and Evolution. Hes in town tonight.

Talk Show Host: Let me ask you this: as a cellular biologist when in your experience are you studying something reading something or doing some research ... when do you come to the point where you go, “That’s God”?

Miller: “As an experimental scientist, I don’t find God in the insufficiency of science to explain things. In other words, I don’t find God in ignorance; I don’t find God because we say “Well, we can’t explain thatthat must be something that God’s doing.”

Host: “But what did God do? Did he just create some kind of primordial soup and say, “Go”?

Miller: “Well, a long time ago people were sufficiently unknowing of how things worked in the natural world to see when the Sun moved across the sky they imagined that God had to push that sun across the sky. And gradually *we began to realize that the world works according to physical laws*.

“So what room is there for God in present day life? Well, I think if you ask people who are believers, How does God act, they would say he acts in a variety of ways ---he answers our

prayers, he inspires us. No doubt there are events that take place that are part of what some people might call “God’s plan.” And what I would suggest is if you look back in Earth’s history if God is working today in concert with the laws of nature --- with physical laws and so forth--- He *probably worked in concert with them* in the past. In a sense in a sense, He’s the guy who made up the rules of the game and He manages to act within those rules.”

Scene shifts to stained glass window in a church showing Mary and the Christ child.

Narrator: “For Miller, and millions of followers of all major religions notions of God and evolution are fully compatible.”

CONGREGATION: “You take away the sins of

Narrator: “But not everyone agrees.

Dennett: “When we replace the traditional idea of God, the creator, with the idea of the process of natural selection doing the creating, the creation is as wonderful as it ever was. All that great design work had to be done. It just wasn’t done by an individual: it was done by this huge process distributed over billions of years.

Priest: “God created man in His image. In the image of God He created him. Male and female, He created them.

Dennett: Whereas people used to think of meaning coming from on high and being ordained from the top down now we have Darwin saying, “No, all of this design can happen. all of this purpose can emerge from the bottom up, without any direction at all.“ And that’s a very unsettling thought for many people.

Moore: “In Darwin’s day, science and politics and religion were all of a piece...when you talked about the origins of life and of species. Astronomy could go along pretty well, because it could testify to the wisdom and power of God in holding the planets in place, but the idea of evolution o. “transmutation,” people said with a snarl put in jeopardy the whole established social order.

Chapter 10: The Human Question

[Scene shifts to dinning room of the Athenaeum Club, London 1856]

Voice: What is in this “Big book” of his do you think?

Another voice: “Transmutation. (sighing). “Another Darwin blotting God out of creation. We want to support your scheme for a museum of natural history. Some people see it as rash, extravagant, grandiose.”

Another voice: “If it’s grand, its because it should house as wide a display as possible.

Bishop Wilberforce: “But we need your help in return. It is up to you as the country’s leading anatomist and paleontologist to prove man’s superiority. We won’t have street ruffians tout man’s monkey origin in her Majesty’s museums.

Another voice: “You can rely on me, Bishop Wilberforce.

Owen: “The human brain differs markedly from that of all other mammals. In man, not only do the cerebral hemispheres overlap, the olfactory lobes and the cerebellum ...but they extend in advance of the one and farther back than the other. Their posterior development is so marked, that I have assigned to that part of the character of a third lobe peculiar to Homo sapiens; the hippocampus minor.

(audience murmuring)

“Peculiar mental faculties are associated with this highest form of brain, and I am led, therefore to regard man not merely as representative of a distinct subclass ...

(approving laughter)

“but as the inhabitant of one reserved for him alone. The human brain is in itself proof of man’s moral and religious faculties. Such are the powers with which we, and we alone, are gifted.”

(audience cheering)

Darwin: [whispering to Thomas Huxley]: “I wonder what a chimpanzee would have to say about that, Mr. Huxley.

Huxley: “I think it’s priceless. His theory is a house built on sand, a Corinthian portico on cow dung.

Darwin: Yes. Damn all the sanctimonious meddlers who try and stifle troublesome research.

The ultimate court of appeal of science is observation and experiment not authority, wealth and rank. Your disagreements with Owen should not be personal.”

Huxley: “I can’t help it. He’s so pompous. The prospect of his slipping on one of his pickled brains is just too good to be true.

Darwin: “Bad feelings will only cloud the issue and lead to bad science.

Huxley: “Tell that to Owen.”

Erasmus: “Huxley’s saying in public what you think in private. Charles, you’ve stalled long enough. You’ve collected enough barnacles to sink a ship of the line. Meanwhile you’re being upstaged.

Darwin: “That’s not important. My book is the thing. once my work is done.

Erasmus: “ Will it deal with man?”

Darwin: “It’s too surrounded by prejudices.

Erasmus: “Well whether it does or it doesn’t you must publish.

[Scene shifts to Darwin and Erasmus at breakfast table. Darwin reading Wallaces manuscript]

Darwin: “Oh my God. Ras

Erasmus: “Who is Alfred Wallace?”

Darwin: “My dear Huxley it’s like a precis of my theory. All my originality whatever it’s worth has been smashed. Had Wallace a copy of the essay I’d written in 44 in front of him he couldn’t have written a better short abstract! Variations being pushed further and further from parent species by a struggle for existenceoverpopulation ,,its all there.

Huxley: “Is your book ready for publication? Publish!”

Darwin: “how can I publish .. Honorably? I’d sooner burn the blasted thing than have him or anyone else, think that I behaved in a paltry spirit.”

Huxley: “Then publish a joint paper, excerpts from your work along with Wallace’s essay. And then you must prepare a manuscript for publication. Who knows it may all be for the best. At last we’ll finally get to learn your views in full.”

[scene shifts to Darwin having a bad dream.]

Darwin [to Emma]: “This book will be the death of me. What a miserable wretch I’d be without you near me.”

Darwin in study and lab

Darwin [reading from introduction of his book]: “When on board HMS Beagle as naturalist I was much struck with certain facts in the distribution of the organic being inhabiting South America and the geological relations of the present to the past inhabitants of that continent. These facts seemed to throw some light on the origin of species that mystery of mysteries.

[Scene shifts to Darwin opening his new published book.]

Emma: The title is very positive.

Darwin: “I should think so – it’s Huxley. The Athenaeum wants me tried, in the Divinity Hall, the College the lecture room and the museum. My book is no more unorthodox than the subject demands. I don’t discuss the origins of man, I don’t discuss Genesis.

Emma: “Charles, don’t be so naïve. Its clear you think man is no exception. Whether your right or wrong you must finish what you started.

[Scene shifts to carriage in the street.]

Owen: [hailing Darwin in the street]: “Darwin? How dare you?! How dare you paint me as a reactionary?!”

Darwin: “I didn’t paint you as a reactionary.

Owen: How dare you put my name with the defenders of immutability? Is my concept of the ordained continuous becoming of living things to be ignored?

Darwin: “But what does it mean? It means animals appearing out of thin air!

Owen: Not at all! You believe that selection is the only possible creative law. Pure chance – the roll of the dice. In fact, new species are created by natural birth according to God’s law!

Darwin: “Well I don’t believe

Owen: “I know who’s put you up to this. Huxley!

Darwin: Please Richard

Owen: I will have absolutely no truck with the Huxleys of this world and nor should you!

Darwin: Its an abuse of science.

Owen: “You should be ashamed of yourself! Your book is and an insult to humanity. Its nihilism! Only a man devoid of a soul could find solace in a bestial ancestry.

[Wilberforce walks away. Darwin walks up the steps to Huxley’s house and is greeted at the door by a laughing Huxley.]

Huxley: “Well, its as respectable to be modified monkey as modified dirt.

Darwin: “Huxley, please

Huxley: “I think it’s splendid. Old ladies of both sexes say it’s a dangerous book.

Darwin: “Splendid.”

Huxley: “Don’t worry. I’ll deal with him. I’m sharpening my beak and claws in readiness.

Darwin (sighs)

[scene is at the gathering of the Athenaeum]

Owen: “Any contribution to our natural history from the pen of Mr. Charles Darwin is certain to command attention. His latest publication, the Origin of Species is manifestly regarded by him as the opus upon which his future fame is to rest. Mr. Darwin claims that every living thing --- every fish, plant, fungus (audience laughing) fly, elephant, man, (laughter and applause), turnip are all equally the lineal descendants of the same common ancestor. Such a notion is absolutely incompatible with the word of God.

Men: “Hear, hear.

Owen: “Man was made in the image of God and redeemed by the Eternal Son. Natural selection is an ingenious theory for denying the working, and therefore the existence, of the Creator. In fact, the human brain differs markedly from that of all other mammals.

Huxley: “Unfortunately, my Lord Bishop you have been misinformed. If we are unprejudiced judges we have to admit that there is as little interval – as animals -- between the gorilla and the man as there is between the gorilla and the baboon. It is ... it is speech alone, and not some spiritual gift that makes man a reasonable being. That is the source of our unlimited intellectual progress. But that does not disguise the fact that to the very root and foundation of his nature man is one with the rest of the organic world. (booing and jeering).

No one ... no one who has ever dissected the brain of an ape agrees with Professor Owen. His findings are wrong. I can only assume that Professor Owen’s brain must have shrunk in the pickling jar.

[scene shifts to Darwin’s lab and Huxley amplifies on his speech]

Huxley: “I mean of course the chimpanzees’ brains he had examined.”

Darwin: “Oh, Lord!

Huxley: “It was then that God delivered Wilberforce into my hands.
[Scene shifts back to Athenaeum

(audience clamoring)

[Owens rises]

Owen: “I wonder, Mr. Huxley. Is it through your grandfather or your grandmother that you claim descent from an ape?”

(applause)

Huxley is relating the debate to Darwin:

Huxley: “I stood up very quiet, very grave and said my say with perfect good temper.

“If the question, if the question is put to me would I rather have a miserable ape for a grandfather or a man, highly intelligent possessed of great means of influence and yet who employed these faculties and that influence for the mere purpose of introducing ridicule into a grave scientific discussion I unhesitatingly affirm my preference for the ape.”

Darwin: You didn’t

Huxley: I said that, or something very like that.

Darwin: “How dare you attack a live bishop in public? Have you no respect for the purple waist coat?”

Huxley: Lady Browser fainted, had to be carried from the room. And then Admiral FitzRoy got to his feet.

FitzRoy: Holding the Bible: “This! Believe in this! Believe in God, not man!”

Darwin: “Oh, my.

Darwin walking in the garden with Erasmus:

Darwin: “We’ll probably never know the truth.

Erasmus: “Well, the truth, Charles, is in your book. It’s the most interesting thing I’ve ever read. The reasoning is so entirely satisfactory to me that ... if the facts don’t fit then, well so much the worse for the facts. [holding up his hand showing a shake or twitch perhaps from his drug addiction] The shakes. Time I was naturally selected.

Dennett: “For more than a century, people have often thought that the conclusion to draw from Darwin’s vision is that Homo sapiens, our species that we’re just animals too, we’re just mammals; that there is nothing morally special about us. I myself don’t think this follows at all from Darwin’s vision, but it is certainly the received view in many quarters.”

Narrator: “Ever since the origin of species was published strict believers in biblical creation have attacked Darwin’s vision.

Shows books that have attacked it: “Darwin on Trial, The Collapse of Evolution, The Creation Evolution Controversy.....”

Narrator: “Their concerns aren’t only about the science of evolution. At stake many believe is nothing less than the human soul.”

Moore: “To suggest that animals and plants and us, humans, came into being in a natural law-like way, in the way the planets move was to put in jeopardy the human soul. And the human soul is the crux of the matter because if we are not different from animals if we don’t live forever in heaven or in hell then why should we behave other than like animals in this life?”

Chapter 11: Humans and the Tree of Life

David Page of the Whitehead Institute:

“In the 19th century, in Darwin’s time it was audacious to claim that humans and chimps were closely related. There wasn’t that much scientific evidence. But since that time the evidence has become strong. First, we saw the fossil record appear. Evidence of human ancestors that had apelike features *established the plausibility of the idea* that humans and chimps had common ancestors. And then in the last 20 years we’ve seen the emergence of a whole new type of data that’s established a close relationship between chimps and humans. And that comes from the analysis of DNA. This is DNA. We’ve got DNA, chimps have got DNA bacteria have got DNA, petunias have got DNA, crabs have got DNA. Every living animal, plant, fish, frog has got DNA, and if we compare the DNA’s of any two species we can establish how closely related they are one to another.

[image of double helix]

Narrator: “In the early days of DNA research a double strand of DNA was extracted from each species to be compared. When heated the strands split apart. When the single strands from each

creature were put together and allowed to cool the two always combined to form the familiar double helix. The degree to which the strands mated successfully was a measure of their similarity. It turned out that human DNA and chimp DNA combined almost perfectly. Today this similarity can be seen even more precisely. DNA sequences can now be “read” letter by letter.

Page: “Here were looking at the DNA sequences of one particular gene as found in human and chimp and what’s immediately evident is that humans and chimps have DNA’s that are 98% identical. They are basically the same, there are just a couple of spelling changes.

“Why are there only a couple of spelling changes? Because we and chimps had a common ancestor only a few million years ago, and these few spelling differences have accumulated during the propagation of this DNA during those few million years. If more time had passed since we had our last common ancestor more spelling changes would have accumulated.”

Narrator: “If the same gene from a rat is compared many more spelling differences are seen. That’s because our common ancestor with the rat lived about 80 million or 100 million years ago and there’s been much more time for spelling differences to accumulate.

Narrator: “Chimpanzees and humans are made from blueprints that are 98% the same. But what about the ways humans and chimps think and act in the world? Are there similarities there as well?

Sally Boysen, Psychologist: [driving a car as a chimp in a baby seat in the passenger side pulls on a bar.]

“Boy, doing some pull-ups. Oh be careful.

Narrator: Psychologist Sally Boysen explores the commonalities between the minds of chimps and humans --- a quest that may help explain how the human mind evolved.

[scene shifts to room filled with toys one would find in a play room for kindergartners. A young chimp is playing on a ladder.]

Boysten: “The developmental milestones really, throughout the life of a chimp are almost exactly the same as humans. Everything is so similar. They respond and do new things and they have the same kinds of rough-and-tumble play.

Harper’s rough and rowdy and runs all over the place and climbs. And Emma really can almost entertain herself. One of the things that our work allows us to see is that chimpanzees can acquire very sophisticated complex cognitive skills, like learning to count, which they normally wouldn’t learn in the wild.

One, two, three, four, five!

Yes they have the requisite neural capacity to do that. *Where did that come from?*

[Scene shifts to a computer terminal where Boysten is talking to adult chimp behind a glass screen.]

“Okay, Sheeb, we’re going to do another turn now. Here we go. One of those. And a malted milk ball. Can you tell me the answer to this with blue and brown? Show me, yeah, go ahead. [Chimp hits number 2 and the response is recorded] Excellent.

“There’s almost nothing that the chimps haven’t been able to learn that we’ve tried to teach them. We’ve seen their ability to grasp extremely complex notions like the concept of zero, for example.

“Okay Sheeb look. What if I didn’t put any candy here at all? what would you say? [Chimp hits the zero button on the computer screen] Zero, that’s right. There’s no candy here. Oh, that’s too bad.”

Boysen: “There’s no way the chimps would be able to do this if they didn’t have a great deal of commonality in, literally, the neurological structure that supports their ability to learn ... just like we do.

“Those things are absolutely comparable and *had* to come from a common ancestor.”

Kenneth Miller: “The similarities that we have with our primate relatives are extraordinary. We share so much of our DNA we share so much of our morphology we even share our blood types. But for all of those similarities there are striking differences. I think the reason for this is really very simple. And that is, the line of evolution that led to us led, for reasons which we are only beginning to understand to an *explosive development of mental capacity*. And what clearly happened is that natural selection favored the evolution of organisms that could communicate, that could manipulate symbols, and could construct language.

Miller: Darwin’s great idea is a grand and marvelous explanation that shows us that we are united with every other form of life on this planet. And I find that an exciting and maybe even an ennobling way to look at things.

Chapter 12: Epilogue – Darwin’s Enshrinement Next to Newton in Westminster Abby

[scene shifts to Westminster Abby where Darwin is buried. Choir singing hymn]

Moore: “Darwin died in April 1882, at the age of 73. The family thought he would be buried in the parish church yard. Darwin had said, months before he died that he would have to look forward to it as the sweetest place on earth. It was not to be.

“In London, Darwin’s friends determined to make his death and burial a state occasion. They went to the Royal Society and they got signatures. They went to the House of Commons and got up a petition. They telegraphed the Dean of Westminster who was abroad and got his approval. A special anthem was even written for the occasion. And on the 26th of April, a week after the death Darwin’s body was borne mightily in procession down the aisle of Westminster Abbey to be interred in the shadow of the grave of Sir Isaac Newton. Darwin’s interment celebrated the vast social transformation that England was undergoing. There were new colonies, new industries and new men to run them.

“Darwin’s body was enshrined to the greater glory of these new professionals for he had naturalized creation and delivered human nature and human destiny into their hands. Society would never be the same. Darwin” vision of nature was, I believe, fundamentally a religious

vision one with which he ended his most famous work on the origin of Species. “There is grandeur in this view of life with its several powers having been originally breathed into a few forms or into one and that whilst this planet has gone cycling on according to the fixed law of gravity from so simple a beginning, endless forms most beautiful and most wonderful have been and are being evolved.

Video ends with images and these words flashed across the screen:

“Infinite possibilities”

“countless experiments”

“billions of years”

“Why are we connected to all life?” “Evolution”

“Continue the journey into where we’re from and where we’re going at the Evolution Web site.”
Visit www.pbs.org

Credits.

The consultant for the movie was “James Moore”

The Drama was based on the book “Darwin” by Adrian Desmond

Advisors included Eugenie Scott, Steven Pinker, Charles Aquadro, William H. Calvin, Sharon Emerson, Jane Goodall, Stephen Jay Gould, Sarah Blaffer-Hrdy, Don Johanson, Mary Claire King, Ken Miller, and David Wake.

A co-production of the WGBH/Nova Science Unit and Clear Blue Sky Productions copyright 2001 WGBH Educational Foundation and Clear Blue Sky Productions