Is Darwinism past its “Sell By” date?
February 6, 2009

Michael Ruse lecture presented as part of the Darwin Distinguished Lecture Series. These events are sponsored by Arizona State University, Office of the President, College of Liberal Arts and Sciences, School of Life Sciences, and the Center for Biology and Society.

Transcript

Manfred Laubichler, Professor ASU School of Life Sciences: [0:05] Welcome everybody to today's Darwin Distinguished lecture by Michael Ruse. Dr. Ruse is Lucyle T. Werkmeister Professor of Philosophy at Florida State University.

Over the last 40 years Michael Ruse has written numerous books and more or less single-handedly created the modern field of Philosophy of Biology. Michael will speak today about "Darwin at 200, Is He Past His Sell Date?"

Audience: [applause]

Dr. Michael Ruse: [0:33] Yes. OK, thank you very much for having me. This is at least my second, perhaps even my third visit to Arizona State, and I'm looking at it very enviously. Everybody thinks that Florida is nice in the winter, but when I left yesterday morning the temperature was 16 degrees.

[0:57] So it really was very nice, I mean I've been taking my clothes off non-stop. So if suddenly I decide to take off my shirt, you'll realize that it has nothing to do with sex, it's just part of an evolution as I'm going through.

Audience: [laughter]

Dr. Ruse: [1:12] "Charles Darwin at 200, Is He Past His Sell by Date?" OK, this is the person we're talking about. The person who's birthday is next Thursday. This is a portrait of Darwin about the age of 30. It is in fact a wedding portrait drawn by a man called George Richmond.

[1:35] I'd like to start right here with this picture. In fact the reason why we've got a painting rather than a photograph is that photography was only just then coming in. A first photo of Darwin is about three years later. So it was expected an appropriate, but it be a picture.

[1:55] The thing I want to draw your attention to is that in fact it's a very good painting. It's a really good quality painting, and there's a reason why it's a good quality painting is that George Richmond was the best portrait painter in England at that time. That tells you something about Darwin straight away; mainly he came from a segment of society that could afford to have the best portrait painter in England paint his portrait.

[2:22] The Darwins, they were not aristocrats, they were middle class, but they were very much upper middleclass. Not to put too fine a point on it, they were stinking rich. I mean before the crisis happened, they were "Silicon Valley rich." These people were very well off indeed.
In fact Darwin's father was a big money man, he was a physician, but it was his maternal grandfather that really counted, because his paternal grandfather was Josiah Wedgwood, the Potter.

So the Darwin's or the Darwin family had done very, very well indeed after the Industrial Revolution, and in fact Darwin added to it when at the age of 30 he married his first cousin, Emma Wedgwood, another grandchild of Josiah Wedgwood.

Now the reason why I want to emphasize this now, is apart from the envy factor, is that you shouldn't expect to find Darwin as somebody who's going to reject his banker. You should not expect to find Darwin, and you do not find him, as somebody who says, I hate society. I'll become an atheist on Friday morning, and I'll follow up with evolution on Friday afternoon. That's not Darwin at all. He's a very solid, well established and in fact much beloved English gentleman.

I think Darwin is a great revolutionary. I think that Darwin is a very great scientist who really moved our thinking forward, but he was a revolutionary, not a rebel. Darwin was not somebody who was rebelling against his society. In fact, another way of looking at him is Darwin is not the Christian God; he does not make things out of nothing. He takes the elements of his society that he knows and loves dearly, and takes these elements and rearranges them rather like a kaleidoscope, that's what makes him revolutionary.

But to understand Darwin, you must understand Darwin as an Englishman, who takes the pieces that are given to him and puts them together and rearranges them into a new picture. So that's what I mean by saying Darwin is a great revolutionary, but he is not in any sense a rebel, that I think is completely to misread Darwin and in fact the Darwinian revolution.

Now as you know, what happens is Darwin first of all intends to be a doctor. He goes to Edinburgh, he doesn't like that. So then he's packed off to the University of Cambridge, 1828-1831, where he trains to be a clergyman.

He doesn't take biology courses, well he does actually. He takes a botany course from Henslow the Botanist, but he doesn't take a biology degree because there are no biology degrees in those days. The course that he takes from Henslow is entirely voluntary and he had to pay five guineas a year to take it, so in other words it was something as it were outside the curriculum in time.

At the age of 22, 22 going on 23, Darwin gets the opportunity to take a voyage onboard HMS Beagle, and this is a painting of the Beagle. He does not have any official status on the Beagle. In fact Fitzroy the Captain was about 25, he was an aristocrat.

His uncle was Viscount Castlereagh the Foreign Minister. Fitzroy would have been a very lonely young man. He was 25, he had a ship I think there were 85 souls onboard ship. As the captain he had literally life and death command over everybody, which is fine, but it would be very lonely.

So Fitzroy was looking for a gentleman who would not be in the navy, not as it were under him, but who as it were could sit and be the captain's friend, and he could eat meals with, and that sort of thing. Darwin could afford to do this, there was family money, he was a gentleman, and so that's why Darwin goes onboard HMS Beagle.
Very quickly he kind of evolves into the ship's naturalist, and makes massive collections all down South America and then around the rest of the world. What happens is they spend some four or five years mapping the coast around South America and then they go home, but they don't go straight home. They go across the Pacific to New Zealand, Australia, South Africa, back to South America for a very short time, and then home in 1836.

So Darwin becomes the ships naturalist, or the crew used to call him "Philosop," Philosopher, meaning scientist, it was natural philosopher. So Darwin is not part of the crew, but he is the captain's friend. In fact he spends some five years going around the world on HMS Beagle. I don't think he spends more than 12-18 months actually on the Beagle, apart from everything else, Darwin is terribly seasick.

But what happens is that the Beagle puts into South America, Darwin gets off, does journeys and these sorts of things, and then the Beagle comes back from a charting expedition and Darwin joins them and they go on further down the coast, and that sort of thing. I mean he's always part of the Beagle, but the actual time that he spends on HMS Beagle is not that great.

As I'm sure that you all know, the really crucial time came when after the Beagle had done South America, they set off around the Pacific and they put into the Galapagos Archipelago, which now belongs to Ecuador, about 500 miles off the coast.

Darwin and the Captain Fitzroy are invited to supper by the Governor of the islands. The Governor tells Darwin that on these islands the giant reptiles, the giant tortoises, are different from island to island.

The islands are within 5-10 miles of each other, and the Governor tells them that nevertheless the tortoises are different, and for Darwin this is a revelation.

Now understand he does not at this point become an evolutionist, but he recognizes that there's something really important going on here.

And Darwin himself had been making collections of the birds, the mockingbirds, and the finches. These are the actual birds that Darwin, or probably his servant, actually shot. Darwin had not thought that it mattered which island they came from.

So they go back to the Beagle and if you could see these labels that Darwin had written out, I think they're in the British Museum of Natural History at the moment. If you could see them you will see that in pen Darwin had written what species they are. Then later he comes back and in pencil is trying to work out which islands he found them on.

He's trying to work out and realizing that in fact it really did matter which islands they come from. As I say, at this point Darwin does not become an evolutionist. It isn't until he gets home about a year later and he starts to show his specimens to people, and he shows these birds to a man called John Gould who was an ornithologist, in fact the leading ornithologist in England at the time.

So this shows you already Darwin is integrated right into the heart of the scientific community, right from the beginning. These are through his Cambridge connections and those sorts of things.
[10:18] And thinking about these birds, Gould says to Darwin there's no question they're different species so it's this then which tips Darwin over into becoming an evolutionist, and this is the first tree of life that we see that Darwin has actually drawn.

[10:36] Now, it's important to keep something in mind. Why was Darwin able to become an evolutionist? Well, part of the reason is that his grandfather, Erasmus, had been an evolutionist. And then when he was in Edinburgh, a man called Robert Brant was an evolutionist and had mixed with Darwin. On the Beagle voyage, Darwin read Jean Baptiste Lemarck's "Philosophie Zoologique". So Darwin wasn't the first evolutionist, he'd heard about these ideas.

[11:06] But very important for Darwin in becoming an evolutionist was his religious development. Darwin as a young man had been brought up as an Anglican, Church of England, what you call Episcopalian. And when he went on the Beagle voyage, he admitted that he was a completely, sincerely, committed Episcopalian, probably almost a Biblical literalist.

[11:28] But on the Beagle voyage, his thinking starts to change and Darwin moves from what scholars call being a theist, that is to say somebody who believes in an interfering or intervening God, which Christians do because Christians believe that God came in the form of Jesus for our eternal salvation. He moves from being a theist to being something of a deist, that is to say somebody who believes in a God who is an unmoved mover.

[11:59] A God who set it all in motion and then lets it unfold through unbroken law. A God who does not need miracles. Now, the classic deists at the end of the 18th century were the Unitarians. Unitarians deny the Trinity. Unitarians think that Jesus is a very important person, but they deny that Jesus is the son of God. They don't believe any of that, they play down miracles.

[12:26] The Wedgwoods were Unitarians. Darwin hadn't been brought up as a Unitarian but it was there in his background. Many intellectuals at the end of the 18th century and beginning of the 19th century were either Unitarians or at least deists.

[12:40] Pretty much everybody who signed the Declaration of Independence, for instance, was in fact a deist. Benjamin Franklin, all of them, including George Washington who was nominally an Episcopalian. But the lovely story is that in fact he had big problems with Jesus as the son of God. And so on Communion Sunday, George Washington would never take Communion because for him this would be blasphemous. He did not think that the bread and the wine were the body and blood of Christ.

[13:11] And finally, his vicar said to him "General Washington, don't you think you're setting an awfully bad example by not taking communion?" And Washington said you know, you're right. And so from then on, on Communion Sunday, Washington just wouldn't go to church at all. [laughter]

[13:28] So, the point I'm making is that this is very important for Darwin because now for him the mark of God is not miracle, but unbroken law. So, evolution is part and parcel of this. So, evolution is creation through unbroken law. So, Darwin is taking one element from his background, the Unitarian, deistic part of his background and, as it were, feeding this in to becoming an evolutionist.
For Darwin, becoming an evolutionist is not an act of rebellion against religion. For Darwin this is, if anything, a confirmation of a religion that he feels very comfortable with and, incidentally, a religion that he keeps right up through the writing of "The Origin." People often remark, oh the Origin talks about the Creator. Darwin believed in the Creator in 1859.

By 1870, he had become something of an agnostic, probably under the influence of Thomas Henry Huxley. Although, he never became an atheist, he never became an agnostic because of science, nobody ever did. He became an agnostic because he didn't like the idea of a God who imposes eternal punishment on people. Particularly eternal punishment for being non-believers.

Darwin thought his father was the finest man he'd ever known. His father was a non-believer and Darwin didn't want any part of a God who was going to send his father to eternal torment. I mean, it's very interesting, virtually nobody ever became a non-believer, an atheist, or an agnostic, very few became atheists, but nobody became a non-believer because of science.

They found the science congenial, but it was always after that. People had theological problems with Christianity or with religious belief so they moved to non-belief and then they found that evolution and these ideas were very congenial.

This is very much the pattern of somebody like Darwin. And it continues to this day, the main reason why I'm a non-believer is having had one headmaster in this life, I sure as hell don't want another one in the next.

So, deism then leads Darwin to being an evolutionist. Darwin is a graduate of the University of Cambridge. The greatest scientist that Cambridge had ever had was Isaac Newton 200 years before. Newton was a great scientist, but what was Newton's great contribution? It was not putting the Sun at the center, that was Copernicus. It was not making the planets go in ellipses, that was Kepler. It was not making cannon balls go in parabolas, that was Galileo.

What Newton did was tie everything together under one causal hypothesis: all bodies attract each other according to their masses and inversely proportional to the square of the distance between them.

Newton provided a cause, what they called a true cause, a vera causa, a force which explained it all. Darwin, as a graduate of the University of Cambridge, wanted to be the Newton of biology. He had not discovered evolution, but by God, he was going to find that cause.

And it's here that the Christian background for Darwin starts to kick in. And also, again and again what you're seeing is Darwin pulling together the elements. Darwin comes from rural Britain, Shropshire.

England had undergone an industrial revolution. If you have an industrial revolution, you have to have an agricultural revolution. Why? Because somebody's got to feed all those people in the cities. With fewer people on the land you've got to have much more efficient agriculture.

And people realized pretty quickly the way to efficient agriculture is by selecting. If you want shaggier sheep you breed from the shaggy sheep like this and you eat that one over there,
you eat those with very thin skins or without any hair at all. If you want a big, fat, cow you breed from these, and the weedy little runts you kill those off quickly and you don't...

[18:02] So, people learned very quickly that selection is important. The Darwin's actually kept pigeons so Darwin knew all about selection. Now, selection is important in two ways. First of all, for Darwin selection spoke immediately to what Darwin considered to be the most important aspect of the living world. And here's Darwin's Christian background, particularly his Cambridge Christian training comes in.

[18:32] Of course, Darwin had been brought up on the works of this man, Archdeacon William Paley. In 1802 Paley published the classic book, "Natural Theology," in which he puts forward the standard argument for the argument from design for God's existence. And Paley didn't invent that argument. In fact Socrates probably did all this.

[18:55] The fist person we know who had it was Socrates. So it's an old argument, but Paley is the one who makes it absolutely as it works standard. Paley says look at the eye. The eye is like a telescope. Telescopes have telescope makers. Therefore, the eye must have an eye maker, namely the Great Optician in the sky.

[19:18] Now, Darwin buys this incompletely. In fact I think right through The Origin Darwin believes in the Great Optician in the sky, except Darwin doesn't want the Great Optician to do it by hand. He wants him to do it through unbroken law.

[19:34] So in other words Darwin's modified the argument, but he buys into this and particularly Darwin buys in and always buys in to the fundamental premise of the argument from design, namely that organisms are not thrown together randomly, but they work. They function. They exhibit final causes.

[19:54] They show adaptive complexity as John Maynard Smith used to call it. So for Darwin the fundamental aspect of the living world is that it is as if design and selection speaks to this because that's precisely what selection does. You want hairy sheep, you bloody well design them. You breed from those and you don't breed from those.

[20:19] You want big, fat cattle, you breed from the big, the fattest and you kill off the skinny ones. You design it. So for Darwin artificial selection or a natural form of artificial selection is going to speak what to him is the most important aspect of the living world.

[20:35] He still can't see to get it to work in effect and it isn't until the end of September, 1838 that Darwin reads a work by another Anglican clergyman and he sees how it works. Now, Belford's and here you start to see what I mean this rebel, revolutionary notion.

[20:56] Darwin is taking something which is absolutely standard belief in... It's just coming into Victorian Britain. Queen Victoria comes to the throne in 1837. So you are going to take an absolutely standard belief but he is going to do something else with it.

[21:14] This is why Darwin is a revolutionary. Now Malthus was worried about the following theological plot. Why do we do anything at all? Why do we bother to do anything? Why don't we all live... my daughter is going to kill me on this. Why don't we all have the Emily Ruse philosophy of life.
[21:35] Emily I should say is at FSU. She is majoring in Afternoon Studies. [laughs] She likes to get up about 11:00. Breakfasts, a leisurely breakfast and you know the time it takes to clean up and everything like that. And then maybe off to a class and then back home and a certain amount of texting and all of that sort of thing.

[21:58] Then another meal and then hit the old man for $20 and then she heads out about 8:00 or 9:00 until 3:00 in the morning and she comes home and it's bedtime. So the cycle goes.

[22:09] Now, why don't we all have that kind of life? And God was worried about this but Malthus saw that God knew how to do something about it. God made our reproductive desires... I hope I'm not talking about Emily now. [laughter]

[22:25] God makes our reproductive desires stronger than our ability to provide food and space. And so what Malthus is saying is what's going to happen is everything comes crashing down in a struggle for existence when more are born than food and space supplies can support them.

[22:44] Now, Malthus' is a very conservative doctrine. Because Malthus is saying state welfare is useless. I mean, he sounds like Ronald Reagan going flat out. If you have state welfare then what's going to happen is you are just going to have more of them in the next generation. You're compounding the problem.

[23:05] So, Malthus has got a very conservative negative view. The industrialists loved this because it meant that welfare is pointless and don't give your workers too much because they'll only indulge themselves and have more offspring that won't have good thing.

[23:22] But Darwin takes this and says, A-hah, the struggle for existence which can occur universally through the animal and plant world means that many more organisms are born than can survive and reproduce.

[23:39] Only some will get through. And those that get through will on average be different from those that don't. And the reason for their success will be their distinctive peculiar characteristics. So in other words you're going to get a natural form of selection.

[23:54] So you see Darwin is taking Malthus's idea but as it were inverting it. And so now Darwin's got his vera causa, which is a force that's going to lead to evolution, the evolution of a particular kind, namely in the direction of adaptive excellence.

[24:14] These are Darwin's finches, birds that were painted actually by the ship's artist onboard the HMS Beagle and I draw your attention to their whacking, great big beaks which of course exist in order to eat cactus nuts and there are other Darwin's finches with very fine beaks and so on and so forth.

[24:32] So by 1838 Darwin is not only an evolutionist, he's now a Darwinian, namely having natural selection and again I'm sure you know for reasons that we're still not quite sure about, Darwin sits on his ideas until finally they are published in "The Origin of Species" in 1859.

[24:53] I'm very proud of this. Not so much of me but of the book. It turns out that Florida State actually has a superb example of the first edition of "The Origin," which was probably bought for about $50 in the 1960s. If you want to buy a copy now it would cost you $200,000. I'm hoping our provost never sees this because he'll insist on selling it I'm sure.
OK, so there you are. So we've got the Origin of Species, 1859. Now, what I want to do is I want to compare and contrast the theory of the origin with the theory of evolution that we've got today.

I want to look first at Darwin's theory and then I want to look at today's theory and ask does it persist? Or is it something which was there in the Victorian period but we should respect it for that but we'd be fools if we wanted to follow Darwin today.

In other words is it something which belongs back then or is it something which in some sense... Now, it's important to note that Darwin says my theory, my book is one long argument. I think it's very important to take Darwin seriously on this.

The Origin is a very carefully constructed and put together work. The Origin is not just one chapter after another. The Origin coheres as a whole. Darwin starts by talking about artificial selection. This leads him to natural selection and now he's got evolution through natural selection.

What Darwin now does is apply his ideas across the spectrum. Now, Darwin again is not making this up. Darwin is starting with something which he picks up from his background. In fact, very influential on Darwin was this man. This man, the name is pronounced William Whewell, not Wavel, Whewell l. An old Lancastrian name, from Lancaster.

Whewell I should say never accepted evolution. By 1859, he was master. He was head of Trinity College and the story is that Whewell would not allow the Origin to be on the shelves of the library because he didn't want the undergraduates corrupted.

But Darwin had known Whewell as a young man and Whewell, in the 1830s, was wrestling with an important problem. Whewell, who was a historian and philosopher of science, amongst other things, had accepted, as everybody else had, the wave theory of light, what they then called the "undulating theory of light.

And the big question was why do we accept the wave theory of light when nobody ever sees light waves? Nobody ever sees them, so why should we accept them? And Whewell said it's because in science we reason very much as one does in a court of law.

Suppose you're faced with a murder, suppose you're faced with a murder, you come in here, and let's say, Jane Maienschein is lying on the floor in a pool of blood. So you send for Sherlock Holmes and you go round and finally Sherlock Holmes says, "Aha! I accuse you, Manfred Laubichler, of murdering Jane Maienschein."

OK, hypothesis - Manfred done it, OK? Hypothesis. Nobody sees this. Hypothesis - Manfred done it. Now, why does Sherlock Holmes feel that he can say that? Because of the clues. Because it turns out that Jane is stabbed by somebody who is clearly left-handed. It turns out that Manfred is left-handed. It turns out...

I mean, if I wanted to stab Jane, I mean, I'd be jab, jab, jab, jab, jab, jab. I wouldn't know how to do it. But it turns out that Jane has been stabbed very skillfully.

Well, in his youth, he was in the Austrian equivalent of the SAS or something like that, or the Marines. He learnt how to kill a man or a woman just almost by thinking about it and he did it.
It turns out that Jane is killed by a peculiar knife. Only in the Austrian knife. Only in the Austrian Tyrol are knives of this kind made.

It turns out that Jane has discovered that in fact Manfred's thesis was not written by Manfred. It was written by Gunter Wagner after all, and so in fact he's about to be exposed.

OK, "Manfred done it" explains the clues. Conversely the clues point out to Manfred done it, you see.

And Whewell says the reason why we accept the wave theory of light, we don't have to see the waves, but it explains things like the interference patterns that you get in Young's double slit experiment. Why would it be that two things of bright light come together and you get darkness? Well, wave theory of light explains this.

So these are the clues, which, it's not a vicious argument, it's kind of a feedback argument. The wave theory of light explains these. Conversely, these support the wave theory.

And this completely the argument that Darwin follows through The Origin. Evolution as fact, actually evolution as fact through natural selection. And Darwin says go through the areas of biology like instinct, paleontology, geographical distribution, actually systematics, anatomy, embryology. All the way across you find clues to evolution.

And don't forget Darwin says "I'm dealing with just the same sort of situation as the wave theory of light. I've got a hypothesis, a causal hypothesis that nobody sees, but there are clues across biology. Conversely the clues make my hypothesis reasonable."

And it's fascinating whenever Darwin was challenged, if you read Darwin's many writings, whenever he was challenged, immediately he comes up with the wave theory of light. Again and again and again, Darwin says, "We accept the wave theory of light, therefore we should accept my theory on the same argument."

So for instance Darwin looks at instinct. Why do honeybees make these elaborate cells, the hexagons? And there's an elaborate discussion to show that this is the most efficient use of the wax and it's the strongest use of the wax.

In other words, we've got a perfect example of an adaptation brought about by evolution through natural selection. Accept my hypothesis and I can explain why it's exactly this form rather than some other form. Conversely this points to my hypothesis.

Archaeopteryx - accept my hypothesis and I can explain why the fossil record is roughly progressive and why the gaps are every now and then going to be filled by missing links. Why there are going to be missing links and we're going to find them.

In fact, I'm cheating a little bit with this. This is archaeopteryx, the reptile with feathers. This was discovered in 1862, just after The Origin was published. Immediately Darwin puts it into later editions of The Origin.

In fact, they had discovered archaeopteryx in 1857, but they'd only found feathers and they didn't realize that they'd got something more than just a fossil bird. It wasn't until they got the full brute that they realized.
But Darwin immediately says, "That's exactly what you expect from my theory - a roughly progressive fossil record but that those gaps represent not real gaps, but incomplete fossilization. And while we're never going to bridge all of the gaps, I predict we are going to fill some of them." And as soon as this happened, Darwin said, "Way to go."

Geographical distribution, those tortoises. Darwin says, "Accept my theory and you can explain this. Conversely, these support my theory." Again, also Darwin says, "Isn't it interesting that the tortoises look like tortoises you find in South America? They're different but they're very similar."

The denizens of the Galapagos look like South America, they do not look like Africa, whereas you go to the Canary Islands and the inhabitants there look like African organisms, and not like South American organisms? Why? Evolution through natural selection.

Homology of course. You see, Darwin is not making these as discoveries. Everybody knew about homology, the fact that the bones of the forelimb of man - as they used to call it in those happy days - and dog and whale and bird, are used for different ends, but the bones are roughly similar. They're isomorphic.

Why is this? Evolution through natural selection explains things. Conversely, these justify, support, my hypothesis.

Embryology, why is it that the embryos are so similar but the adults are so different? "Because," says Darwin, "natural selection rips the adults apart, but the embryos, there's no reason why natural selection should do this. They're quite happy, as it were, just developing. It's only as they get to be adults they have different demands."

And Darwin was so pleased with himself on this one. He goes round to the animal breeders, particularly breeders of dogs and horses, and he goes to people who breed cart horses and race horses, and English bulldogs and greyhounds.

Now, the adults are very, very different, and Darwin says to the breeders, "Are the young as different as the adults?" And all of the breeders say, "Yes, absolutely."

So Darwin says, "Would you mind if I get my tape measure out and measure them?" And to his great, great satisfaction, Darwin found that the colts are virtually identical. I mean, they're different, you could tell the differences, but dimension-wise they're virtually the same and the same is also true of puppies. Because breeders don't care about the young, breeders care about the adults, and so they're selecting the adult form.

And so Darwin says, "I can explain this. Evolution through natural selection explains it and conversely supports it." So this, then, is the theory of 'The Origin'.

Now, question - was this a theory which was going to be accepted at the time? Did people say, "Aha, Darwin, you're right." In other words, to use the language that we all know and love today, did Darwin provide us with a new paradigm?

This is what everybody wants. We need a new paradigm, folks, you know. We've got a terrible situation in Washington. Thank God for Obama. We're going to have a new paradigm. This is the sort of thing. My sex life is not going well. I need a new paradigm.
[35:42] Did Darwin provide us with a new paradigm? Did Darwin provide us with something which just bows us over? These, I should say... I got this off the Internet.

[35:53] I should say that these are not people who've just discovered Darwin. In fact, these are people who were Richard Dawkinsites who've just discovered Jesus. But it's OK, OK. Did Darwin give us that?

[36:06] And the answer is yes and no. At one side no question about it. As far as evolution is concerned a soon as Darwin published, it was like the story of "The Emperor's New Clothes."

[36:19] Everyone went round saying, You know I always knew this. Yeah, you're right, I've always knew this. I mean, we know about the Bishop of Oxford and the big debate there. He was really very much atypical.

[36:30] By 1865, other than the American South, you would have had trouble finding somebody who did not accept evolution. Including the religious people. By 1870, religious people were all on board. I mean, John Roberts has gone... Boston U had gone round looking at all of the Methodist Weeklies and that sort of thing. They all accept evolution, they want souls for human beings, but everybody accepts evolution. So evolution gets accepted.

[37:00] What does not get accepted is natural selection. And it's fascinating to look at Darwin's greatest supporter, Thomas Henry Huxley. Huxley is virtually indifferent to natural selection. He doesn't want to deny it, but it's not his issue. Main thing is he's not interested in adaptation.

[37:20] He's a comparative anatomist, and for them it's homologies that count. Adaptation is for living organisms which have got to make their way. For an anatomist, for a morphologist, the best organism is a dead organism. They want an organism in formaldehyde, as it were, plunked there right in front of them they can cut up.

[37:41] Huxley has virtually no interest in natural selection.

[37:46] He used to give a two year series of lectures. 165 lectures on anatomy, morphology, embryology. Students used to have to take these down, detailed. Huxley was a great blackboard artist, they used to have to copy the stuff, hand it in and be marked.

[38:04] I have discovered four sets of students' Huxleys lectures, four sets. Including H.F. Osborne the famous paleontologist.

[38:15] If you look at these, go thru these 165 lectures, there is less than half a lecture on evolution. And if there's 10 minutes on natural selection it's...There's a whole pile of stuff on things like Negro tooth size and that sort of thing. But Huxley does not want to lecture on those sorts of things.

[38:37] By and large you see, Huxley is an academic but he's also an administrator. He's building science departments. He knows that the secret to building science departments is getting the cash. Means he got to find some way to sell his students to the general public.

[38:56] Embryology, physiology he sells to the medical profession. He turns out students to the medical profession who are at this point just about trying to, start to cure people rather than kill them. And they love to have trained biologists that they then turn into doctors.
He sells morphology to the teaching profession. He says, look in this day and age of science, what we need is hands on experience, rather than Latin and Greek and cutting up dogfish as bait. Huxley runs all of these summer school for teachers. His most famous teacher is H.G. Wells, the novelist, for instance.

But evolution... Huxley believes in evolution, but natural selection doesn't get it. And evolution is much more a museum sort of subject where Huxley and his fellows can spend their time trying to trace phylogenies. Trying to give public lectures or fill out museums, showing the course of history. This is of course Huxley's horse evolution lecture that he gave in his lectures when he came to America.

Huxley was very, very pleased with this because what he did... He was in New York lecturing and he said well, here's the horse, today's horse, with one toe, and then earlier there's a two toed, three toed, four toed. And he said, I predict before long we will find five toed horse further down in the fossil record.

And low and behold, a telegram came from Yale where the bones were. And it said five toed horse discovered. So Huxley makes a big thing out of it.

So it's phylogenies that they're interested in. And of course this is backed very much by the discoveries in the American West. This is the earliest I think, earliest picture that we have of Stegosaurus. That funny dinosaur with those funny plates like that, 1891.

So this is the way that evolutionary biology went off to the origin. It became almost a science of the public domain. It was not causal, it was phylogeny tracing and it was very much a kind of museum science. This is when the big museums were built.

Now, things start to change around 19...about 1900 with the discover, or rediscovery, of Mendel's theory of genetics. And as soon as people start to see this, they start to see how you confuse Mendelian genetics with Darwinian selection and get as it were a full blooded causal theory of evolution.

People often say what a pity Mendel was doing this work in the 1860s. What a pity that Darwin and Mendel never got together then and did it right then. In fact, it wouldn't have worked because Mendel wasn't thinking that he was doing work which would complement Darwin's work.

Mendel thought that he was working very much in the context of thinking in Germany about breeding and about heredity at that time. Fact, Mendel actually, think in 1861, read the first German edition of The Origin, and he annotated, put many comments in the margins, but not once does he say, Ha Ha I've got the solution to Darwin's problems about heredity.

All the time Mendel who an Moravian monk is saying A-ha yes, I see how this would fit in with Christianity. I see how one could be a Christian and an evolutionist at the same time.

So, in fact, Mendel, they're just not thinking it in this sort of way. But by the 1900s they're starting to do this, and somewhat later, roundabout 1930 people start to realize that they've got a full blooded possibility of a causal theory.
[42:42] One of the people who did much work on, certainly on publicizing this, was T.H. Huxley's grandson, the older brother of the novelist. Oldest Huxley, the grandson being Julian Huxley.

[42:53] In America it was the Russian, or rather Ukrainian born Theodosius Dobzhansky, who came over to America and then worked in Morgan's lab. And put the ideas together and in fact wrote the standard work "Genetics and the Origin of Species" in 1830, sorry in 1937.

[43:16] Just to go back to the picture, I particularly like this picture, its just Dobzhansky, with a student you see Dick Lewontin second from the left. You'll see Fransisco Ayalo, who was still a priest on the right. You've got Bruce Wallace just behind Dick Lewontin. And Lee Van Balen, the chap on the top right and corner with the beard.

[43:37] I like this picture particularly because it's Dobzhansky, with his students. And so of course, it wasn't just that Dobzhansky had the ideas, but that he able to spread them and spread them very rapidly through the scientific community.

[43:51] Then of course in 1953, comes molecular biology, and for a while the biologists or rather the evolutions all think that is going to wipe them out. You should see Ernest Meyers' face at this point. But very quickly people realized that in fact molecular biology is the handmaiden of evolution. That molecular biology exists to serve evolutions rather than to challenge it.

[44:15] And so, we now have this synthetic theory. The synthesis of Darwin's theory and Mendel's theory or as it known in England as Neo-Darwinism, which is a full blooded causal theory of Darwinian selection, plus modern molecular genetics.

[44:34] What I want to do now, is I want to go through the theory again. And I want to show you that the theory is the same, but the theory is not the same. Heraclites, the great Pre-Socratic Greek philosopher said you cannot step into the same river twice. And he was right.

[44:53] Parmenides the great Pre-Socratic philosopher said nothing changes, and he was right too. And you see this very much in the theory of The. Origin.

[45:04] So what I want to do is, just do exactly the same thing. But let's go through the material all over again. Well, let's look at, for instance, the Bible of modern instinct and behavior: Edward Wilson's book on sociobiology. Let's look at the kind of work that this represents.

[45:30] The sort of things that Wilson is particularly interested in are the leaf-cutting ants of the Amazon [Inaudible 45:36]. And the leaf-cutters, what they do, is they go out, they forage, they find the leaves, they cut them up, they take them home, then other ants chew them up, they grow a fungus on this, they're gardeners, and then other ants, they take the fungus, and they feed them to the young.

[45:53] And you've got a very complex system with many different castes of insects: you've got great big soldiers, you've got smaller foragers, you've got even smaller gardeners and then you've got really tiny nursery workers. Then, of course, you've got the great big queen.
Now, the sorts of questions that Wilson is asking are questions way beyond the kin of Darwin. He's asking questions like, "How is this the most efficient use of the resources? Why do we have "X" number of soldiers? And why do we have "Y" number of gardeners?"

Questions that Darwin couldn't even start to answer and yet what Wilson is doing is he is showing how all of this is adaptive, evolution through natural selection. So it's Darwin's work, but thank God, we've got 150 years on top of what Darwin did.

Again, fossil record. First of all, Darwin did not have the absolute dates of anything. We have those now. And more than this, and really worrisome, Darwin had no evidence of anything before the Cambrian. We now know the Cambrian is about 550, 540 million years ago it starts.

But the Cambrian gets right off running with really complex organisms like this trilobite that I've got tattooed on my arm. I should say all of my graduate students have to have a trilobite tattooed if they are going to get their degree: left cheek for M.A.'s, right cheek for Ph.D.'s. Nervous titters! And undergraduates saying "I'm buggered if I'm going to F.S.U.!

Now, of course, we've got very extensive evidence of the Precambrian. And, more than this, the very earliest forms are very primitive and almost up to the Precambrian, they get more and more sophisticated.

So you don't find the most sophisticated forms 3.5 billion years ago and the least sophisticated a billion years ago. It fits in just perfectly, so we've got all of this: evolution through natural selection.

We've also got many missing links. I take it Don Johansson is not here? Better put this one in. Lucy, we know full evidence, and what is happening is people are trying to explain these things. And they're trying to explain getting upright or they are trying to explain why the brain explodes up in size.

People don't say, oh, well I've got no idea why this happens, or, it's a miracle. No, they say, what were the selective factors which were pushing this group of apes in this sort of direction? Why was it adaptively advantageous?

Big brains are not obviously adaptively advantageous. Big brains are very expensive to keep up. By and large, you need lots of protein, which means you need lots of meats. So it means, consequently, with big brains you need all sorts of adaptations and reasons why this works. Evolution through natural selection.

Of course we've got other explanations as well, like, why did the dinosaurs go extinct? Don't put this in your notes, OK? This isn't really true, it's just a joke. But the point is it's all done within the Darwinian paradigm.

I love this. This is almost the best example of them all: geographical distribution. Why should this fossil reptile, up in the top right-hand corner, which really, truly is a fat, sluggish reptile, which is in Africa fossils, in India and Antarctica? Well, of course, Darwin had no knowledge of plate tectonics, continental drift.

Darwin was trying to do it through things floating on logs. Others were throwing up land bridges and God-knows-what. Now, of course, we know that the plates slip around the Earth like
that. In other words, it is way beyond Darwin, and yet it's so obviously and so completely Darwin's theory that we're working with.

[49:58] And finally, my favorite example: homologies. Now I love this example because Ernst Mayr, in 1963, wrote a big book on animal species and evolution. A huge book. And he talked about homology. And he says homology is the best example that we've got of evolution.

[50:19] And then Mayr says, and I can still hear it, German accent, "But, you should never think that you can find homologies between organisms of completely different phyla. Anybody who thinks that there are going to be homologies between humans and fruit flies, ho-ho. They don't know biology, that's just ridiculous."

[50:39] Well, wherever Mayr is, whether is up there or down there, I'm sure now he's celebrating because, as I'm sure many of you know, that we discovered that the genes which code for development are, in fact, and you can see them in the Drosophila here, are virtually identical in humans and in fruit flies. The top row is fruit flies, the fourth row is humans, and the molecules are almost exactly the same.

[51:12] The homologies that we've got are just so staggering. This does not refute evolution through natural selection. It adds to our understanding. We now know that organisms are built on the Lego principles. We start with the same building blocks and you can build the White House or the Statue of Liberty from the same blocks. This is the way that it works.

[51:36] So, what do I want to say about Darwin's theory? Well, what I want to say about Darwin's theory are two things, or, one thing in particular: is that it is the same theory, but that it's changed. Thank God it's changed. This is where that I think that the Creationists make a big mistake.

[51:57] They think that any scientific theory which isn't finished, with no questions to be answered, isn't any good. They don't understand that the best science starts with a problem in the morning, you solve it by lunchtime, but by the middle of the afternoon, you've realized you've got two more problems to solve.

[52:16] That's what good science is all about. And I want to say that that's exactly what Darwin's science was all about. It's terrific science, but it was fertile science. It was science that pushed biologists to go on and do something new.

[52:34] So in other words, what I want to say is that Darwin's theory, I think the best analogy is with the Volkswagen: the people's car of 1938. This is actually a photograph of the Volkswagen in Berlin in 1938. This is the Volkswagen in 2006 and that's Emily Ruse behind the wheel. There isn't one part of that car which corresponds identical to the car of 1938.

[53:12] And yet it is so obviously exactly the same car. And that's why I think we should celebrate Darwin's ideas in 2009. It's not because science has stood still since 1859. Thank God it hasn't. It's moved on. But, it's the same theory and it's that same theory which has given biologists 150 years of hard work and let us hope many more years of hard work to come in the future.

[53:45] Thank you.

[applause]
Announcer: [53:49] This lecture is part of the Arizona State University Darwin Distinguished Lecture Series and is sponsored by the A.S.U. Office of the President, the College of Liberal Arts and Sciences, the School of Life Sciences, the Center for Biology and Society and is a production of Grassroots Studio.