

# Design from Nature

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[ 0 : 00 ] about the design issue to do with biomimetics. What on earth is biomimetics, you might say? Well, let me just read you a verse in Romans 1, which we touched on yesterday, and then you might just begin to see where I'm going.

It says in Romans 1, For the invisible things of God, him, from the creation of the world, are clearly seen, being understood by the things that are made, even his eternal power and Godhead. And then it goes on to say, So they are without excuse, because when they knew God, they glorified him not as God, neither were thankful, but became vain in their imaginations, and their foolish heart was darkened.

Professing themselves to be wise, they became fools, and changed the glory of the incorruptible God into the image made light to corruptible man, and to birds.

And four-footed beasts, and creeping things. Wherefore, God also gave them up to uncleanness, through the lust of their own hearts. And then it goes on to describe some pretty dreadful things that God gives them up to, linked, of course, with that judgment in Northern Ireland today.

[ 1 : 15 ] So, God has actually said in his word, that he's demonstrated clearly the creation. I don't know whether you heard last night, but when my wife was driving back from this meeting, she heard a program, which was making out that we need to learn from songbirds, as to how we evolved the ability to actually talk, and to communicate.

And they were somehow making a connection, they thought, that we might understand where learning to speak came from, because they reckon, and maybe there is some similarities, that songbirds use sounds, and they understand each other, and gibbon monkeys do the same. They make noises and understand each other. They said, this is the evolution of language. I must admit, when Juliet and I were texting each other, the verses came to mind similar to the ones that we've just read.

Professing themselves to be wise, they became fools. You see, okay, God has made some creatures communicate.

We're not the only ones who communicate. We communicate using very sophisticated system of sounds, which causes speech, and ideas are expressed in language.

[ 2 : 38 ] But to suggest that that has evolved over millions of years, or over hundreds of thousands of years, in the case of human beings, is frankly absurd. And everything tells you that we are made, as it says in Genesis 1 verse 26, in the image of God, and as somebody pointed out to me, it goes on to say, where's Joe?

He's somewhere here. Joe was pointing out to me, that it goes on to say, in his likeness, we are made in God's image and his likeness.

And the Lord, when he was speaking with the Pharisees that I mentioned yesterday, in that passage in John 10 verse 35, he is actually quoting Psalm 19, where it says, you are gods.

You realise that all of us are made in God's image, as sort of mini gods. We are not God, obviously, but we're made in his image. We have a lot of his creative abilities.

We are limited. We are not God. But we're like mini gods. That's why it says in Psalm 19, you are gods. We are fearfully and wonderfully made, it says in Psalm 139.

[ 3 : 52 ] And there are many things that we could look at. We're going to look at some tonight, which have caused us, as it says in Romans 1, to give glory and thankfulness to God.

And it's the reverse that happens in the world. They refuse to be thankful. That's what that progression starts with. That degeneration, I should really say. You know that the beginning of the downhill slope is that they do not give thanks to God who has made them and all the living creatures.

Constantly, the refrain throughout the whole Bible is that the God that we worship is the creator God. It constantly is referred to in Isaiah, in the Psalms, all the way through into the New Testament.

It constantly refers to that the God that we worship is the God that created the heavens and the earth. That is the God that we worship. He is, of course, the great Redeemer.

And that's his real work, which we particularly honour. But let us not forget that he demonstrates himself to the world as the creator God.

[ 5 : 05 ] No idol can create the world. No, no. You know, when God was revealing himself to the Israelites, he constantly was saying, your idols can do nothing.

But I'm the one who has made everything. I am the creator. I declare myself to you as the great I am. And so when people refuse to believe in God, it says, the invisible things of him from the creation of the world are clearly seen, Romans 1.20.

Then it says in verse 21, because that when they knew God, they glorified him not as God, neither were thankful. And people don't thank God for the glory of what he has done.

They think, oh, you know, it just happened. I'm going to show you today that actually when you get a right perspective on the fact that God is the creator, even of beetles, right, you can actually get some pretty interesting ideas.

Biomimetics means copying nature, mime, mimetic, is the copying bit. Bio is copying things which are living. So it's copying things which are living with a view to using them in engineering.

[ 6 : 31 ] The lotus leaf is an example which we won't deal with in detail, but I just mentioned it. Yes, it's a good idea, Graham. Thank you. I should have asked. Actually, that's better.

Thank you. The lotus leaf is a leaf which has got some slight roughness on it at a very, very small scale.

So only when you put it under the microscope do you see these tiny little pimples. And you can see that what it does is it causes water not to spread.

And it won't, we call it, the technical term, it's hydrophobic. It doesn't like water. So the water wants to roll off. So people have got the idea of making self-cleaning windows and they do work by having a very slight roughness on the surface.

Slight in the sense that the roughness, you can't see or even feel, but it's there at the microscopic level. The only problem is that Pilkington these people who make it make it so expensive that not a lot of people have bought them.

[ 7 : 40 ] But that is an idea which has come from that. The gecko foot, you've probably come across geckos which have these amazing hairs which can actually enable the creature to walk even upside down.

Then there's cases like Velcro which came as a result of somebody walking through a field and seeing the hooks from a burdock plant grip his clothing and he got the idea of Velcro.

The Wright brothers is a classic example of biomimetics in 1903 in December on a very cold day, very similar probably to Whitby in December. But in North Carolina it was not Whitby.

On the sands of North Carolina the Wright brothers took off and actually flew just a little bit further than the length of a Boeing 747 on December the 17th 2003.

And the first controlled flight was made which mimicked bird wings because they actually warped the surface. People don't do that today with aircraft and so they were very ahead of their time.

[ 8 : 53 ] Nobody's really carried that principle on. But that's still waiting to be copied properly.

There's other examples which I won't go into tonight but I will do this one the bombardier beetle.

So we're going to look at a number of examples just a little bit more about the gecko. The reason why the gecko can climb and walk upside down is because of these tiny hairs which are called cilia once they get down to the microscopic level each hair is split into yet another series of hairs which itself those small hairs are then split into even smaller hairs until eventually you get down to the molecular scale.

And if you know anything about physics you'll know that there is a small force normally almost negligible but it's the force which is called the van der Waals force.

And if you disturb those forces which are really only felt right down at the molecular scale you can make use of those forces because they're now spread over a huge number of molecules which are all being disturbed and it's using those forces in order to enable the load of the body weight of the gecko to be held up.

And so people have actually made gecko tape to actually copy the gecko. this is not sticky tape this is actually gecko tape which is made of tiny little hairs filaments if you like which are split into even smaller filaments and so on just like the gecko and it works and I think this is an example of it where you've got this which is gecko tape but it's actually being held on by this bar which has got these tiny little bits of hairs on it they're filaments so it's artificial and you are able to put on a weight and it will easily bear a fairly considerable number of grams there indicating that it is pretty strong and so that is mimicking the gecko so that has been taken into real engineering perhaps one of the ones which has really gripped the imagination of people is that there are tiny little bacteria which have outboard motors which actually occupy the gut of living mammals like ourselves and swim through liquid and they have a little propeller which goes round and it's called the bacterial flagellum this became an icon of the intelligent design argument where many people were trying to argue oh no this evolved and in the famous trial in

[11:50] Pennsylvania when a school was had up by the American authorities for daring to teach creation and the fact that there was a design in living systems this was they had various witnesses they had Mike Beheup who is well known for his book Darwin's Black Box he wouldn't be a confirmed Christian but he certainly did believe and does believe in design and he argued for the design of this system this is right down at the molecular scale it has basically a rotating propeller with a universal joint all down at the molecular level and there were those who were arguing against sadly some people who professed to be believers were arguing against which is a disappointment which illustrates the point that I was making last night that many people professing to be Christians take the opposite view and it does beg the question as to whether they really understood the seriousness of the issue of creation that we were addressing biblically last night but the argument raged and in the end the judge made a decision that it was wrong to teach that this was created that that was not good science however if you were to see this in an engineering firm as big as this and you were to see these stators these rings and these propellers and these universal joints and these bushes you'd immediately say it was designed you'd immediately say that is a marvellous example of clever intricate thinking which has gone into making it and it's obvious actually that the design argument really does have a lot going for it people try to say that this evolved from a type 3 secretory system that's what the evolutionist says but actually when you look at that that's a sort of a needle type bacteria which injects poisons and none of these things are particularly to our advantage but they will say that they have evolved one into the other but in doing that they miss the point that there are a whole set of things which are different in both systems and to say that one evolved into the other doesn't actually fit the facts even if you were to say that that didn't evolve now get this this is where the punchline really comes recently they have found not a single tailed bacterial flagella which is what I've just shown you they found one with seven tails and 24 interlocking gears so if you say that the last one evolved what are you going to do with this one where it's got tails which rotate around each other right and this is what really shows the wonderful engineering in this because when you've got something which rotates like a helicopter blade the danger is that you rotate the helicopter as well okay so if you've got rotating helicopter blades like this and here's the helicopter the danger is that the helicopter will begin to rotate around its own blades now you stop that by having a tail rotor which pushes the body of the helicopter the other direction you understand me so that's it's very difficult to fly a helicopter for that reason because you've got to know what you're doing not only in going up and down but trying to then move this whole thing forward and it's it's not an easy thing to fly a helicopter I wouldn't like to try but Prince William has done it and so it's obviously possible but get this in order to stop this rotating around itself you wouldn't believe this but this flagellum hasn't just got the seven seven wheels you know for rotating the flagellum it's got 24 other wheels which rotate in the opposite direction in order to stop what we call the technical term is the torque of the rotor this will say it all this this is the wheels driving the rotor the flagellum right the seven flagellum and these are the 24 gears going in the other direction and because they're going in the other direction they stop the whole flagellum the bacterial flagellum the seven tailed one rotating about itself and that evolved that has not yet been copied and neither is this but I thought you'd be interested in this this is a walking protein right did you know that in every cell of your body there is right down at the cellular level a system of cargo transport to go from the nucleus of the cell to the outer part of the cell here in the city of Whitby if the mayor wants to say John I want you to do something he sends somebody to John and says John the council is saying I want you to help with the street pastors or please will you tell them

you know what to do you know maybe he's going to send a message right and he'll send somebody along in a little car right to go and tell John or maybe he's saying look we want to make a gift to the street pastors tonight so he sends along a van with a lot of cargo on it to get it to John or to some of the others like Barry who are going out on the street pastors work okay so he doesn't do it himself but he sends the cargo out well did you know that something like this I won't go into all the detail here but it's actually quite amazing the chemistry of how this works but I won't go into that now it's all to do with things like ATP and the thermodynamics of it it's just incredible but again what I'm just going to show you is a film to describe this I hope this is going to work I charged it last night to make sure that the volume stays nice and up let's see whether this works oh dear can you hear this okay this is incredible it's a walking molecule each foot has a short neck which is connected to a strand of a long coiled stalk at the end of the stalk is a fan shaped tail which holds tightly to the cargo being transported that is going on in every living system where kinesin is being used as a transporter system you notice it also referred and I won't go into the details of this to ATP you may have heard of that some of you it's banded around in the literature and it really is a very important molecule it's the molecule which gives energy and every single cell of our bodies also needs ATP if you don't have ATP working you die within microseconds okay ATP is actually the system for taking the food that you ate for tea tonight and actually transferring it into energy going into your cells and the ATP is a very unstable molecule it cannot exist on its own it's also used by the way for making DNA and the staggering fact is that right down at the molecular level there is interacting systems of very carefully balanced chemistry going on to support incredible machinery like walking molecules molecules now biomimetic

Lee that's not yet happen that is nobody's copied that but I'm sure that's going to happen soon the great things are going people will eventually say we need to copy what the can they send this clearly this is showing evidence of something really quite remarkable which has been made by the creator I suggest that it doesn't matter how much you peel this onion of living systems you can peel right down to the molecular level and everything is shouting the fingerprint of God himself Romans 1 is basically stating a principle that when it comes to Richard Dawkins Steve Jones Peter Atkins and these well-known atheist humanists and secularists who are trying to make out that there is no evidence for the creator God will hold them to account for the very disciplines that they've been working in and you are saying well your own discipline showed the evidence that I had made everything Romans 1 20 the invisible things of God are clearly seen being understood by the things that are made even his eternal power of Godhead so and then it then says so that they are without excuse well I've just mentioned

Richard Dawkins in 2006 this is what he said concerning myself and my colleague in crime Stuart Burgess or crime from his point of view and he says in this 2006 letter maybe Burgess and McIntosh are right and all the rest of us biologists geologists archaeologists historians chemists physicists cosmologists and yes for them a dynamicists and respectable theologians so that's wiped out a lot of evangelical churches who agree with us the vast majority of Nobel Prize winners fellows of the Royal Society and of the National Academies of the world that they are wrong not just slightly wrong but catastrophically appallingly devastatingly wrong it is possible if Burgess and Macintosh are right the scientific establishment has fallen well I'm glad he understands the issues and he does to be fair to him he's actually grasped exactly what we're saying we're not proudly saying that we know everything how can I but it does underline an important point that many people who are the enemies of the Christian faith understand the implications of the Christian faith far better than the [ 23 : 49 ] Christians who are supposedly following the Lord Jesus Christ this happened in Christ's own day the disciples had heard the Lord Jesus refer to the fact that he would lay down his life and he would take it again they'd heard him say destroy this temple in three days and so destroy this temple and in three days I'll raise it up but they hadn't understood I'm not saying that the Pharisees totally understood and they certainly didn't believe in him as the son of God but they said we'd better put a guard around the tomb didn't they because they'd understood the implications that if Jesus was right they were wrong may I suggest that actually we need to stand up and be counted and not be afraid when the enemy starts getting all rattled if the enemy gets rattled it means that you're actually beginning to have some effect my our problem is that nobody wrote in this was in I think it was the guardian again that was a bastion of neutrality which which I think published at a similar time a letter of his asking me to be sacked asking that I'd be sacked from the University of Leeds and they wouldn't even let me write a letter in my own defence and I still you know years later argued that they should at least let me have some representation on their website because

that that not this letter but another letter that Richard Dawkins wrote against me is still sitting on the website of the Guardian you can still find it but what my point is this that no Christians and people who should have stood with me were were writing in or possibly they did write in and didn't get their letters published but certainly there was not a noise made by the leaders of the Christians to say look these guys are actually simply saying what is not only good science but what the Bible says as well you see we're not grasping that there is a major fight going on for truth Richard Dawkins though doesn't really understand engineering that's the issue I could refer to my own research in the bombardier beetle in a moment but before I do let me just quote this from

Theodore von Kármán Theodore von Kármán most of you won't have heard of him and I don't expect you to have heard of him except one or two of you who are engineers in the audience may have know about this which is called the von Kármán street in fluid dynamics if you have air going over telegraph wires you get vibration you get them singing right if the wind is going very very strongly over telegraph wire you can hear a note and that note is caused by the fluid dynamics of these oscillating vortices which this guy understood and he was very instrumental in the science of fluid dynamics in aircraft development and he made this important point that scientists study or we might say discover the world as it is so he's saying they do some good stuff you know they describe the world that's there but then he said engineers create the world that never has been and and that's a very important point and I'm going to make this quite a central point in my argument on the science you see it's one thing to just simply describe what's their biologists do it well they're very good at classifying well there's this creature there's that creature there's this slight deviation from that species and they classify them in lots and lots of diagrams and they make this wonderful story that one has changed into the other over millions of years right but basically all they've done is they've just simply classified what's there and very cleverly done so by the way and we do need to know what's there but the point is that they are not used to doing what von

Kármán speaks of which is the engineers have an idea they say ah you see what this has done we could do that in our laboratory we could make something we could design something which nobody has ever had before the Wright brothers got their idea from looking at the birds so they suddenly realized hey we could do something which has never been done before which is a human man-made engine flying machine which can be controlled and what's more is heavier than air and so the the advent of the airplane just over a hundred years ago 110 years ago now when they they built their first machine and this is what Dawkins doesn't understand that engineering is to do with actually having an idea and putting a whole system together maybe taking ideas from nature but then making something work and to make something work takes a lot of cleverness let's look at the bombardier beetle the bombardier beetle in 2010 got an award now the University of Leeds sort of put up with a bit embarrassed by the 2006 flurry of letters in the press and various people were sort of trying to make out that it's not a very good idea is it to have a creation thinker in our midst and so some people started making noises as I said to you Richard Dawkins had written saying that I ought to be sacked one or two people tried to make life awkward for me in the

University they didn't really achieve a lot they have since also tried to make life difficult for Stuart Burgess but the irony is that when the times higher educational supplements at town tired wanted to give us an award oh yeah they were up for the front oh yeah we we want that it's a strange twist isn't it that when things are going well the University is prepared to come and take a bit of credit and quite rightly because they had supported notionally at least the work the people who've really put the money in was Swedish biomimetics 3000 which is a company as the name suggests based in Sweden who had put up a lot of money to do the work that I'm now going to describe it got featured in quite a number of places BBC look north did a program on it Discovery Channel did a program on it BBC material world the Germans got in and a few others physics world and even scientific American very unheard of for scientific American to mention something which originated from a from a creation perspective but anyway they did do a little bit on it in their magazine it's an example of oscillating combustion so it's combustion burning which is not steady that's the way to think of it it's a classic example of biomimetics copying nature the core technology which we have copied is actually the combustion chamber which I'm going to show you more of in a moment the design of which is to do with a valve system and it's that that we've copied we haven't copied the chemistry of this beetle that is still waiting to be copied it has an application to nebulisers that's when people have to actually breathe in drugs and need help for breathing in because maybe the problem is to do with their lungs anyway right so it does have some applications to that fire extinguishers some

people who are dealing with fire extinguishers have got interested in this but the one which is probably in the lead at the moment the application which is in the lead is the fuel injector because some people know that in order to get the advantage on their competitors in racing engines racing cars you need to have just that edge on getting the fuel into the combustion chamber more of that when I come to the applications a bit later so what are we dealing with this is the bombardier beetle that's the actual noise that you hear the bombardier beetle is an extraordinary creature the African one pictured there is quite large about two centimeters and it squirts out of its backside a little bit of liquid which has been heated up and it's nasty smelly stuff but it's essentially mainly hot water and it squirts it into the face of an ant a frog a spider or another creature like a bird which might be trying to eat this bombardier beetle and it always wins well at least 99% of the time it wins it doesn't actually kill its attacker but it stuns it and they are found these bombardier beetles mainly in hot countries

Pakistan Africa but they are also found even in darkest England and even in Wales and they are sometimes found colonies of them under rocks and usually near water generally in the warmer parts of England Peterborough and southwards the particularly found on the south coast of England where it's a little bit warmer I've never found one personally because they're difficult to find and people do sometimes find them who know what they're trying to do we went on a little find for them in California we found them in the water California is quite warm of course and above the mountains of near Los Angeles we went up into the hills and we found some bombardier beetles and we knew where they were there because as soon as you move to stone there there was a cloud of smoke as these bombardier beetles were you know squirting away so they are quite impressive Darwin referred to the bombardier beetle and in his writings he knew of them this is what they do few creatures will risk annoying a bombardier people it mixes a cocktail of deadly chemicals in a special chamber they react and explode a boiling point from its rear end in an awesome chemical weapon pretty impressive one of the really amazing things about this animal is its ability to spray in a very beautifully aimed fashion and that shows up very nicely when you put the animal on indicator paper and what I'm going to do now is I'm going to pinch very lightly one leg after the other just as if I were an ant biting these legs I'm going to start with the right right leg right front leg left front leg at 400 frames per second the action has been slowed down but not enough to see the individual pulses so they went to a lab and film the beetle at an even faster speed at an incredible 4,000 frames a second time to see the next time there were the pulses each one corresponding to the individual bursts of sound when Tom Eisner who's now sadly died from the other one and he's going to be a very well known ivy league university cornell and he did some brilliant experimental work which is described here in the film that the bbc produced of his work called secret weapons this is going way back into the late 1980s if I remember maybe early 1990s and they have brilliantly recorded here how Tom Eisner began to understand the physics of what the beetle was doing and by taking an old cine camera there

[ 38 : 09 ] uh 4000 frames per second he actually realized that there was a series of individual blasts right roughly 10 frames per blast I we reasoned when we saw that film and that's what this is from a paper or referred to in a paper the Proceedings of National Academy of Science in 1999 and this is what actually got me going when I saw that film and saw that footage I realized that there was something extraordinary here and he understood that this is a series of individual blasts roughly 10 frames per blast means that therefore it's about 400 blasts per second middle C on a piano is what come on you musicians middle C on a planet a piano 265 or two was it 256 anyway somewhere in that region okay and then the next C is about 440 okay so you are therefore going to hear a note when this creature blasts between 400 and 500 times per second and that's exactly what you hear you hear you hear that note and I've just made that note by vibrating my larynx between 400 and 500 cycles per second that's what you do when you sing

John or when perhaps it's Paul who does it more than you do but when Paul sings tomorrow whoo and he sort of comes out and draws a crowd hopefully tomorrow at the open air and I hope you can come by the way it's at two o'clock but uh uh and yours truly will be rounding it off but we are actually vibrating our larynx at a pure note right and that's what you hear with this beetle so that was the key to understanding the beginnings of what was going on with this beetle now there is there is a side story to all this which I'll just briefly mention because it is interesting Tom Eisner was half Jewish his father was a Jew and he he his father had to flee the Nazis in the second world war and he he he took Tom and the family all the way to South America and he Tom told me how he saw

what was that ship which was sunk in South America it's come from me um in Uruguay harbour um there was a big

German ship which was Graf Spee yeah he saw the Graf Spee go down and uh he knew that the Nazis were also there in South America trying to get his father right and trying to so there was a big side story to all this and eventually he made his way up through South America eventually into America itself north USA and you know settled there which is why he went to Cornell University but interestingly this is why it's real ironic the person who did all the work on the chemistry of the beetle was a strong Nazi sympathizer in Germany who understood the chemistry of the bombardier beetle that we haven't fully uh grasped yet we haven't fully understood it but he understood a lot of the chemistry it's benzoquinone sorry hydroquinone this is what Schildknecht this Nazi sympathizer in the 1930s did he understood that it was hydroquinone and hydrogen peroxide which were being chemically combined in a small one millimeter chamber which the bombardier beetle has okay and these come into a catalyst we could go into all the details but I'm not going to bore you with all the details of it but there's a catalyst is something which doesn't get involved in the chemistry directly but just encourages it to keep going right so we call that the the biological catalysts are called enzymes we have loads of enzymes you wouldn't be able to eat without catalysts called enzymes right so that's how our body works which is another talk for another time but it is amazing how we carry catalysts in our bodies and it's an amazing system these then these two chemicals then explode hydrogen peroxide is used in rockets to provide oxygen right in order for to get something the hydrocarbons that the rocket's using to burn this is a hydrocarbon and it's using hydrogen peroxide and it explodes once these catalysts get going it explodes that then shuts the inlet valve where all this stuff was coming in and then there is a load that raises the pressure so there's an exhaust and then there is a low pressure part of the cycle and the low pressure part of the cycle then opens the inlet valve again it's a very clever little system now here comes another irony you recognize this sound again the second world war again the nazis they built the doodlebug which not here but a lot further south from here did a lot of damage in 1944 in the home counties south of london when it stopped its engine it was on its way down and people sadly didn't always manage to escape the blast of those horrible flying bombs and they were horrible i mean we we look back at it now we're not in danger but at the time it was awful but they were powered by exactly the same principle that's why i put this in the nazis because they the nazis didn't know that when they built the doodlebug they were actually copying shield next chemistry of the bombardier beetle they didn't know that and they of course were using gasoline petrol the americans call it gas the gasoline and not a bit in the u.s you have to get used to a different language churchill said was separated from the americans by a common language it's so true they don't know how to speak english over there if i keep on telling them that

they need to come over to whitby you know and learn proper english but certainly yorkshire would be interesting but uh but they burn gasoline and of course air but the beetle is burning not gasoline it's burning hydroquinone and hydrogen peroxide right so but the principle's the same so this is really what's going on there's an explosion and then there is a low pressure part of the cycle and more uh fuel comes in so if you didn't quite get that i'll do it again there's a series of blasts it's like a machine gun you know pushing this stuff out of its backside and it will do about 20 or 30 of these right so that will make um in sorry no i beg your pardon it'll do 20 or 30 continuous blasts so each blast might be three or four seconds long right so you're dealing there with 1200 1600 blasts and then it stops and then it does it again and as i say it usually wins the actual chemistry is a bit complicated don't worry too much about these formulae but that's the hydrogen peroxide that's the hydroquinone and it produces benzoquinone and it produces water we're trying to copy that at the moment we haven't quite understood all that's going on here i'll tell you why there's another story which is interesting and that's this how on earth does the beetle produce hydrogen peroxide anyway and that's the question that i'm after because hydrogen peroxide is used in household bleach so if we could find out how to produce it at room temperature cheaply we wouldn't need these massive great big vats places like Ellesmere port and others you know have these huge chemical factories for making all these this stuff we'd be able to make it cheaply so i'm interested in doing that we haven't worked that out yet but we do know that the beetle produces these two chemicals and the shield neck found out it produces this amazing chemistry going on in here we were not quite sure what the catalysts are where some people now think that they are liquid catalysts i had thought that they were crystalline catalysts because when you look inside this combustion chamber there's all sorts of hairs inside which have made me think that it was

crystalline we're not sure about that but we know that this is what happens that sorry that this is basically being pinched under high pressure which stops more fuel coming in this is sliced through and this is the exhaust valve and this opens under high pressure just so that you understand a little bit about this if you put the two chemicals together without a catalyst yeah it does nothing right this is at liberty university where i think what you said is correct a friend of mine is because it's a bit of slow reaction i don't see i don't see really anything going on right now so there's nothing going on when you put the two chemicals there if it's going on it's going on very slowly so now we go on to the next oh it's reading down the center now we're going to put the catalyst in same chemicals yeah see immediately goes on and the catalyst the catalyst in that case was platinum platinum was got was it the platinum doesn't take part in the reaction but it does encourage those two chemicals to get going so you don't need to worry i won't go into the detail on this i'm just going to just now move on to the uh to the application of all this because we then looked at this we realized from conversations with tom eisner and his electron micrographs that this combustion chamber had an inlet valve which closed under high pressure so all the chemicals stopped coming in and an exhaust valve which is this tiny little bit of cuticle here which is like a membrane which lifts up under high pressure so this diagram explains it this exhaust valve is closed under low pressure then lifts up under high pressure and the same time the high pressure stops more fuel coming in having grasped that we then did a computer simulation of this what we did you don't need to worry too much about the detail here but we took the same size chamber as a cylinder and this is just a slice of the cylinder and we said let's suppose that that wants to boil right we're not simulating the chemistry we just got hot water which wants to boil a bit like a pressure cooker some of you uh older ones here will remember that we used to have pressure cookers before macaroids and if you've got a pressure cooker you actually have got something stopping the water coming out and it will only start boiling once you move the valve so this is full of water and it wants to boil it can't boil until you actually lift that valve so what we're going to do is we're going to simulate what the beetle is doing because the beetle for a moment has both the inlet valve and the exhaust valve closed here's the valve we've got here the dimensions of this little tube which is going to simulate the exhaust pipe which from which it blasts its hot water with hydroquinone and hydrogen peroxide burning to benzoquinone but we're not simulating that this is all hot it wants to come out we let it go at a particular pressure this is up one tenth of an atmosphere which is pretty high by the way above atmosphere in this very small chamber and we're going to let that that little dividing membrane be broken so once we do that we actually see that the blue is where you've got water red or brown and yellow is essentially steam and this is a clock here at the top telling us how long it's taking to get rid of all the water and the steam two milliseconds means that you're at 500 cycles per second and you've almost emptied it you've certainly emptied it by the time you get to three milliseconds so we knew that we got it about right that that simulated what the beetle was doing we got we got everything pushed out in about one three hundredth of a second so we knew that we got it pretty well right by assuming that there was a vapor explosion that was the key if we hadn't had the idea of the fact that the beetle was trying to boil the water under pressure you wouldn't have got rid of all that water and steam in that amount of time

[ 53 : 02 ] this is where swedish biomimetics came in they heard me talk about this at a conference and this gentleman who had made his fortune on drugs right proper drugs sorry pharmaceutical drugs not on the street this swedish gentleman heard me speak and he said if i gave you the money would you be prepared to build a rig which simulated the beetle i said i've never done it before but i could get people around me who can do these things and we did it and so he wrote out a check for us basically after a few months of sorting things out with the university and we built a rig which simulated the beetle initially we had it transparent so that we could see what was going on inside we had a coil here an electrical coil to heat the water so there's no chemistry but this the key is that the water wants to boil but is only allowed to boil when it's under pressure that means that you get this vapor explosion any person who's worked with hot metal when it hits the water you get a vapor explosion that's what's going on with this beetle we actually then let the exhaust nozzle valve open under high pressure we close the inlet valve here and then we got this effect you can see i've got a very sophisticated collecting device here and this is the effect of the water wanting to boil at very uh under pressure and once the valve is released it immediately boils and pushes the rest of the water out of the chamber so it's a very good device for actually squirting sprays and this is what has got a lot of the people in industry interested in what we are doing so we started building all sorts of other rigs as well and these have worked very well and people have got interested in what we're doing

one of the things which is of interest is this the the throw ratio which is the throw distance divided by the chamber length for the beetle is about 200 that is the beetle chamber is about 0.1 of a millimeter right so one of a millimeter i think about one millimeter and it is 20 centimeters that the throw of the beetle blast goes 20 centimeters it's about that distance from a tiny little chamber one millimeter so you divide 20 centimeters by one millimeter you get 200.

the beetle is about 200 meters so we found that from our rig which was about 2 centimeters so 2 centimeters is obviously about 20 times the original beetle chamber we could throw right across the room 4 meters so we knew that we got things about right that we got the same physics as what the beetle was doing interestingly this point was picked up by none other than david attenborough in his film on the bombardier beetle but the master of chemical warfare is the bombardier beetle it can create a chemical reaction within its body so violent that boiling caustic liquid explodes out of its abdomen by pulsing the jet 500 times a second it keeps its rear end just cool enough to prevent it being cooked that last point isn't quite right it's the material properties of the beetle which keep it from cooking itself but but but there is a danger is there not of the beetle if it was supposedly evolving blowing itself to bits because you don't play with fire and the beetle of course doesn't blow itself to bits it's got a completely separate skeleton which carries these tiny little tubes of the chemicals and it's not blasting out of its anus it's actually blasting out of a separate tube where all this chemistry is coming out so it's quite a remarkable system the evolutionist of course says that the bombardier beetle gradually evolved this sophisticated system because it is true today that some bombardier beetles no longer blast hot directed blasts like the ones that you've seen some of them just sort of are rather passive and they just emit a nasty smelly quinone which no insects like by the way it's well known that insects use quinones as a defensive mechanism so the argument goes from the from the evolutionists that the really primitive ones are the ones which don't blast and the more recent ones are the ones which blast actually everything tells me that it's the reverse that the ones which no longer blast are probably mutants which have lost the ability to to do this sophisticated you know directed system and we there's so many things here which are waiting to be copied we've copied the valve system right but the beetles got the ability without looking at its predator to know exactly where to put the blast it's got a tiny little turret right like a tank and instead of the turret going just in 360 degrees that way it can actually go up and down and any direction it wishes it can even blast between its legs as you saw there how does that turret work how does the sensory mechanism work such that it knows where the attack is coming from all these things are waiting to be copied plus the chemistry of how does it make hydrogen peroxide i've got a project just started with the university in mississippi where a group of christians who all believe in creation are there in that university and secular university but it's amazing what can sometimes happen you know one man who's got a vision has got all these christians together to work on interesting projects and they got fascinated with this project so they decided to you know try and work out the chemistry of

what's going on with this beetle so i'm advising them a bit on that and hopefully we will make some headway so there's some really great ideas coming from this and as i said the the for the fire extinguisher people they of course want to get the water as far as possible without endangering the poor chap the fireman who's trying to put out the fire so these days what people do is they have packs of water on their backs and they want to make good use of the spray from the water to blast at a fire so that's one application another application another application is for fuel injectors now fuel injectors it's a very different animal for fuel injectors of course you're no longer using water you're using literally fuel right so you take gasoline put it through our system you heat it and you you then let this valve go and it shoots out very very fine droplets and by changing the valve exhaust diameter and changing the pressure changing the heating of the fuel inside here you can get all sorts of different fineness of droplets right down to one micron which is a thousandth of a millimeter droplets and people in the fuel injection industry are extremely interested in that so there's an awful lot of things been done all started with very crude devices to begin with but then this is a more recent a few years ago now but this is a more recent pre-prototype which has been now developed and so we've now got the frequency right up to 100 200 cycles per second actually is possible which is about akin to a very fast racing car going around the track you know where you need to get the injection rate very fast into the car engine so there is a huge a lot of developments here which i'm not doing that the company has taken over i'm just looking from the sidelines i'm the one who perhaps had the original idea but i've let others uh develop it so from this beetle has come all these

ideas which will lead we trust to some interesting results uh are to do with fire extinguishers fuel injectors aerosols these other things are also possibilities so i give the glory not even to the beetle because then i would be disobeying what it says in romans 1 verse 20 where it said that if people actually refuse to give thanks to the created do you know what they end up doing they end up saying as it says in romans 120 because that when they knew not god they glorified him not as god then it says professing themselves to be wise they became fools and then it says they changed the glory of the incorruptible god into an image made like to corruptible man and to birds and to four-footed beasts and creeping things we had an interesting discussion with the patent attorney at one point he said we need to we of course we had to do lots of patents on this and he said what what better we going to patent and then the patent attorney made an extraordinary statement he says i suppose what we could do is patent the beetle itself i said just a minute um somebody's already got the patent on now that of course is the lord himself which leads me to my last point and i can get this computer which

usually works because it's a mac um to the glory of course is to god in the beginning was the word logos and the logos was with god and the logos was god goes on to say in verse three all things were made by him and without him was not any was not made so without him was not anything made that was made that includes bombardier beetles god designed everything right down to the minuscule details was one last thing i need to say god designed this creature which blasts its predators that does raise some issues in my mind as to what on earth was god doing making something which is not quite a killing machine but it's certainly used in resisting those who are trying to kill it so if you're thoughtful you will realize that this does raise the issue which is where do predator prey relationships come from why do we have a suffering world many people don't realize that god when he made the world didn't make it as it is now he made it perfect now i don't know what the ecology you understand the word ecology was ecology is to do with the balance of nature the balance between one creature today we have a balance between lions and antelopes between people and other creatures which we we farm and we eat them right we have a whole ecology ecological balance we have a balance of fishes billions well probably millions of this said is probably is billions of many types of species of fish for a long while we were feeding off cod very easily from this this coastline until we started over fishing and then we had to get the balance right again now what that was before the fall we don't know today there are literally billions of dung beetles i haven't talked about dung beetles today but dung beetles are extraordinary do you know what dung beetles do they roll up bits of dung right poo right and they literally roll it in one direction and keep going and did you know that dung beetles keep going in one direction even at night by tracking the stars did you know that they do tiny little beetle just simply rolls a bit of poo and we're very grateful for dung beetles because they get rid of all the stuff and worms and all sorts of detritus that we get rid of and we just put you know basically you don't you don't want to know all the detail but it's all going on basically because there are tiny little creatures which are breaking down all the stuff which comes from us and from animals now god has designed the world to operate like that now but what it was doing before the fall is not for us to say i don't know all the answers here but i know bombardier beetles are now very sophisticated in their machinery which i've been talking about

now maybe they were using that for another purpose before the fall i don't know maybe the blast was just to soften up some fruit that they were eating i don't know i really don't know or possibly the creature was uh didn't have this system before what i do know is this that the bible says that thorns and thistles came as a result of god cursing what ground it's very interesting god curses the ground and thorns and thistles represent a difficulty a changed earth and i think we've got to realize beetles of course are on the ground and anything which is uh that god does make a distinction even with the beetles you're allowed to eat some but not others but won't go into that but there is creatures there which possibly also got changed we don't know all the details suffice to say this that when you examine what a thorn is people have shown that it's effectively a leaf which has been rolled up tight to make a point now that suggests strongly to me that god when he cursed the ground twisted as it were literally twisted the information system in the dna in some way in our living systems and we can't say anything more but it raises a lot of issues things are difficult now the ecology has changed now and the original world had no sin now it has death which i mentioned yesterday and the big issue is of course that when jesus died on the cross what was he wearing a crown of thorns he bled and died taking the curse for my sin some of you here may not yet be christians remember i mentioned a booklet last night again it's available to you if you'd like to take a copy for yourself please it's primarily for such a person it's not primarily for you to give to somebody else because

otherwise i'll just run out but please consider carefully whether you yourself know the lord jesus christ as your own savior this booklet is not so much on the bob and dave beetle and creation illusion issues this booklet is about knowing that science doesn't discredit the bible and this booklet goes on to say that if you're a scientist it will lead to you saying there is a creator and there is a great need of a redeemer that redeemer is the creator himself the lord jesus christ who had created andromeda galaxies but had created bombardier beetles and this creator was prepared to die naked on a cross the only covering he had was his own blood and he laid down his life that we might be forgiven consider him tonight ladies and gentlemen and make sure that you have closed with christ as your redeemer john there may be some questions you so one two