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Woolly Mammoth: Secrets from the Ice

By Unknown

Imagine an elephant, but with tusks
at least twice the size
of those borne by an elephant
living today.
Imagine an elephant, but covered
in a thick shaggy coat of hair,
some of those hairs
over a metre in length.
Imagine an elephant which lived
not in the warmth of the tropics,
but in the ice
and snow of the north.
The woolly mammoth.
These majestic titans ruled Europe
and Asia
long before our own ancestors
fell under their spell.
Extinct for thousands of years,
they are iconic, yet mysterious.
Climate change means that the frozen
north is melting faster than ever before.
Prehistoric carcasses are emerging
and, from them,
we can unlock the secrets
of these long-lost beasts.
Using the latest technology,
we can now answer questions about the
mammoth which have long-puzzled scientists.
This is, in essence,
virtual time travel.
That's starting to sound
a little bit like Jurassic Park!
We're able to trace their evolution,
revealing their adaptations
to one of the harshest places
on the planet.
This is amazing!
And with every new find,
we take a step closer
to answering the biggest question
of all -
why did these magnificent animals
suddenly go extinct?
I want to show you. Oh, fantastic. That's

brilliant. I want to share with you.
Siberia.
Here, the temperature hovers
around minus 40 for months on end.
Few animals can survive here.
A hundred thousand years ago,
it was a different story.

THUNDER RUMBLES:
This giant swathe of Eurasia was
home to vast herds of woolly mammoths.
Perfectly adapted
to the extremes of the Arctic,
a tiny population survived
on a remote island
until about 4,000 years ago.
But, on mainland Siberia,
they mysteriously died
out at the end of the last Ice Age.
But we're left with a treasure trove
of their remains,
locked in Siberia's layer
of frozen ground...
.. the permafrost.
As global warming
raises the earth's temperature,
melting the permafrost
faster than ever,
the secrets of the mammoth
are finally emerging.
After centuries of collecting
their remains,
we can paint a detailed picture
of these long-lost beasts
far better than we can
for any other extinct species.
We know that they lived
for up to 60 years
and were perfectly built
for life in the freezer.
But many of their adaptations
have remained secret, until now.
And there's one big question,
which remains unanswered.

What killed them off?
This is one of the most famous
mammoth-finds of recent years.
She's called Lyuba,
and she's a little baby mammoth,
probably just a month old.
She was found in 2007
and she is amazingly well preserved,
so that we have her skin,
her soft tissues
and we even have
the contents of her gut.
Lyuba has been radio carbon dated
to 37,000 years old.
Found in the far northwest
of Siberia,
she's considered to be the
best-preserved mammoth ever discovered.
It's wonderful to get so close
to this little baby mammoth
and see how beautifully preserved she
is. You can see the texture of the skin.
You can see individual
hair follicles there,
and there's even some fur preserved,
some little patches of it.
And then on the surface of the skin as
well, there are these peculiar blue discs,
which are part of a fungal infestation
that happened after she died,
part of the burial environment
that she was in.
And she's lost her tail,
that's about the only bit of her
that isn't there.
It's thought that Lyuba
died in a bog,
where she was first pickled by natural
chemicals, and then quickly frozen.
Large specimens,
like fully-grown mammoths,
usually deteriorate
before this occurs.
In fact, any type of frozen carcass

is incredibly rare.
Lyuba is one of a mere handful
of frozen specimens ever discovered.
Isn't it peculiar to think
that humans saw these alive.
I think
that's quite a strange thought,
to know that there were people
living here in Siberia
during the peak of the last Ice Age, and these
animals would have been in their environment.
They would have been
very familiar to them,
just as people living in Africa and southern
Asia share their landscape with elephants.
Our relationship with mammoths dates back
to the early days of modern humans in Europe.
Their herds clearly inspired
cave art.
We've been transfixed by their
majesty for thousands of years.
But, once extinct, mammoths became
the source of myth and legend.
Their huge bones were thought by some
to belong to a long-lost race of giants.
Others believed they belonged to a
bizarre subterranean mole-like creature
that died
when it came to the surface.
The name "mammoth" comes from
an ancient Russian word, "mamont",
meaning "earth horn"
used to describe the animal's tusks.
But it wasn't until 1728 that
British scientist Sir Hans Sloane
spotted the similarities between Siberian
remains and a group of modern specimens
that it was eventually realised that
mammoths were a type of elephant.
Major differences were obvious
in the mammoth remains -
huge tusks, increased musculature
to carry the tusks, a shoulder hump.
the big question was how and why

such an animal
came to live in the extremes
of the northern hemisphere.
We now know that mammoths
were a species created by,
and perfectly adapted to, the most
extraordinary period in Earth's history
the Pleistocene, or Great Ice Age.
This two-and-a-half million-year
cold snap changed the planet,
and transformed the mammoth
into a titan
capable of thriving in the extremes
of the Arctic Circle.
That change occurred
in a blink of evolutionary time,
and was driven by a perfect storm of
exceptional events on a planetary scale.
For millions of years,
Antarctica had been drifting
southwards to its current position,
sending the southern hemisphere
into a deep freeze.
And South America
was charging northwards.
It crashed into North America,
and this altered the ocean currents
and gave birth to the Gulf Stream.
And the knock-on effect of that was increased
precipitation in the northern hemisphere,
which in lower latitudes fell
as rain, and, in the north, as snow.
While these tectonic events
were changing the face of the earth
and propelling it into an ice age,
there were also changes occurring
on a celestial scale, producing dramatic
fluctuations in the earth's climate.
The earth's distance from the sun
changes over time.
Every 100,000 years, the earth is at its
furthest position from the sun's warmth
and our planet enters a cold phase.
Then there's also variation

in the tilt of the earth on its axis
and that happens over a cycle
lasting 41,000 years,
and affects the degree of difference
in the seasons.
Finally the earth also wobbles
on its axis
on a cycle
lasting about 23,000 years.
When all those planetary factors
coincide, winter takes over,
with ice sheets covering
To glimpse the extreme conditions
that mammoths faced,
I'm visiting a remnant
of one of those immense ice sheets.
This wall of ice marks the point
two thirds of the way up
the Athabasca Glacier,
which is about four miles in length
and feeds off the huge
Columbia Icefield in Western Canada,
but even that would have been dwarfed by
the huge ice sheets of the Pleistocene.
In places the ice would reach
up to 13,000 feet thick.
These glaciers are really beautiful.
Really craggy. You look down into the
crevasses and they're deep blue inside.
They're rivers of ice.
It's incredible to think that most
of that would have been under ice,
with just perhaps a peak of the highest
mountains popping out above the ice sheet.
This is amazing!
Wow! Oh!
The ice sheets locked in so much water
that they created cloudless, blue skies.
At latitudes below the ice,
this provided perfect growing
conditions for shrubs and grasses,
creating a vast grassland,
known as the mammoth steppe.
The steppe proved to be a massive

untapped food supply
for any animal able to adapt
to eating its plants.
This newly available niche
drove the mammoths
to evolve from their origins in the
warmth of the southern hemisphere.
At London's Natural History Museum,
Professor Adrian Lister
has traced those origins
through his collection of bones,
tusks, and, in particular, teeth.
What we've got here is a lower jaw,
or mandible, of a very early mammoth.
So here's the jawbone,
and this is a kind of molar tooth
that is adapted for eating plant
matter, as all elephants and mammoths do,
and, by counting the number
of enamel ridges in this tooth -
this one's got about ten -
we get an idea of what kind
of plant food these animals ate.
This one would suggest that this creature
was eating the leaves of trees and shrubs,
quite soft vegetation.
Teeth like this show that mammoths
shared a common ancestor with living
elephants about six million years ago.
Over the next three million years,
mammoths separated into different species
as they moved north
from their Southern African origins.
It was the early mammoths
that grew truly huge,
some standing over four metres tall
at the shoulder,
and weighing twice as much
as an African bull elephant.
From about three million years ago,
we pick up the first remains of the
mammoth line out of Africa, north of Africa.
As they moved through
the Middle East and into Eurasia,

mammoths evolved very quickly.
Adapting to the cooling conditions,
their tails and ears shrank
to conserve heat.
Woolly mammoths eventually ended up
the same size as Asian elephants.
Just like elephants, they probably
spent most of their day eating,
but the plants of the steppe
were far tougher than
those available in the tropics.
Mammoths had four molar teeth.
To cope with the wear and tear
caused by their new diet,
these molars evolved to have
more ridges and higher crowns
than seen in their relatives.
And so we have fossils
like this molar, from Siberia,
and that is just about as far
as it got, that's the limit.
So you can see that there's
about 26 of these enamel ridges.
They're very closely packed.
This is an almost 100% grass eater,
which is a late Pleistocene woolly
mammoth. This is from the last ice age.
As members of the elephant family,
it's believed that mammoths would have behaved
in a very similar way to their modern relatives.
They would have lived
in extended social groups,
females of all ages,
young males and infants.
Now,
remains from the Siberian permafrost
are revealing far more than
just teeth and bones ever could.
The frozen baby Lyuba shows that
mammoths possessed an unusual tool,
perfect for feeding on the steppe.
She's got this very particular shape
to the end of her trunk,
which is quite different

from modern-day elephants,
and it's designed
to be able to delicately pull up
little tufts of newly-sprouted grass
and shrubs.
Because Lyuba is so well-preserved,
new scientific techniques have enabled
us to examine her internal organs,
revealing startling adaptations
to the extremes of the Ice Age.
Recent CT scans show her kidneys are far larger
than you'd expect in an animal of her size.
This type of oversized kidney is
also seen in desert-adapted camels
suggesting that mammoths'
internal structure was also changing
to cope with the dry conditions
of the Mammoth Steppe,
where there was plenty of food,
but little water.
Frozen carcasses like Lyuba
are revered by scientists
as windows into the past.
She was found on the banks
of the Uribei River,
on Siberia's Yamal Peninsula.
She was brought in from the cold by
the French explorer Bernard Buigues.
He's hunted mammoth remains for over
which he shares with scientists
around the world.
Here we have approximately 400, 450
remains of different mammoths, yeah?
But, of course, not 450 full carcass.
But each bone can tell you
the story of the animal
so we can say that, here,
we store around 450 mammoth.
Bernard works closely with a large
network of indigenous Arctic people.
They contact him when they stumble
upon mammoth remains.
He now gets more calls than ever
as the permafrost is melting

at an unprecedented rate,
exposing potential new finds.
A brief window of fine weather
bathes the Arctic
in round-the-clock sunlight
each summer.
It's the perfect time for me
to join him as he makes camp
and starts a new expedition following
reports of a mammoth discovery.
If true, it will further our
understanding of these Ice Age titans.
We're deep in the tundra here, about
and it's beautiful sunny weather
at the moment,
but it could turn at any point
and the snow could return.
This is such a dynamic time.
Things are on the move,
and things are being eroded as well.
The river banks are literally falling
into the rivers as the water levels rise
and so it's precisely now that
ancient remains start to come to light.
Bernard's a member of the
International Mammoth Committee...
.. a team which includes
palaeontologists...
.. geophysicists
with ground-penetrating radar...
.. and even an ex-KGB officer.
Professor Dan Fisher
of Michigan University
is the world's leading
mammoth tusk expert.
He visits the Arctic each year,
and, through analysing
hundreds of tusks,
he's developed an unrivalled understanding of
the mammoth populations that once roamed here.
So did tusks grow throughout
the life of a mammoth?
Do they actually represent
a record of an entire lifetime?

They do.
That's one of the,
I mean just thinking of it
sort of aesthetically,
it's almost magical,
but here these things are that do
grow throughout life,
that are virtual diaries.
There are days represented,
each day as a thin layer of dentine,
days, weeks, years
are all recorded structurally
and in patterns of
compositional variation
and of course they didn't do
it for our benefit!
But what insights it gives us
in the lives of these animals.
'Although each tusk is a valuable
source of information,
'it's only when multiple finds are
compared with each other,
'that Dan's able to construct an
understanding
'of entire mammoth populations. '
I think it can seem as
though you are stamp collecting,
that you're just collecting
specimens for the sake of it,
but there's a real
scientific value to them.
There is. The problem is not solved.
We've established that the data
that we would need are available.
We've established the first few
points that suggest a direction
and give some meaning to
the patterns that we see.
'Understanding mammoths
takes more
'than museum work and text books,
'it requires teams like the
International Mammoth Committee
'to venture into the wilderness,

working with locals
'and hunting for specimens, at times
chasing nothing more than rumours. '
Bernard's just been
on a reconnaissance mission,
so hopefully he should be able
to corroborate whether there
is in fact a mammoth around here,
or whether it's all wild tales.

DOG BARKS:
Welcome back, welcome back.
So Bernard, how did it go?
Difficult to say, you know how fast
things are changing.
Yeah, yeah.
So, some days ago it was under ice,
and today and tomorrow I don't know
we'll see what will happen.
Have you been able to speak to
anybody that's actually seen it?
No because it's a bit secret, yeah,
you know the one who knows about the
mammoth, won't say to anybody and...
But I see that you are very
impatient and I'm...
Yeah, yeah, I'm excited
to get there.
Yeah, I am, I am, I'm also.
'Bernard has scant information
to work with.
'During this hunt his team
are hitchhiking
'with a Siberian gas company's
private train network
'to visit the scene
of a mammoth sighting.
'It's now flooded after
the spring snow melt. '
You see the location is quite big,
yeah?
It is a large lake. And do you think
the mammoth is where
in relation to the lake thing,

because it's a big lake.
It's difficult to know can be in the
middle of the lake,
can be on the side. I hope it's not
in the middle of the lake.
Yeah, yeah, can be, can be.
'The team is trying to use ground
penetrating radar
'to search for specimens
underground. '
'Here they work for days
in an effort to find
'one of the rarest of all
prehistoric riches -
'a frozen carcass.
'Looking for ancient mammoth
remains is unpredictable.
'It's a science,
but an inexact science.
'This hunt concludes with
a negative result. '
I am a little bit frustrated but,
just now I need to keep in mind how
to organise the next step
for this mammoth because
I will not let him,
let's say alone, yeah,
we need to take care of him.
See what will
happen during the summer.
Yeah.

LAUGHTER:
'Each new specimen
has the potential
'to deepen our understanding
of mammoths.
'In many ways we actually know
more about mammoths
'than we do about many living
species,
'enabling us to recreate how
they would have lived
'on the Siberian plains. '

'Much of that understanding
has come from
'the recent advances in analysing
mammoth tusks. '
I first met Dan Fisher
out in the field in Siberia,
but now I've come to his place
of work
at the University of Michigan's
Museum of Natural History,
to find out what happens to the
tusks which he brings back with him.
'It's the internal
structure of a tusk which reveals
'a mammoth's true secrets.
'But the only way to see it
is to break a tusk open. '
Dan, this is a beautiful tusk.
It seems like an almost sacrilegious
thing to think of doing,
you know this has
survived for thousands of years
and we're going to cut it open.
Well, I understand that,
but what if you found an incredible
old manuscript and it was closed?
Would it be sacrilegious
to open it and read it?
Would it be sacrilegious
to learn from it?
Yes, in some sense, we are,
you could say, violating the tusk.
But in another sense it's really
capturing the story it has to tell.
Which tooth is it that
forms the tusk?
The tusks of elephants
and their relatives
are modified second incisors,
so not our middle ones,
but just lateral to that.
The lateral incisors.
Can you tell
if it's a left or a right?

Yes, this is a right tusk,
based on the geometry of curvature,
is such that it's
characteristic of what
we see on the right
side of mammoth's faces.
So a right tusk. And do you know how
old this animal might have
been at the time of death?
This was probably
say about a 15-year-old.
That's a ballpark guess
right now,
we'll find out after
we cut the tusk.
Yeah, so a teenage mammoth! Right.
'Dan needs a clean cut,
'so he builds a bespoke cradle for
each tusk before slicing it open. '
All right.
'The largest mammoth tusks
ever found
'weighed almost 120 kilograms each.
'Far more than an average adult man.
'Both male and female mammoths
possessed large tusks,
'and it seems that the weight of
carrying such huge objects
'required them to have larger
neck and shoulder muscles
'than we see in modern elephants.
'The surface of tusks show
microscopic scratches,
'possibly caused when mammoths
used them
'to clear ice and snow while
foraging for food.

MAMMOTHS TRUMPE:
'And polished areas indicate
they may have favoured
'one of their tusks
for resting their trunks on. '
Well we've done it,

now we've just got to open it up.
Ooh.
The moment we've waited for.
Can I do this Dan?
Yes, you certainly may.
So just lift up and away.

SHE WHISPERS:
That's beautiful.
It's gorgeous.
So, I can see a darker streak and a
paler one and a darker one,
so is that a year in this
animal's life?
That would be a year, yes.
The dark portions
basically are winter,
and so the light and the dark
together would make one year
and the next light and dark together
would make the next year.
So, this is a record
of an ancient Winter. Right.
'The tusk is packed with
information,
'but the patterns in it are hard
to see until it's polished
'and viewed under
ultra violet light. '
Oh, wow.
OK, now that is a lot better.
That's fantastic.
What a difference. Isn't it?
That's amazing, that's so much more
detail than we could see.
It's like you've put on magic glasses
and you can see through it. Yeah, yeah.
'Like other teeth,
tusks grow from the jaw outwards.
'Once highlighted, the growth
bands are clearly visible,
'spreading from root to tip.
'Although this tusk
shows about 15 years of growth,

'there are in fact hundreds of
microscopic growth lines present. '
We're seeing some really
beautiful fine lines here. Yes.
So we can see successive winters
and summers, winters and summers,
Right. Winters. Right.
Now, in fact, the direction of time
though is outside in, so the years.
It's the opposite of trees is
the way to think of it.
In a tree you would think
time goes this way
but in a tusk time goes this way.
And it is like looking at tree
rings,
you know we have these kind of
annual cycles in tree rings as well.
Except that tusks have weeks
and days which trees don't have.
That's fantastic.
This is just incredible and very,
very beautiful as well.
Under this ultraviolet light we can
see this detail within the tusk
that is a thing of great beauty,
but underneath that beauty,
inside that beauty,
is this information
about this mammoth's life.
'Drilling out tiny amounts of
ivory from daily growth lines
'allows Dan's team to analyse
chemical isotopes
'laid down on that day,
painting a prehistoric picture
'of the animal's life
with a level of detail
'that's not possible for
any other extinct species.
'Oxygen isotopes,
from the water it drank,
'reveal where the mammoth roamed
throughout its life.

'Nitrogen isotopes reveal
where a mammoth was
'getting its protein from.
'We can even pinpoint exactly
'when an infant was
weaned from its mother's milk.
'Carbon isotopes show the types and
relative quantities of plants eaten.
'Thinner and darker growth lines
'indicate winters when less food
was available,
'and in some cases,
periods of starvation.
'Because the growth lines are
so detailed,
'Dan can identify the point when,
upon reaching sexual maturity,
'teenage male mammoths
were cast out from their herds
'and left to find food
for themselves.
'It's also possible to see
that sexually mature males
'starved themselves every year,
during the period known as musth,
'just as living elephants do.
'This sees them all consumed
by the desire to find a mate.
'They fail to eat and their tusks
show a period of decreased growth.
'The tusks also bear witness
to traumatic events,
'including the most
spectacular of all sights
'a battle between males
competing for mating rights.

THEY TRUMPE:

THEY GROWL:

HE TRUMPETS:

HE TRUMPETS:

The study of mammoths
is nothing new.
They were first described
scientifically over 200 years ago.
But now new techniques in DNA
analysis are being used to
decipher the mammoth genome.
'Here
at America's Penn State University,
'geneticist Stephan Schuster
runs a team
'of DNA specialists who are using
cutting edge 21st century
'technology to analyse mammoth DNA.
'Their results are pushing
our understanding of mammoths
'far beyond what was
previously possible. '
How difficult is it to extract
DNA from a mammoth?
It's actually, it's quite difficult
because there's only tiny
amounts of DNA left.
At the same time you need to imagine
that all the bacteria
that lived on that animal deposit
their own DNA on top of the DNA
coming from the animal.
'DNA contains the
genetic instructions
'used in the development
and functioning of all animals,
'but it deteriorates very
quickly after death.
'In the case of long dead mammoths,
many of the remains recovered
'provide virtually no usable DNA,
'so Schuster uses the plentiful
supply of mammoth hair as a source. '
So take me through the process
of extracting DNA from a mammoth.
It's actually quite surprising,
it's not so unlike what you would do
with your own hair.

So first we wash it, we rinse it
with water, we shampoo it,
in the end we even bleach it.
And then we use an enzyme to
digest the hair shaft,
and we release the mammoth DNA
that's stored on the inside.
'Genetics labs commonly use
bone as a source of ancient DNA.
'But frequently contaminated,
'mammoth bones often provide
little useable DNA.
'Schuster's use of mammoth hair
'provides a surprisingly
pure sample. '
In one instance we working
on an individual
that was 18,000 years old,
and we could get more than 90
percent of mammoth DNA from it,
and the oldest specimen that we
sequenced
was roughly 60,000 years old, and
there we still get
more than 50 percent that
is endogenous mammoth DNA.
'Genetic analysis has dispelled
a myth about the very source
'from whence the DNA comes
mammoth hair.
'Mammoths have traditionally
been depicted as having
'orange-brown hair.
'It's now known that they
possessed similar genes to
'humans for hair colouration.
'Theoretically they could have been
blonde, ginger, or brunette.
'Whatever the colour,
the quality of the coat was crucial.
'Like the Arctic musk ox, mammoths
sported double layered coats.
'Short, dense, downy hairs next to
the skin provided insulation.

'Long, shaggy guard hairs kept out
the wind, rain and snow.
'Thick hair is an obvious cold
weather adaptation,
'but now advances in
genetic studies provide us
'with detailed insights
into molecular level adaptations,
'allowing mammoths to cope with
the extremes of the Ice Age.
'Dr Kevin Campbell of Manitoba
University in Canada investigates
'how their blood evolved to cope
with the freezing conditions. '
What I'm really interested in
is the protein haemoglobin,
the primary component of the blood.
This protein is really
the interface between the atmosphere
and the cell, you know,
it's that transporter protein
of all the oxygen in the body.
'Kevin usually studies mice, and
how the haemoglobin in their blood
'delivers oxygen to their cells,
especially in cold weather. '
'But his childhood obsession with
mammoths prompted him
'to try to see if he could figure
out how well the haemoglobin
'in mammoth blood worked
in the extreme cold of the ice age.
'However, blood dries up and
decomposes quickly,
'so no mammoth haemoglobin
has survived
'in any of the specimens
discovered so far.
'But, because Kevin had
the mammoth instruction
'manual in the form of their decoded
DNA, he was able to compare
'their code for making haemoglobin
with that of their close relatives,

'modern elephants. There were only
four differences between the codes.
'This enabled Kevin to use host
bacteria to produce
'his very own protein based
on modified elephant DNA.'
And effectively we turned it into
mammoth DNA. Functional mammoth DNA.
A functional protein that has been
extinct for thousands of years.
For thousands of years.
A functional protein that hasn't existed in any
animal for thousands of years, that's amazing,
it's starting to sound a
bit like Jurassic Park.
And it's not even just
functional it's authentic.
This is, in essence,
virtual time travel.
The end product is precisely
the same, had I gone back in time
and taken a blood sample,
it is absolutely authentic.
That's absolutely remarkable
and once you've got the mammoth
haemoglobin then you can test it,
you can see how it does.
You can look at how it picks up
oxygen and how it lets go of it.
Precisely the same way as I would
take it from your blood.
'In most animals, haemoglobins
ability to deliver oxygen
'to body tissues decreases
at low temperatures.
'To see if mammoth blood had any
special adaptations to the cold,
'Kevin tested the haemoglobin
he'd created
'across a range of temperatures. '
And sure enough, when we looked
at the haemoglobin of the mammoth
versus that of the living animals,
at normal body temperature,

around 37 degrees Celsius,
their properties were the same.
It has the same abilities to pick up
and offload oxygen.
But what about at low temperatures?
Yeah, so as temperatures went down,
the abilities diverged.
So as temperature got lower
and lower,
mammoth haemoglobin, we found,
was more able to offload oxygen
than that of the Asian elephant,
and far better than that of humans.
It is incredible to be able
to take ancient DNA
and to resurrect
a protein from the past.
A protein which hasn't existed
in a living animal
for thousands of years,
and once we have this protein
we can look at how it behaves.
Mammoth haemoglobin can deliver
oxygen at very low temperatures,
meaning that mammoths could
let their legs,
their extremities GET cold.
And they could then
hold on to their body heat,
and conserve energy through the
long cold winters of the ice age.
It was crucial to survival.
'These new molecular level
investigations are bringing
'the science-fiction
style possibility
'of cloning a mammoth ever closer. '
'In the far east of Siberia
an incredible new discovery
'is being heralded as the holy
grail of mammoth science.
'In the city of Yakutsk, members of
the International Mammoth Committee
'have unearthed a completely intact

frozen mammoth thigh bone.
'Although thousands of years old,
'it's one of the best
preserved bone specimens
'retrieved from the permafrost.
'So perfectly frozen that it
contains pure mammoth bone marrow.
'This could be the best source
ever of fully intact mammoth cells,
'with undamaged DNA.'
THEY TALK IN JAPANESE
'The marrow will be sent to a lab in
Japan where they will try to extract
intact cell nuclei, and insert them
in to a host elephant egg.
'If successful,
'scientists there predict that they
will be able to clone a mammoth
'by using a female elephant as a
surrogate mother within five years. '
'But the ethics of creating
such a clone
'is likely to kick up
a storm of debate.
'Should scientists even be
attempting
'to resurrect an extinct species?
'Rather than trying to clone
a long-dead species,
'many scientists are far more eager
to understand why the mammoths
'died out in the first place. '
'Their extinction coincided
with the warming climate
'at the end of the ice age.
'The environment they'd perfectly
adapted to was changing.
'The blue skies that created
the steppe grew heavy with cloud.
'Rain returned to the North.
'Dry grassland was replaced with
wet tundra plants and forests,
'the mammoths' favoured food
supply was dwindling.

'But the genetic studies completed
recently,
'suggest that woolly mammoths
'had coped well with similar
changes in the past.
'A population crash occurred,
'30,000 years before they finally
disappeared.
'But they recovered,
suggesting that something else,
'other than changing habitat may
have spelt the end. '
The mammoth had survived through
many fluctuations in the climate,
through all of these warming
and cooling cycles,
why was it at the
very end of the ice age
that they seemed to give up?
It might not have been
an all-or-nothing process,
that it's just depending
on this one last cycle.
It might actually have been
a gradual process that after
every warming and cooling period,
that not only the population
numbers but also the diversity
of the animals went down.
'Professor Dan Fisher thinks
he might now have the answer.
'After analysing hundreds
of ancient tusks
'from different mammoth species,
'he's uncovered a pattern suggesting
'that mammoths were being
increasingly hunted
'by predators as the climate grew
warmer, and their numbers dwindled. '
So, you've obviously seen
changes in lots of tusks
that you think are evidence of
predation pressure.
So, what are those changes,

what was going on in these
mammoth populations?
The changes that we see
that seem best
explained by increases
in predation pressure,
are things like maturation at a
younger age, calving intervals,
or intervals between calves in
females
that are, if anything, shorter,
in other words these are changes
that are reasonable responses
to a changing balance of risk
between survival and reproduction.
It's better if there's more
predation going on
to reproduce a little bit earlier,
even if it's smaller body size.
And to have a few more calves,
even if there's less investment
in individual calves.
It's a better bet, so to speak,
in the long run to have that
kind of a life history in a regime
of higher incidence of predation.
So I think the evidence is that
human hunting was an extremely
important aspect of what drove
the extinction.
'If Dan Fisher is right it's a huge
step forward
'in explaining mammoths' extinction.
'He's sure mammoths were maturing
fast and having babies early towards
'the end of the ice age, a classic
sign that they were being hunted.
'But in Siberia, the evidence that,
that predation was by man is scarce.
'Now potential new evidence
has surfaced.
'Dan's colleague,
mammoth hunter Bernard Buigues,
'thinks he might have made a new

discovery which could support
'the idea that humans hunted
mammoths to extinction.
'In a secret location on the edges
of the Arctic Ocean,
'thousands of miles away from where
I first met him, he's recovered
'a new specimen, which was found
frozen in the banks of a river.
'He's suggesting it shows
signs of human interaction
'this could be a missing
link in the human/mammoth puzzle. '

CHATTER:
'I seize the chance to witness such
a find and fly back to Siberia
'to meet Bernard, who's transporting
the mammoth
'across the frozen tundra.
'We agree to rendezvous in the
remote wilderness of Yakutia. '
Well, this is it,
this is the rendezvous point.
And I know they're on their way,
I can't hear anything yet though.
But it is incredibly cold.
I hope it's worth it.
They're bringing this mammoth in,
they're going to eventually
take it to Yakutsk,
and we'll be able to have
a look at it there,
and hopefully it will be
another piece of the puzzle.
It will add to our understanding
of these ancient creatures
that once roamed around this
landscape.
Oh, I think I can see them.
Can you see the lights over there,
on the horizon?
They've just crested the hill.
Oh this is fantastic,

it's just so exciting.
Bernard! Oh, my God!
You've done it.
Yeah, yeah, yeah.
Oh my goodness,
and where's the mammoth?
The mammoth is
laying like this yeah,
he's on the back with
the four legs up,
and it's a young mammoth.
Yeah, it's smaller than I expected.
It's a wonderful specimen,
you will see. I want to show you.
Oh, fantastic. I want to show.
Oh, that's brilliant.
I want to share with you.
All right, lovely.
'We board an ex-military
transporter plane
'to travel a further
'where we'll start the analysis
of the mammoth
'in a permafrost ice cave.
'Will this frozen carcass reveal
any clues to help explain
'the mammoth's extinction?'
I can't wait to see it,
it's travelled all this distance.
It is like unwrapping an ancient
mummy. It is an ancient mummy!
It is an ancient mummy, sure.
The trunk. It's the trunk.
It's beautiful.

SHE GASPS:
Oh, my goodness! Oh, my goodness,
that's amazing!
Long hair, yeah.
That fur's really long.
'From its size it looks
as though this mammoth
'was about 3 or 4 years old
when it died.

'After thousands of years lying
frozen in the ground
'it's twisted and contorted.
Now lying on its back,
'it's head is flopped to one side
and its legs stick up in to the air.
'Its foot pads and thick strawberry
blonde hair
'are exquisitely preserved. '
I'm jealous.
He has much more hair than me!
Isn't it hard to believe that
this is something which died
so long ago? I mean it doesn't
look like an animal which has been
dead for thousands and thousands of
years, an animal from the Ice Age.
You can't believe that it's
more than 10,000 years old.
It looks so fresh,
it looks almost alive.
So fresh yeah, yeah, yeah.
It is beautiful.
It IS beautiful.
'This specimen is also mysterious.
'We don't yet know if it's male
or female, or when it died.
'But most mysterious of all
are the signs of human interaction.
'It has two large cuts on its back,
'through which many of its bones
have been removed,
'including its spine and skull. '
So this is very clearly
not natural processes,
this is absolutely human tampering.
The really big question is,
did this happen recently,
or did it happen in antiquity?
For me definitely it happened
a long time ago.
A long time ago, because,
can you see, the skin is dry, yeah,
mummified,

I can not see how it can be cut.
And it's not so easy to open it,
and of course,
we need to work more on this.
Yeah, and this is a wonderful,
wonderful thing.
You know, it's an amazing specimen
of a young mammoth,
and this is just the beginning,
isn't it?
Because now the investigation
will proceed,
and we will find out as much as
we possibly can
about the life and the death
of this animal,
and the way that humans
interacted with it.
Yes, this is exciting,
this is very, very exciting.
It's actually very difficult to
see anything with
the mammoth in this frozen state.
The scientists are going to have
to defrost it to get
to the bottom of this story.
How exciting though if they do find
out that this mammoth was
tampered with by ancient people.
'If it was interfered
with in the deep past,
'this would be an incredibly
important specimen
'showing interaction between ancient
humans and woolly mammoths.
'People usually kill
animals for food.
'But this specimen hasn't
been butchered,
'and although now dried out,
most of the meat is untouched.
'Humans have certainly interfered
with this carcass.
'Bones have been removed

and the tusks are missing.
'But for me, the big question is
'whether that happened very recently
or in the deep past?
'The scientific investigation is
only just beginning
'it may be years before
we have the answer. '
It is so exciting,
and such a privilege,
to be here with this mammoth as
it's unwrapped,
and to have been with it
on its journey,
as it comes in from the tundra.
It's a historic moment for Yakutia,
for Siberia
and anybody that's
interested in mammoths.
'Iconic and majestic,
mammoths were once a mystery.
'Now we understand them better,
we still revere them.
'Perfectly adapted, on the inside
and out,
'they withstood the extremes
of the Arctic Ice Age,
'while few other animals could.
'Genetic and chemical analyses
are revealing
'the secrets of their lifestyles.
'Long gone from our landscape,
we're taking a step closer
'to bringing back these
incredible beasts
'using the latest techniques
in cloning.
'And this brand new discovery
may well take us a step closer
'to understanding how our own
ancestors
'could have contributed
to the extinction
'of the greatest of all ice age

titans, the woolly mammoth. '