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Titanic: The Final Word with James Cameron

By Tony Gerber

Iceberg, right ahead!

JAMES CAMERON:
of Titanic's story we all know.
(METAL SCREECHING)
But what happened to Titanic
after the last eyewitness
saw her slip beneath the surface?
Titanic is
the perfect unsolved murder mystery.
It hit there, but then it kind of whiplashes
when it hits the ground back here.
What happened
in the final minutes of the ship?
How did it break up? How did it fall?
How did it hit the bottom?
Why did she sink so fast?
Could more lives have been saved?
Did I get the details right
in the feature film?
No, I'm talking about the sinking,
the way you depicted the sinking.
We didn't do it 'cause we didn't know.
For the first time ever,
I've gathered all the evidence
and eight of the world's
leading Titanic experts
all together, in one place.
Some have been to the wreck,
some approach it through the testimony,
some approach it
through the physical forensics.
We respectfully disagree.
CAMERON". No one gets out of this room
until we piece together, once and for all,
what happened in Titanic's final minutes.
We're going to argue.
I guarantee it. It'll get heated.
Ooh...
Coincidence? There's no coincidence.
There's no such thing as coincidence.
- I agree.
- No. (CHUCKLES)

CAMERON:
of the tragedy,
fifteen years after the film's initial release,
it's time for the final word
on what really happened to Titanic.

MAN 1:
of his search. Over.

MAN 2:

CAMERON:
certainly much longer than
any of the people who were
actually involved in the event did.
I've got it ingrained in my memory.
I could walk the ship in my sleep.
Keep lowering!

CAMERON:
it just brings back to me all those nights
of shooting with the crowds,
running and screaming up the decks.
(SCREAMS)
Then going back to one
and doing it all again.
See you in the sunshine.
For me, filmmaking comes out of my desire
to explore unknown worlds.
You want to see Titanic on the sonar?
Check this out, bro.
You're gonna love this.
I wanted to dive the wreck
more than I wanted to make the movie.
Diving the wreck was
my way into the story.
- There she is, baby.

- MAN:
It's a dream come true for me.
Titanic does not give up her secrets easily.
The more you work on this,
the more you can bring it into focus
and fill in the gaps.

And there are some enigmas.

Titanic:
the closer you get to it,
the more you see completely new patterns.
There have been a lot of ideas,
a lot of theories.
It's time to just say,
"This is what really happened,
to the best of our collective knowledge."
This shouldn't be all sort of nicey-nicey,
blowing pink smoke around.
Let's beat it up.
That's the best way to
arrive at an answer that makes sense.

My Titanic:
Ken Marschaii, artist, visual historian.
P. H. Nargeolet, explorer,
Underwater Operations, RMS Titanic.
Bill Sauder, historian,
Director of Research, RMS Titanic.
Parks Stephenson,
Naval Systems Engineer.
Don Lynch, Chief Historian
of the Titanic Historical Society.
Dave Gallo, Director of Special Projects
at Woods Hole Oceanographic Institution.
Commander Jeffrey Stettler,
Naval Architect, US Naval Academy.
Brian Thomas, Coast Guard Naval Architect
and Salvage Engineer.
We have the team and the tools.
From hundreds of hours
of my expedition dive footage,
to deck plans and survivor testimony,
we're going to take all we learned
and create a new visualization
of the sinking.
From iceberg to bottom,
it's never been animated so precisely
and so dramatically.
We're determined, once and for all,
to learn what happened

after Titanic disappeared
beneath the surface 100 years ago.
after Titanic disappeared
beneath the surface 100 years ago.
It's a good, just kind of
drive-a-stake-in-the-ground moment
for us to say, "Let's get the history right."
To me, the exercise of making the movie
and preparing to make the movie
was about understanding history.
Like, what is history?
History is
this kind of consensus hallucination.
There are some people who, they tell
the story like it happened yesterday.
And then there are others who,
over the years, have been telling the story
and the story changes, you know?
So, yeah.
And how much does the telling of the story
become the memory,
as opposed to the memory itself?
Our task here is to
separate perception from truth.
So what is it that we know for sure?
At the time of her construction,
Titanic was the largest ship ever built,
269 meters long
and standing nearly 20 stories high.
Her weight was over 46,000 tons.
Her hull spanned four city blocks.
She had nine decks
encompassing 370 first-class cabins,
168 second-class cabins,
and 297 third-class cabins.
Accommodations for up to 3,547 people.
(METAL CLANGING)
(BELL RINGING)
Mechanically, she was state of the art,
fitted with 29 boilers and 159 furnaces.
Each of her steam engines
was the size of a three-story house.
Over 6,000 tons of coal
filled her coal bunkers.

From her innovative double-bottom keel,
to her 16 water-tight compartments,
Titanic. was considered unsinkable.
Each compartment had doors
that were designed to close automatically
if the water level
rose above a certain height.
Titanic would be able to stay afloat
if any two compartments
or the first four became flooded.
According to her builders,
even in the worst possible accident at sea,
Titanic was virtually unsinkable.
-Iceberg, right ahead!
-Thank you.

CAMERON:
that on April 14, 1912,
Titanic sideswiped an iceberg
and sank in two hours and 40 minutes.
Full astern!
- Hard over.

- MOODY:
Why ain't they turning?
- Is it hard over?!
- It is. Yes sir. Hard over.
(METAL SCREECHING)

CAMERON:
this is what's left of Titanic,
a tangled wreck on the ocean floor.
Thousands of broken pieces.
But from her rust-covered remains,
we may still be able to figure out
what happened in her last moments.
Well, it's very important to find out
where all the objects wound up.
And then you can
work backwards from that
to sort of reconstruct
how the processes got started.
You've got to
peel away the bottom impact,

and you got to understand
what happened in the water column,
you got to understand
what happened at the surface.
Then maybe you can work your way back
to what actually set off the sinking
in the first place.
It's like a murder-mystery case
where some piece of evidence is an outlier.
Everything fits perfectly,
but there's one outlying piece of evidence,
and it seems so trivial,
and yet it unwinds everything else.
It's a great forensic process to go through.
It's the same thing that they do
at an NTSB analysis of a crash site
for an airliner.
You know, "How did that engine
get way over there?
"How did that wind up two miles back?"
You know, you can't really
piece together what happened
until you can account for every single piece
and where it got there.
Six hundred and forty kilometers
off the coast of Newfoundland,
and more than three kilometers
beneath the surface of the North Atlantic,
lies Titanic.
The wreck site spans
1.5 kilometers of the sea floor,
and is anything but accessible.
It takes about two-and-a-half hours
to descend in a submersible.
Daylight doesn't reach this depth.
It's eternal darkness.
Here, we find the bow and stern section
600 meters apart.
We find the ship's boilers
clustered east of the stern.
Cargo cranes sheared from the deck.
Broken pieces of funnel.
Ground-up shell plating.
Sections of the ship's keel,

or double bottom.
Rudders and propellers
pinned in the sediment, intact.
An open shell door at D deck.
There are serving plates, tea cups, shoes,
countless personal artifacts.
These are all clues in the mystery.
What caused
this magnitude of destruction?
How can we begin to make sense of it?
So, it's good to wrap our heads around this.
So, now you start looking
at a debris field map.
So, now you start looking
at a debris field map.
STEPHENSON". It's part
of that crime scene recreation
of seeing everything on this macro level.
We can get down to individual images
of each individual piece,
but you need the context of it,
to keep that forest in sight.
You have to have
that map of the wreck site
to do any meaningful forensics.

CAMERON:
in two and lie apart,
like a crime scene where the body and head
are on opposite sides of the room.
You can see it. You can see it on the
debris field map here.
It's a very interesting thing.
Bow points north,
and it's partly dug into the sediment.
Its open end is ragged,
it's not a clean break.
At first glance,
it appears the farthest object north,
but there's the number one cargo hatch,
and that's 80 meters forward of the bow.
And the hatch bolts are all severed.
So, what did that?
And how did the bow break from the stern?

What did this?
The stern points south,
facing the opposite direction of the bow.
Looks like a bomb hit it.
To the east of the stern lie five boilers
from Boiler Room 1,
the midsection of the ship.
I think the location of these boilers
is our first lead.
If you just draw a circle
around those five boilers,
and you take the center of that circle,
I think that's where the ship
broke up at the surface.
Right.
CAMERON". Okay, these five boilers
help us to find the hypocenter,
the ground zero for the disaster.
The hypocenter directly underneath
where the breakup took place
on the bottom
would be where the heaviest
and most uniform objects
would be clustered.
Now, with it,
we can extrapolate the journey
taken by each part of the ship,
from the surface to
where we find them today, on the bottom.
And then you have a kind of fallout pattern,
downwind, if you will, or down current,
for very light objects like teacups
and light debris and coal.
The coal being spread the farthest,
'cause it's the least heavy in water.
We can account for many objects
on our debris field map,
and explain how they traveled
from the breakup at the surface
to end their life four kilometers
down at the bottom.
But not every part can be
so easily explained.
Something that just occurred to me

for the first time in all these years is...
If that happened way up there,
isn't it interesting that we've got...
These would be your poop deck cranes,
and they're this close to
their original location.
The stern cranes sort of grouped together
and lying adjacent to the stern
was a little mystery that we had to solve.
And in solving that mystery,
it would shed some light
on what actually happened to the stern
when it hit the bottom of the ocean.
Why were those cranes there?
Where did they come from?
Odd, isn't it?
Then the question is,
what held the cranes with all this,
as opposed to them just scattering?
I don't know. I'm inclined to think
these came apart at a higher altitude.
I think that it's just coincidence
that they happened to wind up...

- CAMERON:
- Coincidence? There is no coincidence.
There's no such thing as coincidence.
- I agree.
- No. (CHUCKLES)
There was a tendency
on the part of the group,
I think, to reject the idea of coincidence,
which, I think, is always good
in this kind of analysis.
Jim will let you disagree with him
as long as
you have a reasonable argument,
and your facts are all in a row,
and they're doing a chorus dance
behind you.
I'm gonna jump to the crazy part of this.
- Yeah.
- All right?
Which is these two double bottom sections

and this big chunk.
There are three pieces of the wreck
whose placement on the debris field map
don't make sense.
They're outliers.
They're enigmas because
they're strangely out to the east
of the hypocenter.
We know from a past expedition
that these two, out of the three,
are pieces of Titanic's double bottom.
We know these parts are
from the same section of keel
because their ragged ends align
like two pieces of a jigsaw puzzle.
How did these two chunks of keel
detach from the bottom of the ship,
and end up to the east of the hypocenter?
And what about the third outlier?
Now, I'm just trying to account
for something that I don't understand,
which is this thing.
- This is just a big pile of junk.

- STEPHENSON:
Big, dirty pile of junk.
Nobody'd ever seen it before.
It's way off to the east.
It's beyond these double bottom pieces.
Okay, so the mystery piece,
the enigma piece is this.

STEPHENSON:
You know, about the upper
couple of decks of that.
It's even bigger and larger
and heavier than the boilers,
yet, it ended up way far out there.

CAMERON:
from beneath the third frontal deckhouse,
end up way out there?
All right. Well, why don't
we stick to what we think we know,

and fill in the rest of the picture?
To fill in the rest of the picture
and visualize Titanic's final moments,
we need to go underwater
and take a closer look at the damage.
I see the wreck.
I see it.
Mir ll, Mir ll, this is Mir I.
Depth is 3,353 meters.
I love this stuff.
Exploration.
Real, honest-to-God,
deep-ocean exploration.
To me,
it's an alternative to making movies,
which is as technically challenging,
as emotionally challenging,
and it's something that
I can use my skills as a filmmaker.
It's about creating the technology.
It's about the personal challenge of actually
going into this hostile environment,
doing things right, doing things safely,
and coming back with results.
Say goodbye to the surface world.
I've been a wreck diver
for many years at scuba depths.
I love shipwrecks. I love the romance
and the mystery of shipwrecks.
And the Titanic's the ultimate wreck.
It's the Everest of shipwrecks.
And I said,
"Let's do a real expedition to the Titanic:
"to shoot scenes for the movie."
And this was all new territory,
nobody had ever really done this before.
But looking into the darkness here
and wondering what was beyond,
what's down there, you know,
is what led me to want to go back and
explore it thoroughly with new technology.
So, of course,
as soon as the movie was done,
I was immediately planning

my next expedition.
Okay, dive one.
It's gonna be JB and Bill in Mir ll,
and me and Vince in Mir I.
Come in here, explore these rooms.
Up until our 2001 expedition,
no one had attempted an extensive survey
of the interior of the wreck.
So, when we went back for
the 3D documentary Ghosts oi the Abyss,
we developed remotely operated vehicles,
or ROVs.
We call them "bots."
Built to withstand the incredible pressure
at that depth,
they could maneuver through
small holes in the wreckage
and explore up to 600 meters
from the manned sub.
Previous ROVs had been leashed
to the sub by a short, bulky tether.
Our state-of-the-art mini ROVs,
affectionately nicknamed Jake and Elwood,
had an on board power supply
and just needed a spool
of hair-thin fiber-optic cable
to receive directions and send
the live video feed back to my sub.
As I guided them through the wreck,
they unwound this cable behind them,
like Theseus unwinding the bail of twine
as he explored the labyrinth.
This made it possible, for the first time,
to film interior areas of the wreck
that hadn't been seen
since the night Titanic sank.
The bots are finally going to Titanic.
Three years in the making.
See you on the bottom.
Since my first expedition,
I've gone back twice.
Sight enabled.
Comm link, camera power.
All right. I think we're ready to fly.

Elwood's coming out.
Pretty cool.
Looking good, Elwood.
Tell him to go ahead, we'll meet
in the center of the grand staircase.
I've shot hundreds of hours
of archeological survey footage
inside the wreck.
Now they're where I wanted to be.
Those are the lead stained-glass windows.
Look at that. Unbelievable.
And another thing
that's absolutely fascinating is
this idea of telepresence.
When you fly an ROV,
after the first few minutes,
and really for subsequent hours at a time,
you completely forget
your physical human existence.
(CAMERON LAUGHING)

MAN:
And you become that vehicle.
It's almost like you can feel
what it's feeling.
This is what you get
when you get the lighting in the right place.
You get a good sense
of the depth of the space.
That's right in front of the elevators,
lbeheve.
There's a well-preserved brass bed here.
I'd be in the other sub outside, navigating...
I think on this dive, you were.
Yeah. We could see Jim inside.
Every now and then,
you could see the little light in there.
And you knew, "Okay, Jim, we need
to move a little bit farther aft, because..."
"Yes, yes, all right."
Then he flips it up and moves back,
and then you got to
get in the current just right.
And then, "Okay, Jim, we're coming,

"but we are kind of caught in current here."
Then we'd do a pass.
"Jim, how did that look?"
And there'd be a pause.
"Love it, love it, love it. Do it again!"
Something like that.
So, they were maneuvering 18 tons
out there
to get one light through a porthole.
Rising up and aiming the light downward.
There's... Turn.
That's good!
I made 33 dives to Titanic.
Laying eyes on the site is
one of the most important forensic tools.
The power of observation.
Some of the damage is self-evident,
easy to understand.
Other aspects are baffling.
Like cops at a crime scene,
we're inventorying all the evidence.
Now we can begin to rewind the clock
and start to put these pieces back together
to tell the story of Titanic's final moments.
You've got to get to the night
the ship hit the bottom.
What happened when it hit the bottom?
Then you've got to be able to separate out
all the bottom impact damage
from what might have happened
as it descended through the water column.
It's important to know that
things that people have identified as
possibly iceberg damage probably aren't.
A good example of this is
the so-called "big opening,"
a hole blasted in the starboard side
of Titanic's bow.
We now know it isn't iceberg damage.
But how do we explain it,
and the other destruction to the bow?
It hit first here,
pushed forward as it settled.
It hit first here,

pushed forward as it settled.
So, the question is,
what did it do when it hit?
It hits, crushes like that, momentarily.
This stops moving at that point,
other than to slide forward.
And then it's got a mound of debris
underneath it,
and it bends the other way when it lands.
And I'll show you
what that looks like in animation,
because we thought about this a lot
when we animated it.
Take me a second to find it here.
Okay, we made this in '95, for the movie.
I still think it's a useful reference
for the bow's impact,
even though
some of the other details aren't right.
This is arrival.
There is the initial deformation,
which actually puts the forward well deck
in compression,
probably buckled in compression,
at that point.
And that's the point
at which the big opening starts.
'Cause it's actually getting exercised
in two directions.
And then the back end now is falling,
falling down,
and is hitting and compressing.

GALLO:
The hatch cover flying off, there.
Right, exactly. We animated that.
The hatch, it's the farthest piece of the ship
from the breakup.
How did this thing get out there?
Jim, those forces, to snap bolts...
I mean, that's something
I can't get my mind around.

CAMERON:

of initial impact,
or at the moment that the ship slams down,
the hydraulic forces inside the ship
are enough to blow this hatch off.
So you've got some internal over-pressure
here, that's hydraulic.
And over the large area
of that number one hatch,
it just breaks every bolt at the same time.
The hatch doesn't peel off sequentially,
it's an evenly distributed over-pressure.
It just breaks
every bolt head simultaneously.
Hydraulic outburst accounts
for the mysterious placement
of the number one hatch.
The damage we see to the bow
is more extensive
than simply the force of impact
at the bottom.
What could have possibly happened
as the bow plummeted four kilometers,
down to the ocean floor?

BODINE:
on the starboard side.
She kind of bumps along, punching holes
like Morse code...

CAMERON:
Titanic, we used animation
to illustrate for Rose's character
what we thought had happened
as the ship sank.
So now as the bow goes down,
the stern rises up...
Since then, we've come a long way
in our CG modeling and 3D animation,
but most importantly
in our understanding of the disaster.
So, what happens? (CLICKING TONGUE)
She splits, right down to the keel.
The bow section planes away,
landing about a half a mile away,

going 20, 3O knots
when it hits the ocean floor.
(IMITATES EXPLOSIONS)
Pretty cool, huh?
Thank you for that fine forensic analysis,
Mr. Bodine.
Of course, the experience of it...
was somewhat different.

CAMERON:
a good story,
but some of the forensic details
aren't quite right.
So with what we're learning now
in our current investigation,
we're going to get to update this.
It's pulling the whole ship down.
It now breaks. There's a relaxation.
It's pulling it down, it rips away,
and then natural flooding.
This is a big deal for me.
I've wanted to do this for a long time.
A detailed and thoroughly accurate
visualization of Titanic sinking
does not exist.
Working with animator Casey Schatz
and naval system engineer,
Parks Stephenson by remote,
I'm gonna improve
what we did 15 years ago.
This looks great.
This is the sum total of everything
that you and Parks have been working on
over the last few weeks.
- Yeah.
- I think it looks awesome.
All right, let's go to the bow section.
It's nice when you see it in scale like this,
isn't it?
Oh, yeah. Oh, totally!
It just makes sense. When you see it
in scale, it all makes sense.
And this is accurate, the ship is to scale
to the water column, right?

Absolutely, I've been OCD
about everything.
- Okay.
-(CHUCKLING)
Not shocked by that.
See? That's it, man.
That's exactly the way I always pictured it.
So the stern is actually
only a few lengths behind.
Yeah, it was surprising,
but it follows down fairly closely.
CAMERON". Yeah, see,
everybody always talks about
how it's planing forward.
Yeah, it's planing forward, but if you looked
at this, you'd just say it was falling.
Yes, it's planing forward,
and that accounts for its displacement.
But it's one forward and six down,
so it's basically just falling.
It dives and stalls.
And when it stalls, it moves forward.
And then it dives and goes down,
and then it stalls and moves forward.
We can't complete our update
of the animation
till we answer some more questions.
Let's keep working backwards
from the wreck.
We've analyzed the force of impact
with the bottom,
but that doesn't explain
all the observable damage.
What could have possibly happened
as the bow plummeted
two-and-a-half miles
down to the ocean floor?
To me, one of the fun parts of this
is looking at what happened to the bow
To me, one of the fun parts of this
is looking at what happened to the bow
right when it departed the surface.
And looking at the evidence
for that high flow rate,

that high longitudinal flow rate.
Weighing at least 20, 000 tons,
Titanic's bow tore away from the stern
and plunged downward at a speed
of 40 to 50 kilometers per hour.
This is the forward well deck of Titanic.
And you can see there,
that kind of tubular object is the mast.
You see the mast?
We are up on the top of the deckhouse
right now, I think, aren't we?
Yes! Just hold right on this. This is good.
Do we have any pictures
of that area handy?
Maybe one of Ken's paintings
is a betterjumping off point.

STEPHENSON:
the wreck section there.

CAMERON:
Ken feels very connected to Titanic.
And quite honestly,
the movie was pitched using his paintings.
I just opened up the big double-truck
spread of his glorious painting
of the ship going down
with its lights blazing
and the rockets being fired off,
showed it to the studio executives
and said,
"This ship, Romeo and Juliet. "
And that's it.
It was probably the shortest pitch
relative to the amount of money it raised
in the history of movies.
Well, yeah, you can actually
see it pretty well in this painting.
This is a good image.
Let's keep this image up.
Oh.
So, let's see what we've got.
We got a mast that's knocked aft.
So what force knocked the mast aft,

and then kept it there?
Even though the ship hit the bottom
with a slight forward vector.
All of the B deck, forward-facing windows,
broken, broken, broken,
and that one's broken.
So, to me, that all adds up to
a very strong longitudinal flow
over the ship,
sufficient not only to break the mast,
but to get that mast into position,
and then allow it to shelter these windows
from a peak hydrodynamic pressure,
which subsequently broke those windows.
(STAMMERING)
And when the bow broke away
and started speeding up,
that's also what tore the crane off
and the jib on this crane
went down behind it there.
Where we find the mast today on the wreck
is clearly a result of the bow section
breaking away from the stern
and diving toward the bottom.
And that initial speed,
which could have gotten up to as high
as maybe 40 knots or something like that.
That pressure of sea water pushing back,
it's too much for the mast.
lt just bent back, and probably
bashed around a little bit for a few seconds,
destroyed the wheelhouse,
which was made of wood,
and ended up right in that position.

CAMERON:
or the force of the racing water,
caused considerable damage.
So, this was our attempt to show
the mast doing that, in the '95 animation.
So here is the mast coming back,
hits the wheelhouse,
wheelhouse starts to peel off.
Mast is kind of bouncing around

in that area,
and then the wheelhouse
disintegrates in the flow.
And I think it was more dramatic than that.
I think it was like a house in a hurricane.
I think it just went in one.
You know how,
when the house will start to lift,
and then there's a moment
where it just goes
because it gets too much
of an angle of attack.
I don't think it just peeled away like that.
I think it kind of like... (WHOOSHES)
- Yeah.
- Yeah.

CAMERON:
this right when I update the animation.
But for now, the hydrodynamic flow
can't explain all of this damage.
This deckhouse wall is pushed outward.
Same on the other side, pushed outward.
Why just that? Why not all of it?
- This roof is mushroomed.

- MARSCHALL:

CAMERON:
or pancaked down with extreme force,
and the top of the gymnasium
is bent down. The windows are all bent.
That's not sag. It was buckled down.
The roof was found to be sagged in with
a few pieces of funnel shell on that side.
CAMERON". What caused this damage?
Are we missing something?
So you've got this big wreck
coming down through the water column,
it's pulling water down with it
and it's been moving for miles,
literally at 25 miles an hour,
pulling along this wake behind it,
just like the wake behind a race car

that another race car can get into
and kind of draft.
So there's all this moving water,
a big column of water.
Ship hits the bottom, stops suddenly.
The column of water does not stop.
It comes down on top of the ship,
pancakes down the roof,
crushes down the decks,
and then spreads out across the sea floor.
So it actually winds up
moving kind of horizontally
and blowing objects away from the ship.
THOMAS". Do we have any data on
the magnitude of the down blast?
I mean, the hydro guy in me says that
it can't be all that huge.
We are talking about buckling
and deforming in a big way,
these moderate-sized structural members.
And the total mass of water can't be
any much more than the mass of the ship.
- Down blast is enormous.
- Okay.
It's huge loading per square inch.
Yeah, I just... I professionally disagree
with that statement.
It can't be the momentum
of the deck mushrooming,
and then plastically deforming
and remaining there in permanent set?
Plastically deforming just from inertia?
So, the deck is falling,
falling, falling, stopping,
there's nothing supporting
the middle of the deck, it just...
Yeah. It's got water underneath it
that needs to be compressed
out of the way for it to deform.
What it does is, as it squashes the ship,
it increases pressure
on the water inside the ship,
which can't be compressed like air.
So it has a hydraulic effect,

just like the fluid in a hydraulic cylinder,
and it tends to blow things out the side.
So this thing stops cold, and you've got
50,000 tons of water moving above it
at, still, 30 miles an hour.
That's 30 knots coming down.
Whatever its sinking speed was.
Which is the equivalent of the flow here
that broke the mast,
and broke all these windows,
and peeled off the davits, and did all that.
They like to say that the steel doesn't lie,
but, you know, I like to...
I think I'd revise that. I'd say that the steel
probably tells more complicated stories
than we can tell from
how it's lying on the bottom of the ocean.
There's two different energies going here.
Number one, it took off, did this.
Flow passed, weakened
a lot of these structures up here.
Then it hit, and those weakened structures,
which were moving with the ship,
all of a sudden, they do this.
And then on top of this,
then you have your down blast.
So it's a combined effect.
Sure, it's definitely combined.
I think that the steel and the water
are kind of flowing together.
I agree with Parks on that, absolutely.
But there is one curious detail
that baffles me.
All the windows of the officers' quarters
on the boat deck are open.
The air was freezing that night,
they wouldn't have opened them.
So, who or what opened
those heavy-latched windows?
So the interesting thing is, why are
these windows all open and forward?
- Yeah, that is really interesting.
- Well, it went... The very front one...
- No, but why are they unlatched?

- Why are they unlatched?
- Unlatched is a different deal.
-It's down blast.
We know why they're forward,
the hinges are that way.
It's the overhead
just getting enough of a compression,
'cause this is right under it,
and all those windows...
Yeah.
So they just blew open.
But why wouldn't it just break the glass?
Why would it unhinge
solid brass hinges and latches?
Yeah, one after another.
Keep in mind,
there's two ways to latch this window.
There's a day latch, which is done from
the casement, like we would all think of.
- And then there is a storm...
- Which is this thing.

SAUDER:
You close the window, you turn the crank,
the eccentric shifts,
and it pins that window in place.
That's not latched, so there's a day latch
that is actuated from the inside, right?
If that handle weighed
more than the latching side,
when the ship flopped down to the bottom,
all those handles flipped open?
No, I think what happened...
No, I think what happened is, um,
the spindle that goes in
probably just failed from tension.
A lot of times, people will look
at a device from the Victorian period
and go, "Well, what's this for?"
And they will make up an answer.
And unfortunately,
it's the wrong answer because
our understanding of machinery
is different from the ones at the time.

Oh, okay.
Because it's a fairly large area,
and it's at the end of the fulcrum.
Yeah, I see what you are saying.
Sure, it just blew them open.
- Yes. It's not meant to...
- But didn't break the glass?
And that was weaker than the glass.
- But didn't break the glass.
- Yeah.
Bill Sauder very modestly says
he knows the ship better than the builders,
and I actually believe he does.
He's the curator of an enormous collection
of Titanic artifacts.
He has more day-to-day contact
with the physical remains
of the ship than anyone.
The one thing I'll remember about
Titanic artifacts, to the day I die,
is when the Saalfeld perfume vials
came up.
When you recover stuff from the Titanic,
it's wet, it's rusty, and it's rotten.
And the smell that comes off it
is perfectly alien, perfectly fetid.
You know it's a kind of death
you have never experienced.
So the lab is kind of unpleasant,
and then all of a sudden somebody
opens up this satchel, this leather satchel,
and out comes the fragrance of heaven.
It's all these flowers and fruity flavors,
and it's delicious.
It's the most wonderful thing
you've ever had.
Um...
It was just a complete,
overwhelming experience.
It was like, all of a sudden the fragrance
of heaven kind of goes through the room.
So...
Instead of being surrounded by
all of these dead things,

um,
(CHOKING UP)
for those few minutes,
the ship was alive again.
(SOBBING)

CAMERON:
from the flow, to the impact,
to the down blast.
I understand the damage to Titanic's bow,
but the stern is
a completely different story.
It shattered beyond recognition,
like it was hit by a bomb.
We're gonna figure out why.

MARSCHALL:
my name is Ken Marschall.
I've been studying the Titanic
for over three decades now.

CAMERON:
to this investigation
because he knows the wreck site
better than anyone.
He has created these remarkable paintings
that stand even today
as a definitive guide to Titanic,
in life and in death.
After 30 years
of studying the ship so intently
and painting the ship so many times,
a hundred times,
to see this thing in three dimensions
and be standing here,
I am absolutely speechless.
I've been painting Titanic
since the late 1960s.
1967, actually, was my first painting.

CAMERON:
and the talent to composite
hundreds of separate images
into these big picture mosaics.

He is especially invaluable
with the internal archeological survey
that we did with the robotics,
because he can actually look at something
and identify it.
There will be big brass letters that will say,
"A deck," "B deck," "C deck," or "D deck,"
the first thing you see
when you come out of the elevator.
And there it is. Bingo, baby! Bingo!
Tell him, bingo.

MARSGHALL:
I've been spending truly my adult lifetime,
I feel, subconsciously trying
to bring all those souls back to life,
in a weird way.
To honor their memory,
to keep it alive in peoples' memory.
The ship and the people.
When Bob Ballard's expedition
with the French found the wreck in 1985,
the first images confirmed
that the ship had broken apart.
But it was impossible to
see the entire wreck in one shot,
so Ballard's publisher enlisted me
to paint composites,
big-picture views of the ship created
from studying hundreds of close-ups.
And that was my first exposure
to the wreck,
other than the few pictures I'd seen
in magazines or in the news.
Seeing all of this imagery for the first time,
Bob setting me up in a room downstairs,
right below his lab.
Thousands of feet of individual stills
and I had to crank through this film.
And I was doing sketching,
and I was pinpointing particular images
that I needed enlargements of and
duplicates of in order to do these paintings.
I thought we would find her, and

she'd still be in relatively good condition
and still would look more like the ship,
but instead she was just nuked,
just blasted apart.
It was like going to an autopsy.
It was quite a rude awakening.
After three days of that,
I broke down in tears one night.
I remember I called home
to speak to a friend,
and I remember saying words to the...
It kind of makes me tear up right now
to think about it.
But I said to him,
"My ship! My ship, it's gone."
Um...
It was... It was so destroyed.
And I knew the ship was in two pieces,
(CLEARS THROAT)
but to see these close-up images
and the high resolution of some of them,
and to look down and see how
completely ripped apart the ship was...
I know it as I would a brother, a sister,
a mother, a father.
And there she was,
in a million pieces. Dead.

CAMERON:
easy to understand.
Other aspects are downright mysterious,
like the stern.
It's completely bizarre at first sight.
Just like a bomb went off overhead.
When I dived it, it was remarkable
to see the extent of the damage.
The rudder and the enormous propellers
pinned in the sediment
are hauntingly intact.
Surrounding the stern is
a large concentration of mangled debris.
It really looks like a plane crash.
How do we know that the stern took off
toward the bottom going pretty fast?

The poop deck.
So the aft-most deck, the poop deck,
is doubled over completely.
One centimeter of steel folded like a taco.
How did this happen?
It's got a big electric crane sitting here,
that's got a lot of sail area across,
on that axis.
Right? So to take off toward the bottom,
you got a really powerful
hydrodynamic loading here.
So you got a big, sort of prying moment
right here,
and it just rips this deck up,
which then catches lift,
peels back, and flops over double,
and winds up like that.
And you think that happened
in the first 500 feet...
The first 30 seconds.
Now, you might have had some implosions
in here, loosening rivets.
You know, bang-bang.
(PEOPLE SCREAMING)
The stern left the surface
in a very different configuration.
It had all its broken parts
faced into the current.
And I think it just blew off,
all pretty close to the surface.
And if something held on, it might
have been packed up against the face of it
or flat back against the underside.
And it took a while
for that to exercise loose,
and all the loose stuff
had already been blown off.
He is proposing that
the stern fell leading edge first,
and that it was water passage
into and around that damage area
that sort of peeled off and exfoliated,
basically, the first third of the stern.
We didn't get this right in the '95 animation,

but we're gonna nail it now.

SCHATZ:
this is not like
that DD one, where it was just...
- It was just leaves...
-it was just coming off in regular...
- Right, right.
- Yeah, yeah. Copy.
So all this stuff has come off the ship
pretty much by the time the ship
is probably two-thirds or three-quarters
of the way through that end swap,
so it's quick.
So that's happening now.
So stuff's coming off,
and, boom, decking is coming off,
and now it's all off.
Yeah, oh, it is fast. Wow.
If you stick your hand out the window of
a moving car with a deck of playing cards,
if you turn it this way, you can hold on to it,
and that's what the bow was.
You turn it that way, they are all gone.
They'll all spilt apart and blow backwards.
Because the second their angle of attack
increases to a few degrees,
then it increases rapidly.
Once it's at 90 degrees,
there's no holding on to it.
It's gone. It all happens instantaneously.
And at the moment that happens,
when those cards blow like that,
there's a much stronger back force
on your hand.
Yeah.
- Try it sometime.
- Yeah, I will. (CHUCKLES)
- Might get busted for littering.
- Exactly!
CAMERON". It feels great to have
a second chance to get this stuff right.
In the '95 animation, the stern didn't spiral,
but we now know that it did.

Because I think that
when the stern hit the ground,
it did not hit straight down. I think it slid.
Oh, definitely, because its back is broken.
The axis of this part of it...

- MARSCHALL:
- Rudder is pinned in the sediment perfectly,
and the props are pinned
in the sediment perfectly,
and that's the anchor,
and then it comes down.
Which actually makes sense,
'cause it peeled off all this stuff over here
and blew that side out flat.
- Yes, that's true.
- Right.
It still doesn't explain
these freaking cranes.
Yeah, I know.

CAMERON:
Where did they come from?
Did they originate from the poop deck?
Did they originate from the well deck?
Or the A deck level?
We had to have an answer.
Those cranes are loose,
and they are two-and-a-half miles up.
- And somehow they end up...
- No, no, no. I think...
- These cranes came down with the stern.
- Exactly.
Somehow attached to the overturn
on the underside of the poop?
How did they end up over there,
when the poop deck went like that,
way up there?
That's just my question.
Did they fall from the surface?
Were they deposited there toward the end?
It's kind of hard to tell. Every time we tried
to poke at a scenario that would explain it,
there was a problem with it.

- All right, let's take a look.
- Which one they are?
I think there was this one part still there.
I'm not sure.
Well, here is an interesting thing, these
cranes can be completely gone, unrelated,
and the three that
you see sitting right here are these.

STEPHENSON:
CAMERON". Okay. All right.
So it's these three.

STEPHENSON:
So, now you are talking about
a hydraulic outburst impact effect.
The ship hits the bottom, plows in,
compresses all of this shell plating
underneath here,
and everything gets ejected up.
Including the entire well deck,
which winds up lying someplace nearby.
I had to bring to bear
some of my observations
about the effects of hydraulic outburst.
When these big masses come down
and stop suddenly on the bottom,
build up these intense,
internal hydraulic pressures,
and how that can eject big, flat areas,
like decks, and like side shell plating
and so on, and that probably launched
the cranes off the ship at that point.
Okay, that makes sense.
The placement of the cranes
and the damage to the poop deck
help explain how the stern got obliterated.
Now let's turn to what we don't know,
the three outliers.
We haven't yet explained them.
Until we do, we won't know exactly
what happened to the ship
as she vanished beneath the surface
100 years ago.

One of the more unique challenges
to studying the wreck
is trying to see past what 100 years
of sitting at the bottom of the ocean
has done to the steel.
Titanic is not rusting in the way
that we would think of rusting.
It's actually being eaten by bacteria.
And the bodies of these bacteria form
these amazing structures called rusticles.
They look like stalactites,
and they are actually formed
in kind of a similar way
in that stalactites are a deposition
of minerals created by gravity.
This is actually the deposition
of dead bacteria
that have iron inside their bodies
that they have absorbed from the ship,
and they just kind of form these structures
that are actually organic.
I think the rusticles are now
part of this amazing monument
at the bottom of the ocean.
- Tell him to move ahead slowly.

- MAN:
CAMERON". Part of what's fascinating for me
is that it's this onion skin process.
You have to peel away
the layers of the damage,
working in reverse order from what
you're seeing right now in the present.
Now we're looking at Titanic
from 100 years later,
so you've got the deterioration
at the sea floor,
on top of the bottom impact,
on top of the descent,
and then the breakup at the surface.
Once we apply our forensic process,
Titanic's remains in the debris field
begin to tell the story
of what happened on that night,

April 14, 1912.
So far, our theory of how the wreck
traveled through the water column
and what happened at impact
fits the evidence,
except for three outliers.
How did these two pieces of double bottom
and a pile of deckhouse debris
from beneath the third funnel
end up far from the rest of the wreck?
Well, the two double bottom sections
are wing-shaped, so...
- These are wings.
- Yeah.
- These are 747 wings.
- Yeah.

CAMERON:
within a fairly narrow cone of each other,
so it's likely
they were attached to each other
and separated at some point
in the water column,
and then fell separately.
I agree. They had a weakened area that
kept them together for a certain period.
When you're sitting at a table of experts,
and you start whittling away
at what's real and what's not real,
and you end up with real mysteries
that are solvable...
You know, the answers are there.
The clues are at the bottom of the ocean.
So, they're coming down through the water
-kind of like that.
- Right.
Right? And then finally it just exercises it
so much, it breaks apart,
-whatever that last connection was.
- Right.

CAMERON:
something like this.
The pieces of double bottom keel

begin life together,
and on the journey down, exercised apart,
planing away like an aircraft wing
to where we find them today
out in the debris field.
- All right. So, that accounts for that.

- STEPHENSON:
- That's not a planing shape.
-It's not.
- This is just a big pile of junk.
-It's a big, ugly pile of junk.
Big, dirty pile of junk
that would not have any strong tendency
to plane in any one direction.
And it's a big, lumpy shape.
It's just a pile of crap
on the ocean floor right now.
It has no aerodynamic qualities,
has the same aerodynamic qualities
as one of the boilers.
It's even bigger and larger
and heavier than the boilers,
yet, it ended up way far out there.
So, how did it get way over there?
(STAMMERING)
I think one of the big problems we have
is that we're thinking way over there,
when really, detaching from this point,
it's way over there.
Okay. No, no. I got it.
- We're not getting the vertical scale.
- No, no. Understood.
Right. So if something detaches here
and frisbees off, it's only going that far.
STEPHENSON". Jim threw out
a couple of quick ideas about it.
Being attached to the stern,
and the stern spiraling down,
and maybe it flung it off over there.
But the problem with that is,
there was a chunk of the ship
between that chunk and the stern,
and that didn't get thrown out there.

We don't have very good imagery of it.
We're going to need better imagery of it
to try and understand it more,
and see if there's clues in there
that will help us understand
why it ended up out there so far.

CAMERON:
still mysteries,
we've learned enough
to rewind the clock farther
on the night of April 14, 1912,
to the moment Titanic lost her fight
to stay afloat and broke in two.
Let's take a look at the results of
a two-and-a-half year study
by naval architects
to see if we can pinpoint
where Titanic split and exactly how.
We've peeled away the layers
to reconstruct the story of the forces
that hammered Titanic
as she plummeted and hit bottom.
Now, it's time to look at
the breakup at the surface.
How did an unsinkable ship,
the world's greatest technological marvel
at the time, break in two?
If the wreck site is a crime scene,
the breakup was her last breath.
In the days that followed the disaster,
the US Senate hearing
and the British Board of Trade inquiry
recorded contradictory
eyewitness testimony about the breakup.
Some saw her break in two.
Others swore she went down whole.
The British Board of Trade
concluded that Titanic sank intact.
Not until 1985,
when explorer Bob Ballard's co-expedition
with the French found the wreck,
did we have proof, once and for all,
that Titanic broke apart.

Dr. Ballard will take questions now,
if you have any.

MAN:
the bow and the stern
are at opposite ends of the debris field?
Well, we found the boilers there,
major pieces of the stern,
and that's separated by 800 meters.
I don't know.
And again, I'm sure that 30%, if not more,
of what I'm selling you right now
I will try to eat
in a few weeks, when I finally get a chance
to look at my data.
SAUDER". I'm kind of embarrassed
that somebody in the '70s or the '80s
didn't put forward the breakup.
- When you read the many accounts...
-it's all there.
-...it says, like...

- MARSCHALL:
...vast amounts of cork were found.
Well, that's what they used
to insulate the uptakes.
You know, the Pan's Wood,
it's a piece of wood from the lounges.
As a matter of fact, you use it in the movie.
I think Rose is on it,
and Leo says, "Goodbye."
Well, if the lounge is gone,
and there's woodwork
from other parts of the ship,
clearly there's no middle part
of the ship anymore.
Why didn't the light bulb go off
in anybody's head?
Because the wreck hadn't been found yet,
and so there wasn't
as much worldwide interest.
And so, there weren't groups of people
like ourselves focusing on this
as much as we are now.

STEPHENSON:
that institutionalized myth.
- Exactly. Who saw it break.
- There were survivors who said it broke.
And they tried to tell the story,
and they were shouted down by experts,
who insisted over the years that,
"No, it couldn't have broken.
You're mistaken."
- But this is the fun part of history.

- STEPHENSON:
Because everybody wanted to
think of Titanic as this majestic...
They wanted to romanticize it.
We wanted it to sink as this beautiful icon
that just passed away into another world.
And be sitting on the bottom of...
And is sitting on the bottom
in some ghostly, perfect way.
Ruth Blanchard said, "People say that
I'm wrong, and that I didn't see right,
"and that the ship
didn't really break in two.
"I was only 12,
"but I saw it, and we were
all talking about it in the lifeboat.
"'Did you see that the ship broke in two?
"'One part went this way,
and the rest went back down."'
Now, they can't
all be having this hallucination.
We heard a terrible explosion,
and as all of you know,
the Titanic had four funnels.
And when we heard this explosion,
the Titanic broke in half.
I remember at one of our conventions,
when Ruth Blanchard talked about
the ship breaking in two,
and this was before they found the ship,
and one of the officers at the society
grabbed the microphone

and explained
how it was just her perception
because the funnel had fallen.
And in hindsight,
I wish she had taken the microphone back
and said, "Were you there?"
I called Don Lynch to this investigation
for his insight into the experience
of the Titanic survivors.
He spent his entire career
gathering their stories.
Many of the survivors
were his close personal friends.
Well, when I firstjoined
the Titanic Historical Society in 1974,
and I realized
nobody had made an effort to find them.
And so, I started tracking them down.
I got to know a number of them,
I got to know some of them fairly well.
The story of the Titanic is in the survivors,
that's how we know what happened.
And people sort of ignored that
all those years.
There was always this fascination
with the ship and the shipwreck,
and they didn't feel
we could learn more from the survivors.

CAMERON:
what does seeing it break mean?
Does it mean
seeing the ship suddenly move,
associated with a loud noise?
- No, they see an actual clean break.
- Right. Okay.
So, do we know where the clean break is?
- Right here?

- STEPHENSON:
the clean break is. And this is based
on the wreck.
- You're saying based on...
- On observations from the wreck.

Well, it should be, actually,
at the promenade deck.
It should be towards the top
of the promenade deck,
or just at the bottom of the boat deck,
midway between the second
and third funnels.
- Here.

- THOMAS:
- Oh, so that's right.
- He's just about right.

CAMERON:
this detail wrong.
It shows the clean break
just behind the third funnel,
and we now know that
it broke in front of it.
Okay, I'm gonna fix this
in the new animation.
So, we know where she broke.
The question now is, how?
It all comes back to,
did it detach in the vertical position?
And what does that mean to
what subsequently happened to the stern?
'Cause the stern is
where all the people were.
And there are so many conflicting accounts
of the stern being vertical, but not vertical.
Kind of also, you know,
"How wrong was the movie?"
That's kind of important to me
as well, you know.
But I think we were right about
the idea that the bow swung down,
once the forces were relieved,
and it broke, swung down,
and took off for the bottom with a high rate.
Right. So, one thing is very strong enough
to hold the bow attached to the stern.
Double bottom.

- STEPHENSON:
- Double bottom is holding it together.
Titanic was constructed
with a double bottom,
which in theory made the ship's underside
more resistant to damage and flooding.
Could this innovation have delayed
Titanic's breakup and bought time,
maybe only minutes,
to save additional lives?
Did a piece of the double bottom
hold the bow and stern together
till the very last moment?
We've all been thinking of this as the
classic break-the-sword-over-the-knee,
one split, and that's fine,
'cause that does account
for the primary fracture at Frame 12 aft.
But is it possible that there is
some sort of rotational component?
Because I want to ask whether or not
you're looking at,
in medicine, what's called
a "greenstick fracture."
- Oh, absolutely.
-If you take a bone and twist it,
it doesn't cleave, it fractures
in a complicated spiral way.
The so-called "greenstick fracture"
is the way in which
the keel broke away from the ship,
to account for how it's isolated
from the rest of the wreck.
Sometimes when structures fail,
the last part to fail will stay connected
to both ends.
Maybe we should take it over to the...
- Do you wanna go?
- Okay. Yeah.

- STEPHENSON:
-(CHUCKLING)

- MARSCHALL:

- I beg your pardon?
A little early in the party for that,
don't you think?
Right. So, yes.
It actually works quite well.
This is one of our scientific analysis tools.
Yeah, it's pretty good, because
look what happens when you rip through.
A banana turns out to be a great way
to model the breakup of Titanic.
So imagine that
the bow is going underwater,
and the stern's being lifted up.
And you've got
a center of buoyancy right here.
This is gonna be so cool,
'cause it's gonna break just like the ship.
So it starts to break at the top,
there's a buckling failure underneath,
which you can see right there.
Starts to tear down. Right?
So now the stern's falling back,
the bow's sinking down,
and as they separate...
Whoa, check that out.
There is the double bottom
separating from the stern
and from the bow.
All right?
Now the only thing that's missing...
You've got to tear it.
And this is how the bow separates
and drops down, like that.
Now the stern's sitting at the surface
with this big piece of double bottom.
The stern now floods, goes vertical,
heads for the bottom
at high speed, like this.
And this big piece of windage here,
that's flapping in the breeze, bends back,
breaks off, and goes frisbeeing off
across the debris field
about a quarter of a mile away.
Banana peel theory.

(CHUCKUNG)
Okay, let's rewind the clock to
the early morning hours of April 15, 1912.
Go back to the moment
just before Titanic broke
in order to understand
the escalation of forces
that caused this massive failure
in a structure
that's designed to be unbreakable.

STEPHENSON:
is what determines if the ship floats or not.
In Titanic's case, the stern maintained
its positive buoyancy for a while
and stayed on the surface,
then the bow became nothing
but a dead weight
that's got to go to the bottom of the ocean.
CAMERON". Once the bow had gone under
and lifted the stern right out of the water,
stresses not anticipated
by the ship's designers wreaked havoc.
If this bow was hanging down like you say,
it's totally negative buoyancy.
Or very close to it. Probably has
still some airspace at the top.
Which speaks to the buoyancy in the stern
because that thing is holding up...

- CAMERON:
- All of that.
Thought of as a complete system,
it's still positively buoyant.
But there's this huge negative mass,
pendulous mass,
which breaks off at some point,
maybe at this angle, maybe at this angle,
maybe it hangs on for a second.
Maybe as it is achieving that angle,
it's ripping away.
In order to test popularly held assumptions
based on eyewitness accounts,
I've commissioned

a team of naval architects
to apply a scientific method
to Titanic's breakup,
to really separate myth from reality.
Do you wanna tell us about
the modeling software that was used?
Sure. I think we need to shift...
- We'll switch to Stettler's computer, please.
- Yeah, we'll come back to this.
So, what I wanted to do...
I'll just stand up a little bit,
here, to illustrate.
These are called
hydrostatics and stability softwares,
and there's a number of them out there.
Basically the way they all work is,
-you use the lines drawing for the ship...

- CAMERON:
-(STAMMERING)
- The Harland and Wolff drawings?
Right, the original drawings
from Harland and Wolff.

CAMERON:
was at the cutting edge of all industries.
Harland and Wolff, based in Belfast, Ireland,
was a revolutionary shipyard
that designed iron ships
that didn't simply copy
the design of wooden ships.
This allowed them to build bigger, better,
and technologically superior vessels
ahead of any of their competitors.
Unfortunately, their crowning
achievement, Titanic,
flooded, split in half,
and sank to the bottom of the ocean.
Now, using today's most advanced
shipbuilding computer tools,
Commander Stettler
will attempt to figure out
why Harland and Wolff's design failed.
So this is just a representative section,

as we call them.
All the compartments had to be defined
by the balance of the decks.
So you can see the coal bunkers,
and the salt water tanks are green,
and the blue are the fresh water tanks.
So we model the hull
as a bunch of these sections,
basically, these slices,
and for each slice, that slice has
an area of property associated with it.
And we can actually calculate, basically,
the resistance to bending,
or flexure, of that section of the hull.
And then we can use that to find the stress.
So let me just shift the view a little bit.
Now let's look at the stress, say,
in this panel here,
and plot the bending moment.
So, now you see what's on the bottom
is actually negative.
Compressive stresses in the bottom.
- Compressive stress in the bottom.

- CAMERON:

STETTLER:
and a little bit of red up there,
that's tensional or positive stresses. Okay?
So what's interesting is,
it's basically saying that
the bottom plating of the ship will buckle
-before the material reaches a yield stress.
- At a smaller stress.
Just to be clear,
based on your calculations,
we're thinking that
the bottom buckled first,
before the shell broke at the top.
Correct.
We know the steel was better in tension
than it was in compression.
Right, but that makes the keel
even stronger.

It was put into compression,
but was still strong enough to hold
-the two sections together momentarily.
- To hold together.
What Commander Stettler was able to do
was bring a rational, mathematical model.
No cinema tricks,
no mythology, just the facts.
"This is what the computer said."
I found that was a breath of fresh air,
because it lets you sever the chains
with those preconceptions you have
and say, "A-ha!
"This is what happened."
CAMERON". Commander Stettiefis analysis
gives us the scientific proof
to support our ideas of Titanic's last hours.
But what about the flooding itself,
and how the rushing water
brought the ship down?
Did her stern really rise out of the water?
It's a controversial shot in the movie,
a gut-wrenching, big-screen moment
based on survivor testimony.
Is this really how it happened?
(PEOPLE SCREAMING)
If the breakup was Titanic's last breath,
the iceberg strike was her death blow.
(METAL SCREECHING)
It damaged 90 meters of her hull,
allowing flooding in five
of her 16 major watertight compartments.
An injury that fatally crippled the ship.
No one has ever actually seen
the iceberg damage.
It lies buried in the sediment,
underneath the ocean floor.
But using the modern analytic tools
of the shipbuilding industry,
can we fill in some holes
in our understanding of the flooding?
So, Commander Stettler's gonna start off.
He's gonna show us the sinking studies.

- MAN:
-(lNAUDIBLE)

CAMERON:
the flooding analysis to look for facts.
We know some things about
the initiation of the flooding,
that it sideswiped an iceberg,
that it opened the first five compartments.
We have some outer boundaries
that were set up by the testimony.
We know it didn't take three days to sink,
we know it took about two-and-a-half,
two hours and 40 minutes.
So, there are certain things we know.
They were able to create
a model complex enough
and accurate enough to be able to tell us
certain things we didn't know before.
How did the floodwater
move through the ship?
How did the bow so rapidly go negative?
How did the stern rise?
Let's turn to the naval architects'
progressive flooding model
to look for facts.

THOMAS:
I was working on is a hydrostatics study.
It involves tracking the floodwater
as it moves from the sea,
through the holes in the hull,
up and through all the compartments.
I have sliced the model up
in a bunch of places,
so you have Hold 1, Hold 2, Hold 3.
We haven't ever been able to track
the compartment-to-compartment
progression of floodwater before.
It allows us to determine
if the floodwater would've reached
one part of a compartment
or a different part of a compartment first.
It allows us to much more accurately see,

at any intermediate stage of flooding,
how the ship is loaded
and what the structural
consequences of that are.
All right, so here we go.
It's recalculating everything
on ten-second intervals.
As you can see, there's a long period in here
between, say, 25 minutes
and 45 minutes or so,
before you get much flooding
in other places.
Can you stop for one second?
How is it getting to here?
Is that Scotland Road?
This is Scotland Road. Yeah.
CAMERON". Scotland Road is the long
passageway on the port side of E deck
that travels the length of the ship.
As Scotland Road flooded,
it completely undermined
the precaution of sealed compartments,
like an accelerant,
acting as a shortcut for the floodwater
over the top of the bulkheads.
Here we go.
Because the starboard side on E deck,
sort of starboard of Scotland Road,
is allowed to, in our model right now,
flood earlier, it floods first.

MARSGHALL:
dissected in such a way,
and to see how the flooding progressed
in a forensic way like that,
was almost like seeing Titanic sink
for the first time.

CAMERON:
was an open door on D deck, just one.
Why would someone open a large door
on the lower level of a rapidly sinking ship?
Second Officer Lightoller at one point
sent a boatswain by the name of Nichols

to grab some men and go down
and open one of the doors.
And I think the idea was that,
since he wasn't loading the lifeboats full,
that they would come back
and take people off
through the doorway or something.
And he never saw the man again.
And when they found the ship in 1985,
there it is. The door is open.
The interesting thing about the D deck
shell door on the port side is that
it communicates down a quarter
all the way forward.
If you look at it here. Here's your door.
If your water could come in here,
it could come down and
flood the entire forward D deck.
We should stop it
at the peak of that stress curve,
because we know it didn't go past that,
so that's your upper bound.
Okay, the peak of the stress curve
is the moment we're after.
It's just before the ship broke.
When we reach this point,
we'll know the final angle of the stern.

THOMAS:
at trim.

CAMERON:
Okay, the model shows us
that the flooding caused
a 19-degree maximum angle of tilt.
There is no subsequent force
acting on the ship
that would tend to break it,
that exists greater than that moment
until it hits the bottom.
And we know it broke
before it hit the bottom.
That might be our maximum tilt.

STEPHENSON:
Not as much as we thought.
Ken, you're going to have to
repaint your paintings, buddy.
- I'm going to have to reshoot my movie.
- Which one's easier?
Painting. I'll help you paint the paintings.
(ALL CHUCKLING)
I think this is pretty amazing.
I mean, this is completely new to me,
that in the two-and-a-half hours
it took Titanic to sink,
she never capsized.
We never really thought about that.
It was staring us in the face.
Ships capsize.
We saw it recently
with the Costa Concorde
that sank off the coast of Italy.
And when you look back
at the history of
all the other famous shipwrecks,
they all roll over.
Bismarck rolled over,
Andrea Dofla rolled over.
But Titanic just went almost straight down.
Yeah, toward the end it had, maybe,
a variously reported six,
maybe eight-degree list.
That's not much.
That creates a whole new question.
Were they trimming the ship?
Were the engineers,
none of whom survived,
actually trimming the ship actively?
Were they fighting that?
Were they that good with their pumps
by filling the trim tanks and seeing the ship
was listing one direction,
controlling it and trying to keep it upright
so they could get those boats off?
Or did they just get lucky?
Was it the most amazing piece of luck
in maritime history

that they managed to
successfully evacuate
700-some people in the boats
while the ship just sat
perfectly upright in the water?
I've never thought of that before.
Well, there are some questions
we're just going to have to live with.
But before I send these guys home,
there's a game I like to play.
What would you have done
if you were captain of Titanic?
Could more lives have been saved?
Titanic set sail
with more than 2,200 souls on board,
but just over 700
would survive the disaster.
Some went down with the ship.
Most froze to death floating
in the frigid waters of the North Atlantic
waiting for a rescue ship.

SEAMAN:
Careful with your oars.

CAMERON:
for 50% of the passengers
and crew on board,
could the crisis have been managed
more effectively?
Can anyone hear me?
Let me pose a problem
based on everything you guys know.
Let's say I've got a time machine
and I can teleport you back to Titanic
one second after the ship
has already hit the iceberg.
You can do anything,
but you've already hit the iceberg.
So it's really an exercise in,
could the crisis have been
managed differently
if they knew what we knew?
How would you have saved everybody?

And it's not meant
as an indictment of the choices
that were made by the captain
and the officers.
I think they were managing the problem
about as well as humanly possible
under the circumstances.
But with what we know now,
could we have done any better?
Like, how would you
have saved everybody?
Save everybody, I think it was not possible.
You can save much more.
We can shift the number, that's for sure.
I think you could save everybody.
I think you could save everybody
and their dog.
Really?
I think there's a couple of ways to do it.
There's two ways to do it that I can think of.
There is a ship.
There is a ship six to eight miles away.
- One.
- Well observed by everybody.
All right? It's there. You can see it.
It's thought to have been
the British steam ship Californian,
within radio contact of the Titanic
right before the accident.
One of the officers told people
when they were getting in the boat
to go row to that ship.
Captain Smith.
Captain Smith, he was telling people
to row to the ship.
Why row to the ship?
Why not drive your ship to that ship?
Six miles with a boat like that?
No, no, no. Not that boat. That ship.
Drive your ship to the other ship.
And I would say even drive it backwards.
You don't want to go too fast,
'cause you're damaged.
You've only got to go six miles.

It's not very far.
No, but it could be an hour,
or something like that.
Drive it backwards,
it's going to tend to plane up slightly
and not add to the flooding.
You'd actually relieve the pressure
and slow the flooding.
You think it's just pure head pressure?
We respectfully disagree.
It's a big ship and
the holes are far underwater and it just...
I think Jeff and I made the point in there.
We disagree with that one.
You're going to evacuate some of them.
Some are going to go in the water
and some are going to have to
get picked up by the other ship.
So that's your biggest problem,
is the transfer.
Driving a ship backwards,
I was not in favor,
but I had no objective reasons.
It just seemed like
the wrong thing to do to me.
It just seemed like
the wrong thing to do to me.
My first favorite idea is to
put everybody on the iceberg
'cause it's not sinking.
Take a fur coat, sit on the iceberg.
If you have access to the iceberg.
Why don't you have access to it?
You just ran into it.
You left it behind.
A couple hundred meters away.
It's sitting right there.
If you have trouble convincing people
to get into a lifeboat...
(ALL CHUCKLING)
They didn't have any trouble
when they got up to boat 13 and 15.
- That was later.
- Yeah.

STEPHENSON:
How are you going to put 2,000 people
on an iceberg that
you know is pretty irregular?
And how in the hell are
you going to get them on top?
- What I would do is...
- I think I'd be taking a chance on that.
- Here's the option.
-It's either that,
or cling to the stern, which is going down.
No, no. Option two.
They had received reports for days
that there was field ice,
and they knew
they were within five miles of it.
- Field ice. Pack ice.
- Right.
Now that you can easily walk right onto
from any shell door.
Sure. Just drive the ship right into it.
I would've headed northwest
until I hit the pack ice.
Much easier than climbing.
- But then you have to sail.
- Yes, yes.
Why you don't sail to the ship?
To the ship?
Because of the transfer problem.
I would prefer to be on the ship than...
What if the ship turns out to be
a 50-foot fishing sloop?
How do you get 3,000 people
on a 50-foot ship.
I don't think we came up
with any super brilliant ways to solve it.
There were a couple
that might have worked,
if you were incredibly ballsy
and just went for them.
You could've spent your time
fashioning rafts.
Oh, that's another...

That could be a possibility
with all the chairs and stuff like that.
But the people,
they will be already in the water.
You could go tear the woodwork
off the first-class lounge
-and throw more of that into the water.
- One guy took a bunch of deck chairs
and he made a raft out of it and survived.
Yeah, but you can put
more and more on them...

STEPHENSON:
but that's one guy on his own initiative.
If you had the crew concentrated
on fashioning rafts
from the carpenters' stores, I think that...
I don't see that happening.
You might've saved another 50 people.

MARSCHALL:
with the idea of
gathering together
a whole bunch of mattresses
and lowering them over by ropes
over the side, and they suck against the...
'Cause they knew from the inside
where the leaks were.
Ken had an interesting idea of putting
mattresses down the side of the ship
and trying to block the inrush of water
into Boiler Room 5 and Boiler Room 6.
And I think, as we argued it,
there was some possibility that,
that might've worked.
So our model indicates that if you just
lower the permeability in the holds
and forward spaces enough,
that you would reach equilibrium
and you would never go down,
or it would take
hours and hours and hours and hours.
So how do you...

THOMAS:
all the lifejackets on board,
just all of them,
and shove them down
in those four compartments.
You would lower the permeabilities
really low.
- That's pretty scary.
- Like a ping-pong ball?
- Yeah.

- CAMERON:
But all you got to do is
reduce, like, 20% of that total volume.
- I mean, that's a lot of volume, but...
- How do you get them in?
Because you try to push them down,
they keep popping up.
You put them in before the flooding.
- I like that.

- MARSCHALL:
The risk of taking the lifejackets
off of all the passengers,
saying, "We're going to do this instead."
Well, they can live, or they can die
in the water wearing lifejackets.
MARSCHALLI Yeah.
Now take away every lifejacket from
every man, woman, and child on the ship,
and put them all into one room.
(SIGHS SKEPTICALLY)
That might be piling your chips
on one, kind of, long shot.
Now based on
what we've learned in this room,
what did we get wrong
in depicting the tragedy
in the feature film?

MAN:
said, nice and cheery, so there's no panic.
"Wedding Dance."
(PLAYING)

CAMERON:
a beating for what we showed in the movie.
There were people
that disagreed with certain aspects of it
because they had their own
preconceptions of what it was like.
Stop, stop, stop!
(SCREAMS)
Hold the left side!
It was generally, broadly
well-accepted in the Titanic community.
I think it's really more that
we're just hard on ourselves.
Based on what we know now,
what did we screw up in the movie?
(LAUGHS)
We didn't screw it up. We were basing it
on what we knew at the time.
Exactly.
So, I think, of course, Ken could
give us a list about 100 things long.
Are we just really nitpicking
over physical things
that we would do different
with your sinking?
What you would consider nitpicking
and what I would consider nitpicking
are two different things.
- Your broad strokes are my nitpicks.
- No, I'm talking about the sinking.
- The way you depicted the sinking.
- Yeah.
- There is a mistake. There was a...
- The broad strokes are very accurate.
At one point during the sinking,
there was a clear list where
lifeboats were really scraping the side
and they were trying to push with oars
to even lower the boats,
and that isn't depicted in the movie.
So that's something that could be changed,
if it were ever to be done.
The next time I build a 1.5 million pound set

and lower it four stories into a tank,
I'll make sure I get that list on there.

MAN:
Boat 11, which is caught
with the condenser discharge,
is trying to row away while
13 is coming down almost on top of it,
right behind that.
And just about the time
that 13 hits the water,
15 will be coming down on top of that.
And the wash from that discharge
washes 13 aft,
right underneath 15
to the place where the passengers
can reach up and touch the bottom
of that 15 coming down.
And they were panicked.
They didn't know if they could hear them.
But, fortunately, they were able to
release the falls on 13 just in time
to row out of the way.
And then 15 came down right
where 13 had been just moments before.

LYNCH:
They should be able to stand up
and touch the bottom,
and it shouldn't be
really much lower than that.
Thanks for your opinion.
Now I'm going to make it exciting.
What I told various interviewers
during the marketing of the film was,
"I want this movie to be
like you went back in a time machine
"and you actually were there for the sinking.
"That's how accurate I want it to be."
Now that didn't prove to be possible.
What about the colors of the rockets?
(PEOPLE GASPING IN AWE)

LYNCH:

and there was...

CAMERON:
they were white.
Well, no. It wasn't the consensus.
It was because
nobody would've believed you
if you'd had them burst into colored balls.
That's my memory.
Do you think they were colored?
'Cause you asked me about...
We know they were now. I mean...
- They were white.
- We had enough...
- He says they weren't white.
- They went up white,
-and they burst into colored balls.
- Yeah, they were white.
- All of them.

- STEPHENSON:

LYNCH:
and burst into colored balls.
Yup.
Well, no, it wasn't the consensus,
it was because
nobody would've believed you.
The only people who said they burst out
into white balls were the officers.
Can we put Parks' monitor up, please?
'Cause this is something
we did not know then that I now know.
-2004, we found a box of rocket detonators.

- CAMERON:

STEPHENSON:
about this is,
there was a hole
behind the brass cone of the detonator
that was cut out to let you see
the color of the balls that would
come out of this white burst.

This is definitely bluer and greener,
and this is definitely warmer, redder.
Obviously white.

SAUDER:

CAMERON:
I wish we'd had that
when we were making the movie.
We would've made it look right.
And so, apparently they were sending up
rockets that did burst into colored balls,
the way people remembered.
He's got to go back and change everything
he's ever written about the rockets,
Ken's got to go back and
redo every painting he's ever done,
and I'd have to go back and redo the movie
and change the colors of
some of the rockets at least.
Of course what we all cling to is,
at least some of them were white.
Well, how about the fact that
all of your paintings and the movie
Well, how about the fact that
all of your paintings and the movie
show the elevation of the stern
significantly higher than
what we now know from this simulation.
We now know
the angle of the ship's too high.
It's dramatic. You know, it looks cool.
(PEOPLE SCREAMING)
So it's not like there was this equipoise,
this moment of it just sitting there.
Even though we protracted it in the film,
and that's the romanticized image of it.
In fact, it would've just accelerated
through that angle
until it finally did that.
It's not vastly different
than what we've showed,
just a little less dramatic.
And I think that we're constantly trying to

take into consideration
what eyewitnesses saw
and how dramatic it was to them,
how it felt to them, and how they might've
slightly exaggerated things later,
in the telling of the story,
as almost everyone would do.
Bloody pull faster! And pull!

CAMERON:
in broad strokes.
The ship broke at the surface.
We know that.
(PEOPLE SCREAMING)
The bow plunged vertically. We know that.
The stern hung around for a while.
We know that.
So the movie was true in its broad strokes.
So I didn't feel after the film
that I had a lot to defend.
I felt like we had done good work
at the time.
But it was limited.
There was still so much more
that the wreck site could teach us,
which is why I personally
went back out there
on two successive expeditions.
My decision has been to
not change anything in the movie.
Because once you start that process,
where do you stop?
And the things that are wrong
are things that would only bother
eight people in the world.
Myself being one of them,
but I can live with it.
Even though I'm not going to
change the movie,
I do get to redo
the animation of the sinking.
It's going to be very cool.
The most accurate depiction ever
of what happened that night,

100 years ago.
We've beat it up.
We've disagreed.
But we've found a lot of consensus.
We've advanced our knowledge
of Titanic's final moments,
and have plugged what we've learned
into an updated visual record.
The final word on the disaster in animation.
So this is the last thing I, uh...
As Quicktime, that you had...
Now did you notice that,
in Stettler's paper, he said that
the final trim angle before the break
was 23 degrees, not 19?
Yes.

CAMERON:
of our investigation,
Commander Stettler revised his results
and published 23 degrees
maximum angle of tilt.
You know, if our two-and-a-half year
engineering study shows 23 degrees,
we should show 23 degrees.
Okay, there.
That's the number that he settled on, right?
It's two degrees off right now.
That's an easy fix.
You know, we've been arguing
over the number of degrees
for about 15 years now.
Let's make it 23 degrees.
Oh, absolutely. I'm happy to do it.
All right. Let's put this to bed.
There we go.
All right. That looks good.
The ship's veering to port at 22 knots.
Sideswipes the iceberg.
Murdoch ports around the iceberg,
trying to keep from hitting the propellers.
That looks pretty good.
Okay, so now we're watching
in accelerated time.

We see the first five compartments flood.
They equalize pretty quickly.
Bow is pulled down.
We see the port list.
Port list looks right.
That looks like about nine degrees.
Oh, you can really see the effect of that list
on the flooding.
So, yeah, superstructure
starts to get pulled under.
Funnels collapse at their base.
Now the bow is accelerating downward.
That looks good.
We're starting to see the stern come up.
We got our maximum peak stress,
and yeah, boom!
It breaks.
Okay, bow swinging down...
That looks good.
The double keel hang on,
then they separate.
Bow plunges straight down.
All right, we got mast snapping back,
the funnels are ripping backwards,
pulling off all the davits.
Bow is going down like a torpedo.
Here's the angle when it falls through
into a stable position.
Let's see the stern.
Keeling way over to port. That looks right.
And she goes... Yup, that is right.
She goes almost vertical
just when she goes under, and then, boom!
Implodes.
Now she accelerates,
and all the stuff starts to rip off.
See the shell plating going.
There goes the double bottom.
Double bottom frisbeeing off.
And the stern's falling through.
So now the stern's falling aft-end down.
And we see the spiraling.
Here comes the bow.
Bow is falling in its stable position,

and it hits...
Yeah, boom!
It kind of breaks its back.
And we see the hydraulic outburst
and the down blast effect.
Let's see the stern.
Oh, you see the shell plating blowing off,
decks, everything kind of settling around it.
Looks like a big airplane crash site.
Badda-bing, badda-boom.
That's exactly what we're looking for.
And action!
And action!
I've been working on Titanic
for nearly 20 years.
I've planned this investigation
to be my final word.
It's time for me to pass the baton
and move on to some new challenges,
but I'll never stop thinking about Titanic.
For me, it's so much more than
simply an exercise in forensic archeology.
Part of the Titanic parable is of arrogance,
of hubris,
of the sense that we're too big to fail.
Well, where have we heard that one before?
There was this big machine,
this human system that was
pushing forward with so much momentum
that it couldn't turn,
it couldn't stop in time to avert a disaster.
And that's what we have right now.
Within that human system
on board that ship,
if you want to make it
a microcosm for the world,
you have different classes.
You've got first class, second class,
third class.
Well, in our world right now,
you've got developed nations
and undeveloped nations.
You've got the starving millions
who are going to be the ones most affected

by the next iceberg that we hit,
which is going to be climate change.
We can see that iceberg
ahead of us right now,
but we can't turn.
We can't turn
because of the momentum of the system.
Political momentum, business momentum.
There are too many people
making money out of the system
the way the system works right now.
And those people, frankly,
have their hands on the levers of power
and aren't ready to let them go.
Until they do, we're not going to be able to
turn and miss that iceberg,
and we're going to hit it.
When we hit it,
the rich are still going to be
able to get their access
to food, to arable land, to water, and so on.
It's going to be the poor,
it's going to be the steerage
that are going to be impacted.
And it was the same with Titanic.
And I think that's why this story
will always fascinate people,
because it is a perfect, little encapsulation
of the world and all social spectra.
But until our lives are really put at risk,
the moment of truth,
we don't know what we would do.
And that's my final word.
English - US