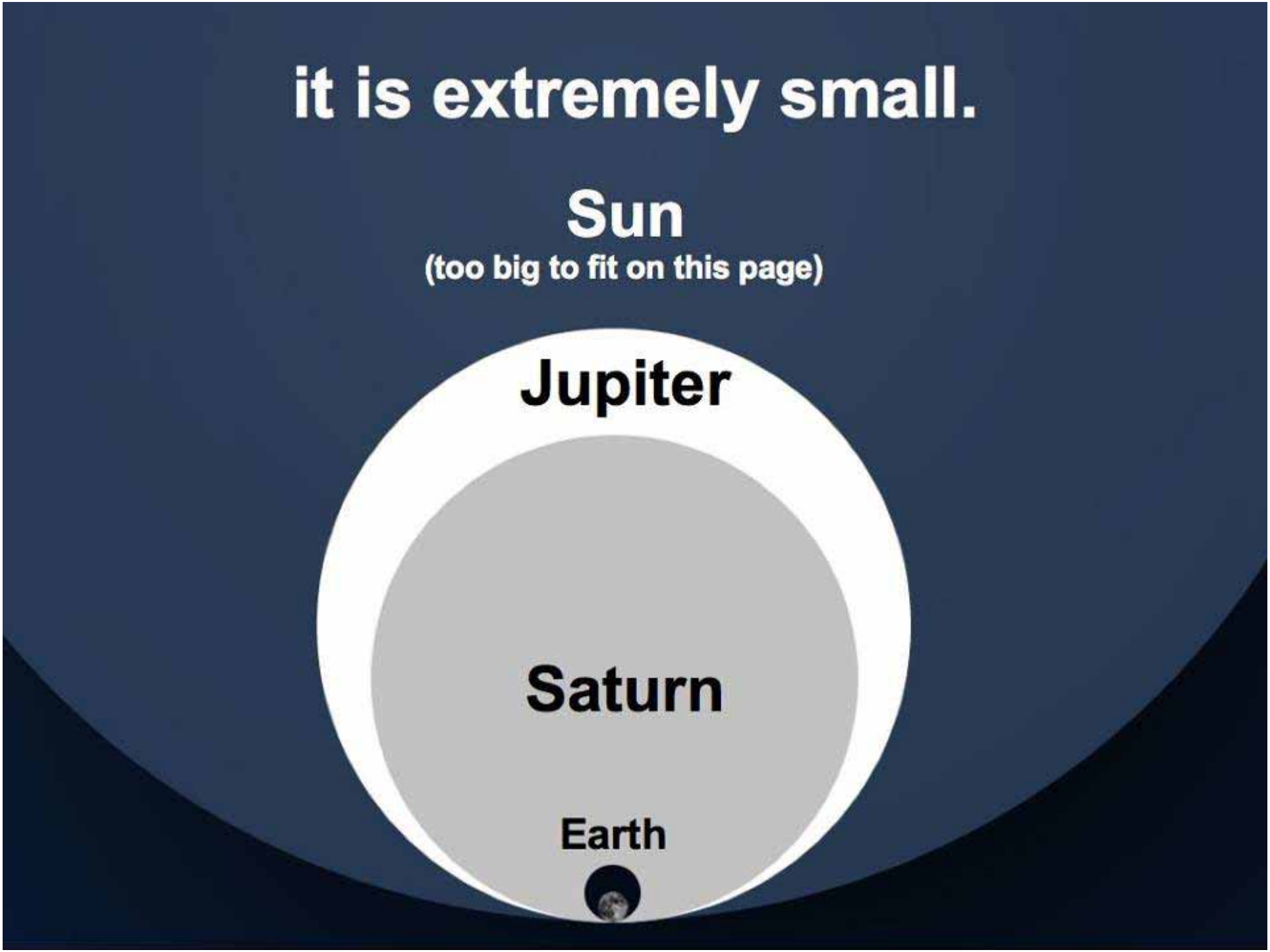

why the Moon?
enabling research
and discover

This is the Moon,

it is extremely small.



We've been there before…

yet, we know very little about it.


Relative locations of Apollo landing
sites superimposed on a map of the US.
15
17
11
12
14
16
Montana
North Dakota
Wyoming
Nebraska
Idaho
Oregon
Nevada
Utah
Colorado
Kansas
Iowa
Wisconsin
Michigan
Illinois
Indiana
Ohio
Missouri
Kentucky
Tennessee
Oklahoma
Arkansas
Mississippi
Georgia
Texas
Louisiana
Florida
Arizona
New Mexico
North Carolina
South Carolina
West Virginia
Virginia
Pennsylvania
México
Gulf of Mexico
Minneapolis
Milwaukee
Chicago
Detroit
Cleveland
Toledo
Pittsburgh
Columbus
Dayton
Indianapolis
Cincinnati
Kansas City
St Louis
Omaha
Lincoln
Denver
Colorado Springs
Wichita
Tulsa
Memphis
Atlanta
Charlotte
Dallas
Austin
Houston
San Antonio
El Paso
Albuquerque
Phoenix
Tucson
Los Angeles
San Diego
Sacramento
Salt Lake City
Toronto
Buffalo
Hamilton
New Orleans
Jacksonville
Orlando
Tampa
Miami

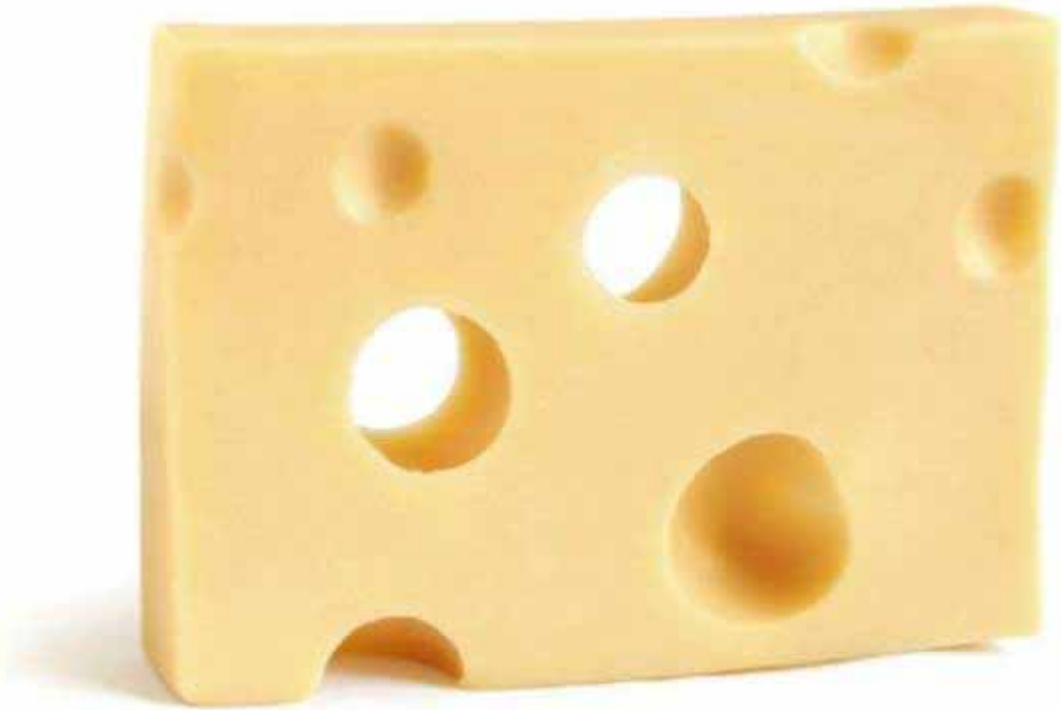
Six "landings" in North America would have given us very little knowledge of the continent.

But, consider this…

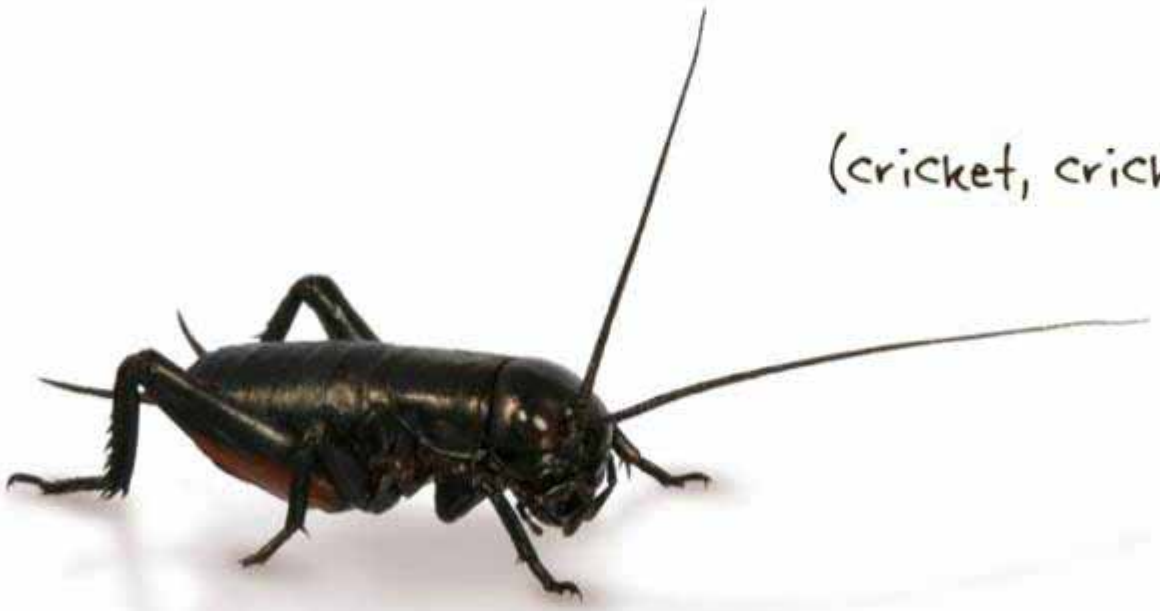
The Moon's surface area is roughly the size of North and South America combined.

NASA has plans to return
(by 2020)


But, why the Moon?



Hint: the answer does *not* involve cheese


(cricket, cricket...)

1. Exploration


Think,
Christopher Columbus

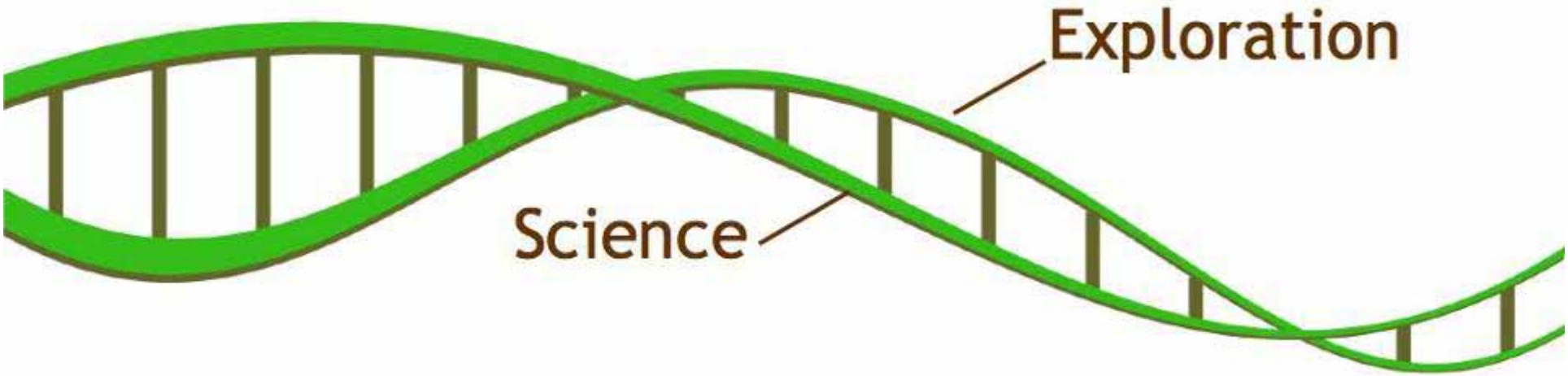
2. Science


Weather Balloon
Antarctica, Earth

Let's talk more about
Exploration and Science

I promise this won't put you to sleep

Think of it like this…


Exploration
Science

They are intertwined.

Exploration

is going into the unknown

Exploration

is looking over the next hill

Exploration

is sacrifice for risky rewards

Science

is understanding nature

Science

is observation, hypothesis, experiment

Science

is asking questions

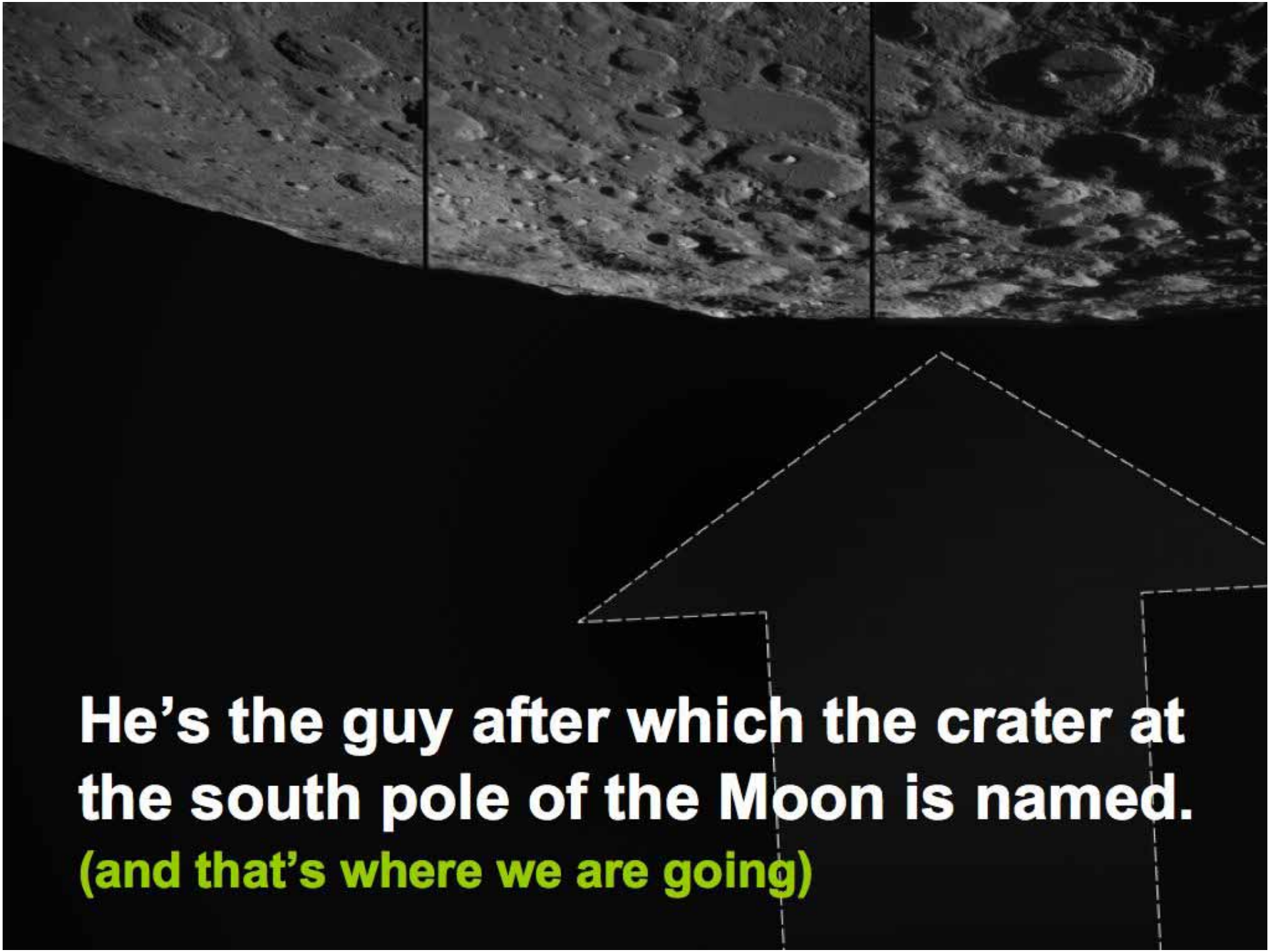
To do science we must first explore.

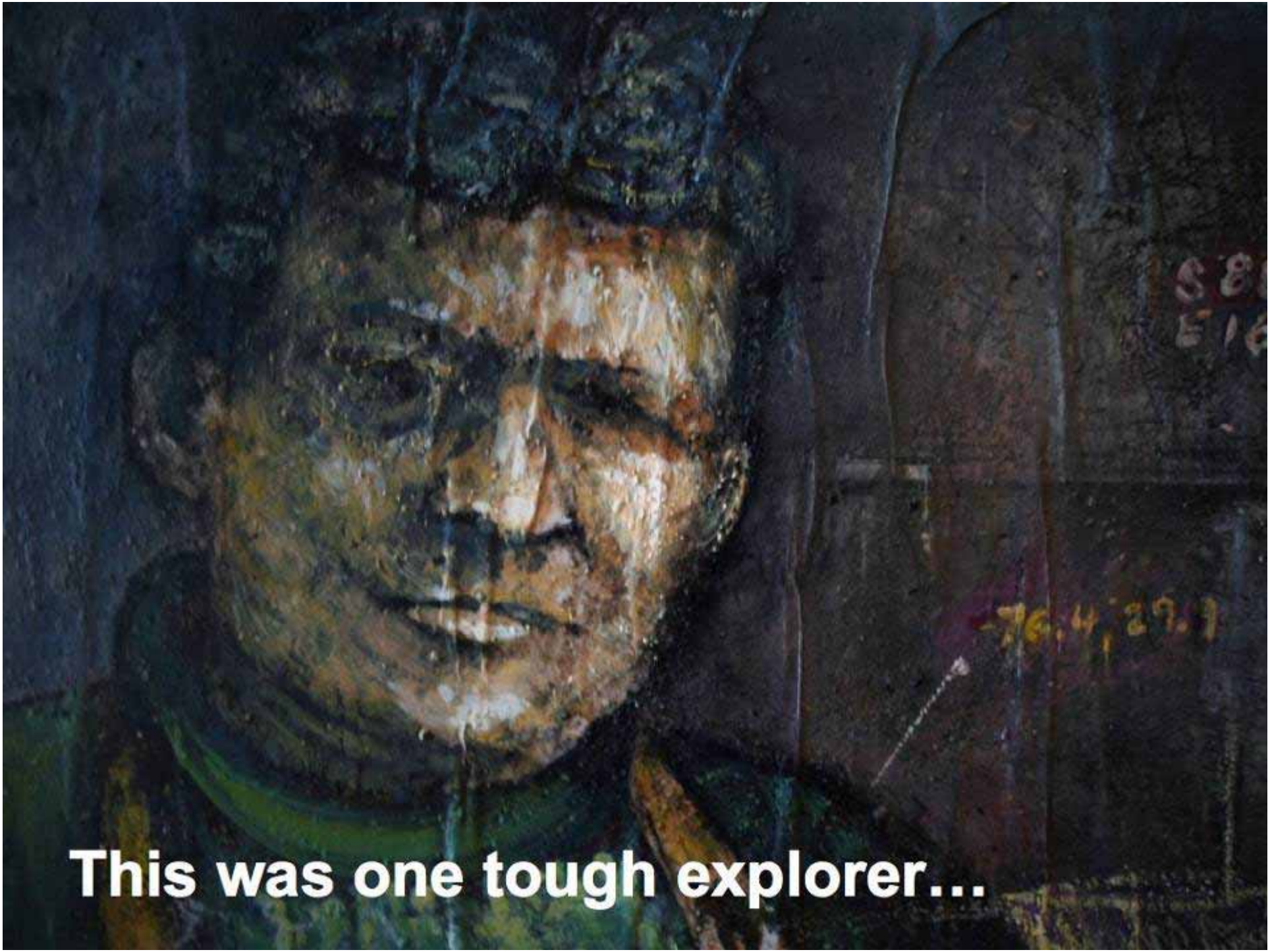
Exploration does not equal science.

Exploration enables science.

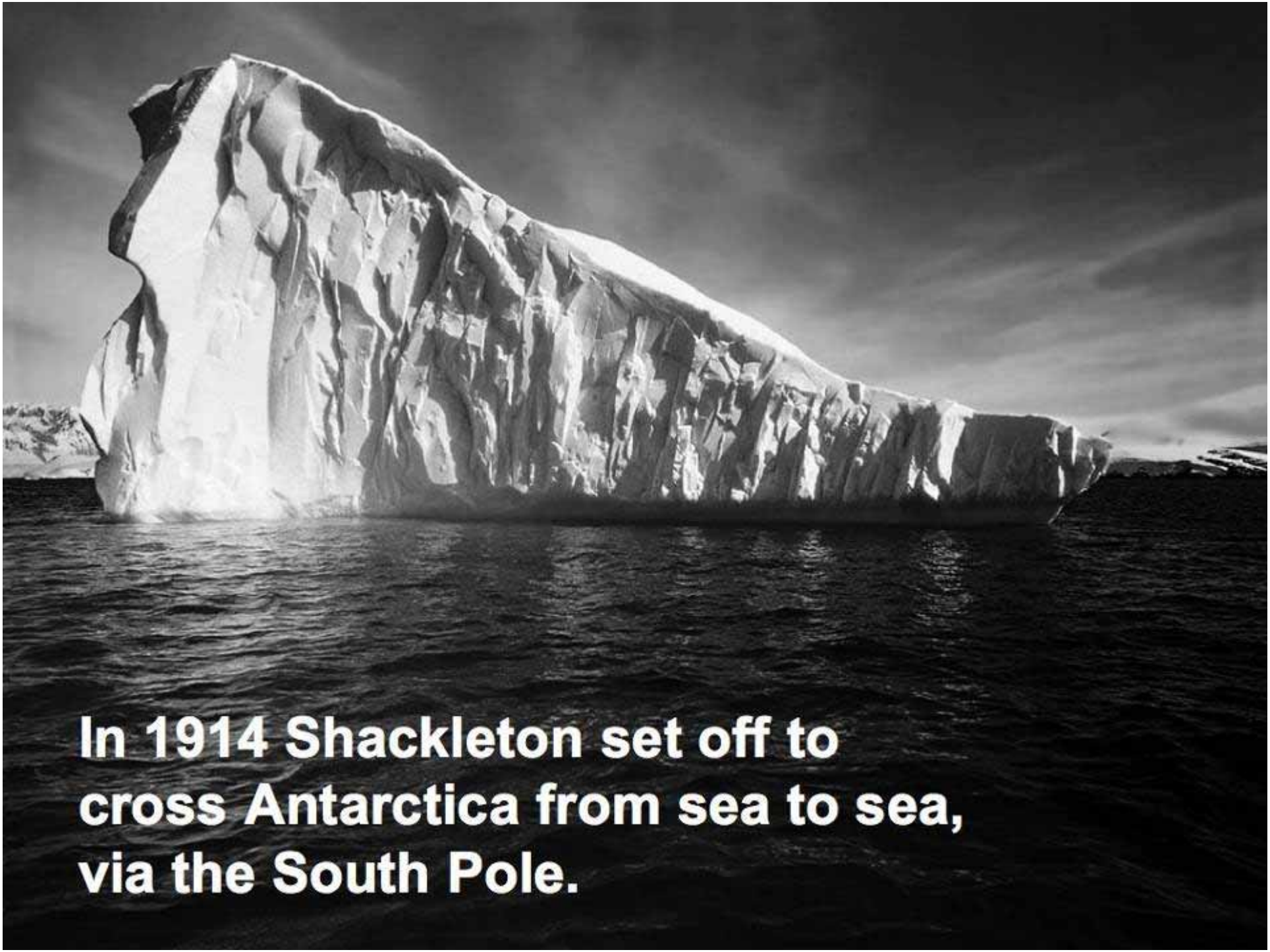
One of my favorite explorers is Ernest Shackleton.


Where have I heard that name?


He’s the guy after which the crater at the south pole of the Moon is named.
(and that’s where we are going)

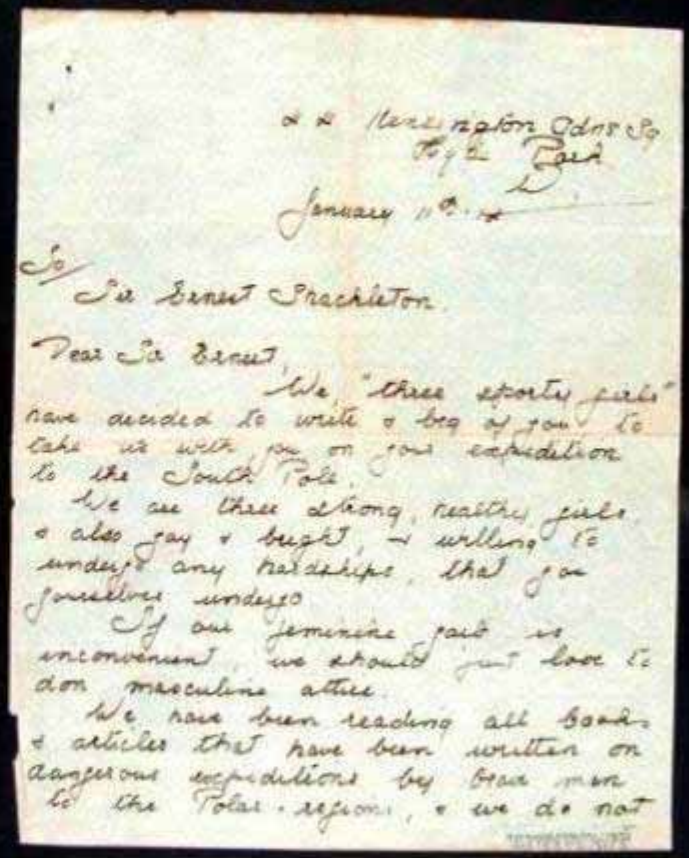

This was one tough explorer…

… and his story is a true tale of the risks and rewards of exploration.


In 1914 Shackleton set off to
cross Antarctica from sea to sea,
via the South Pole.

Over 5000 people applied to be on his crew.

(including 'three sporty girls')



January 11th.

To
Sir Ernest Shackleton.

Dear Sir Ernest,

We, "three sporty girls" have decided to write a beg of you to take us with you on your expedition to the South Pole.

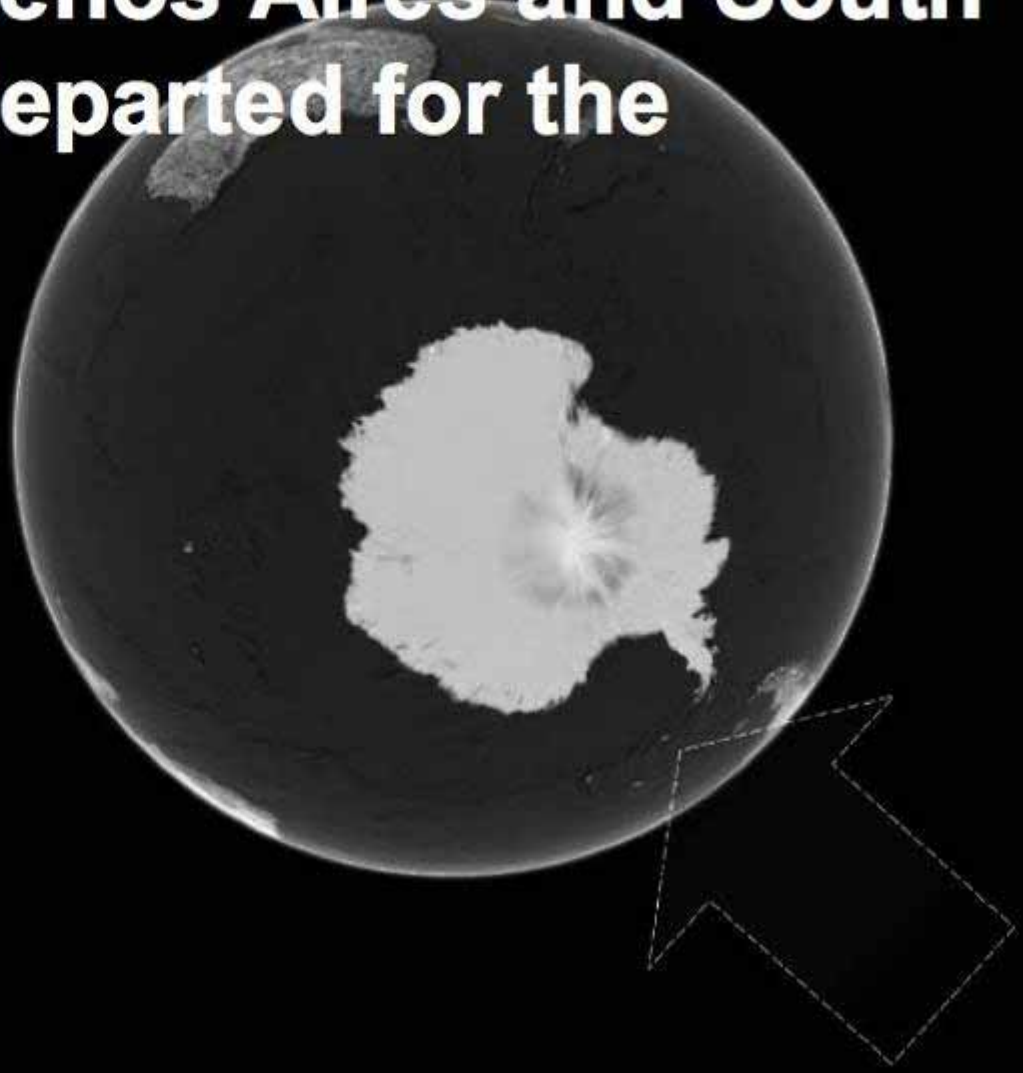
We are three strong, healthy girls & also gay & bright, & willing to undergo any hardships that you yourselves undergo.

If our feminine garb is inconvenient, we should just love to don masculine attire.

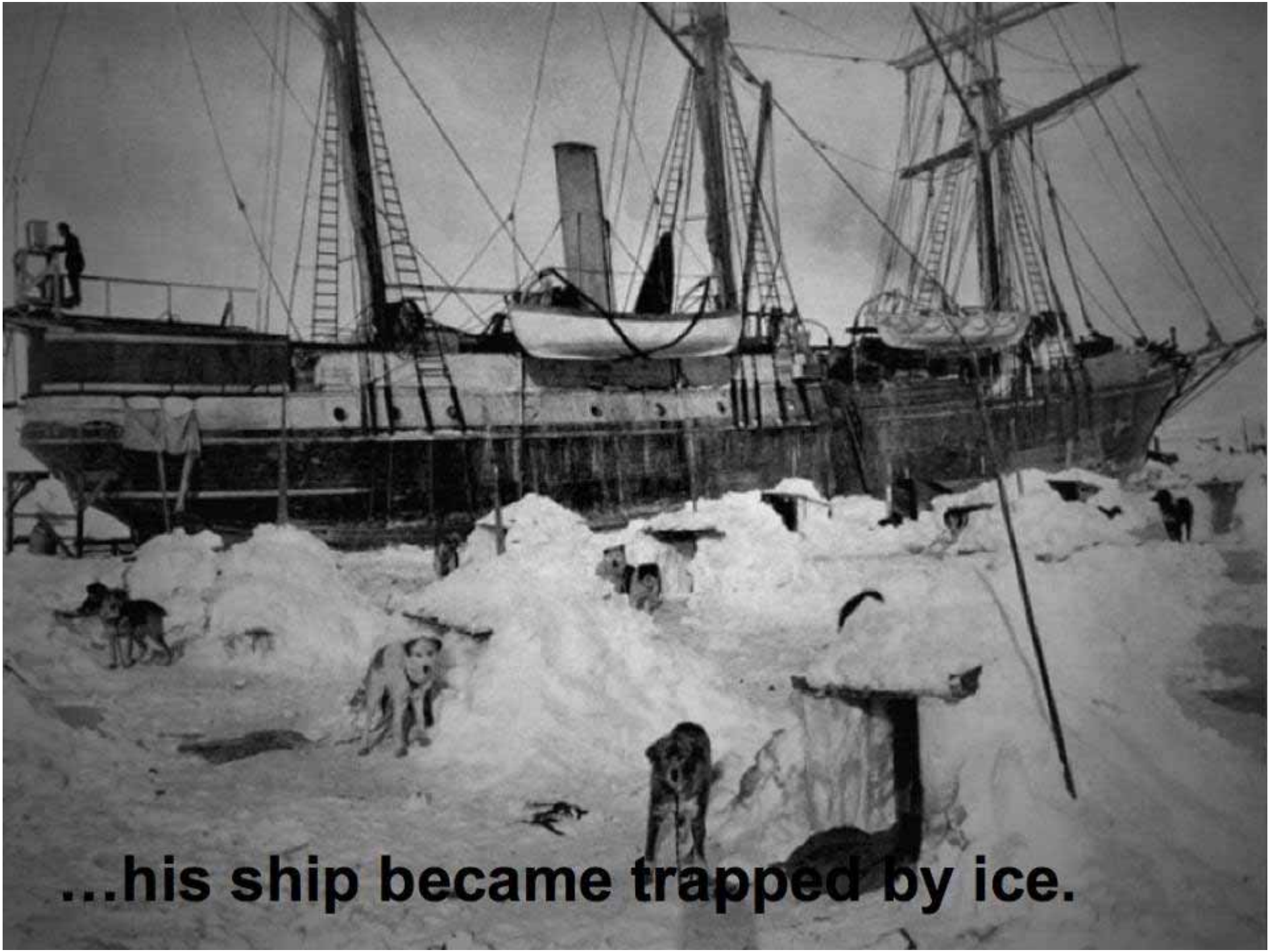
We have been reading all Books & articles that have been written on dangerous expeditions by brave men to the Polar regions, & we do not

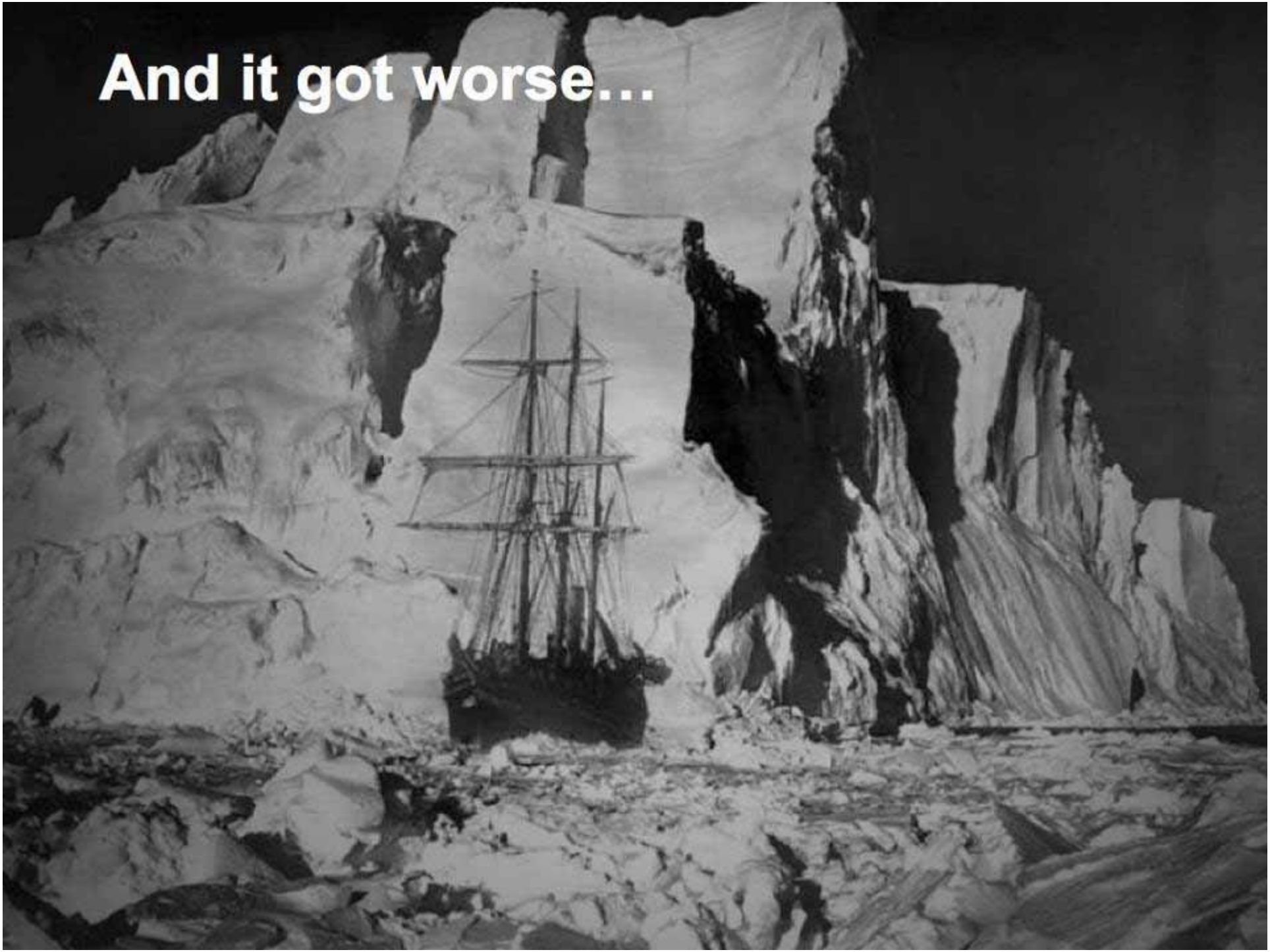

This was his crew.

They left England in 1914. After stopping in Buenos Aires and South Georgia they departed for the Weddell Sea.



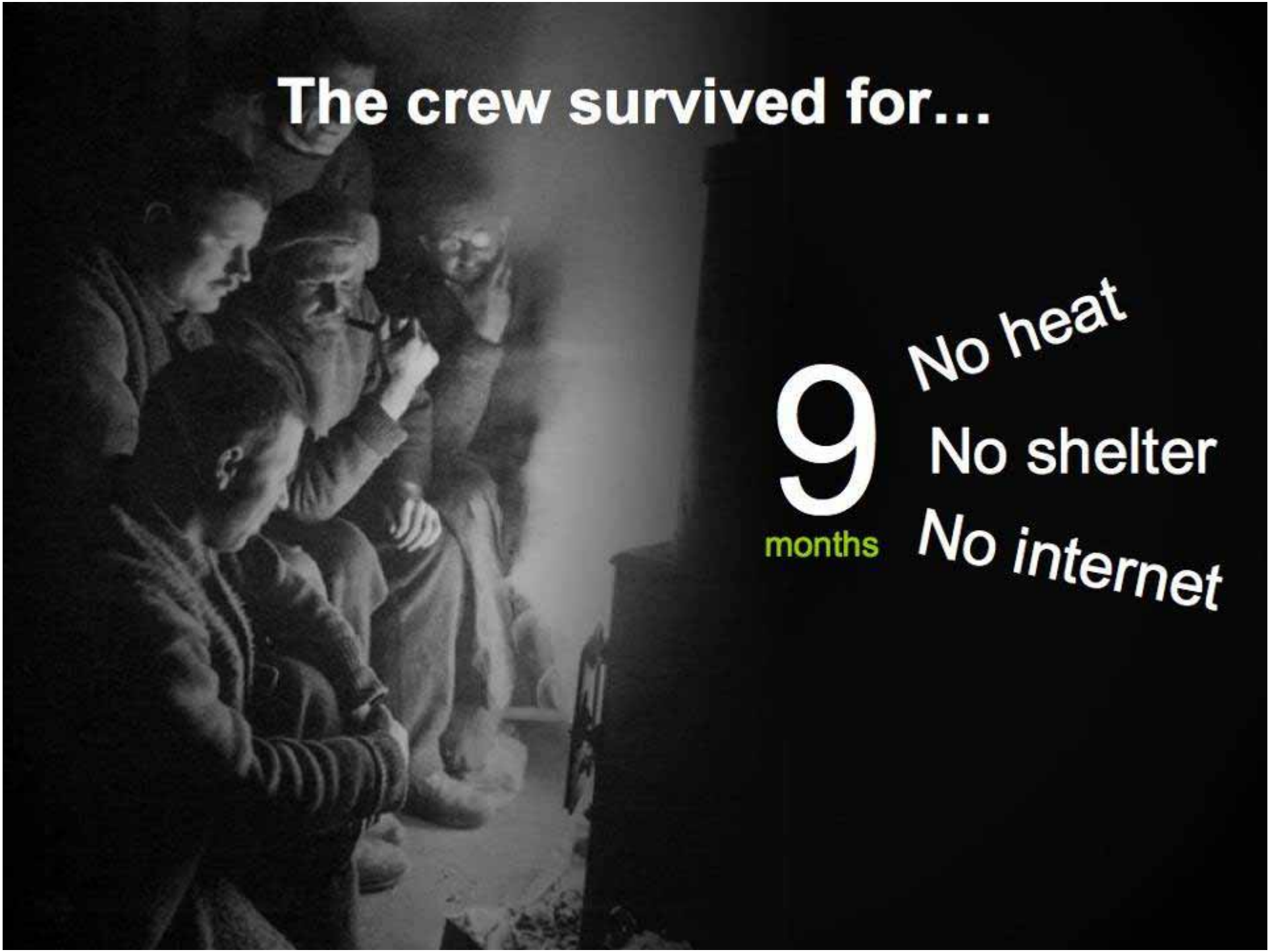
All was going well until…


...his ship became trapped by ice.

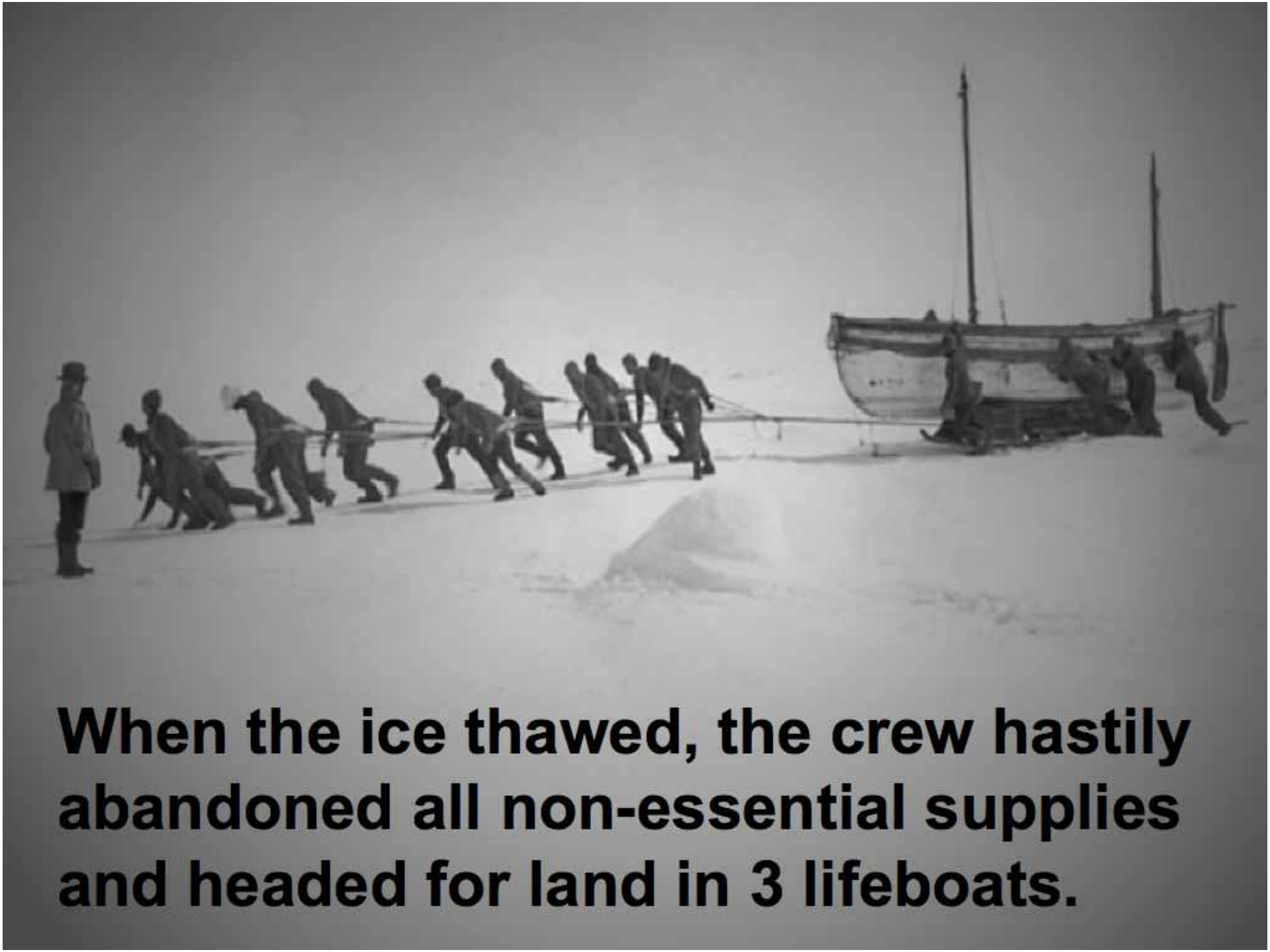

And it got worse…

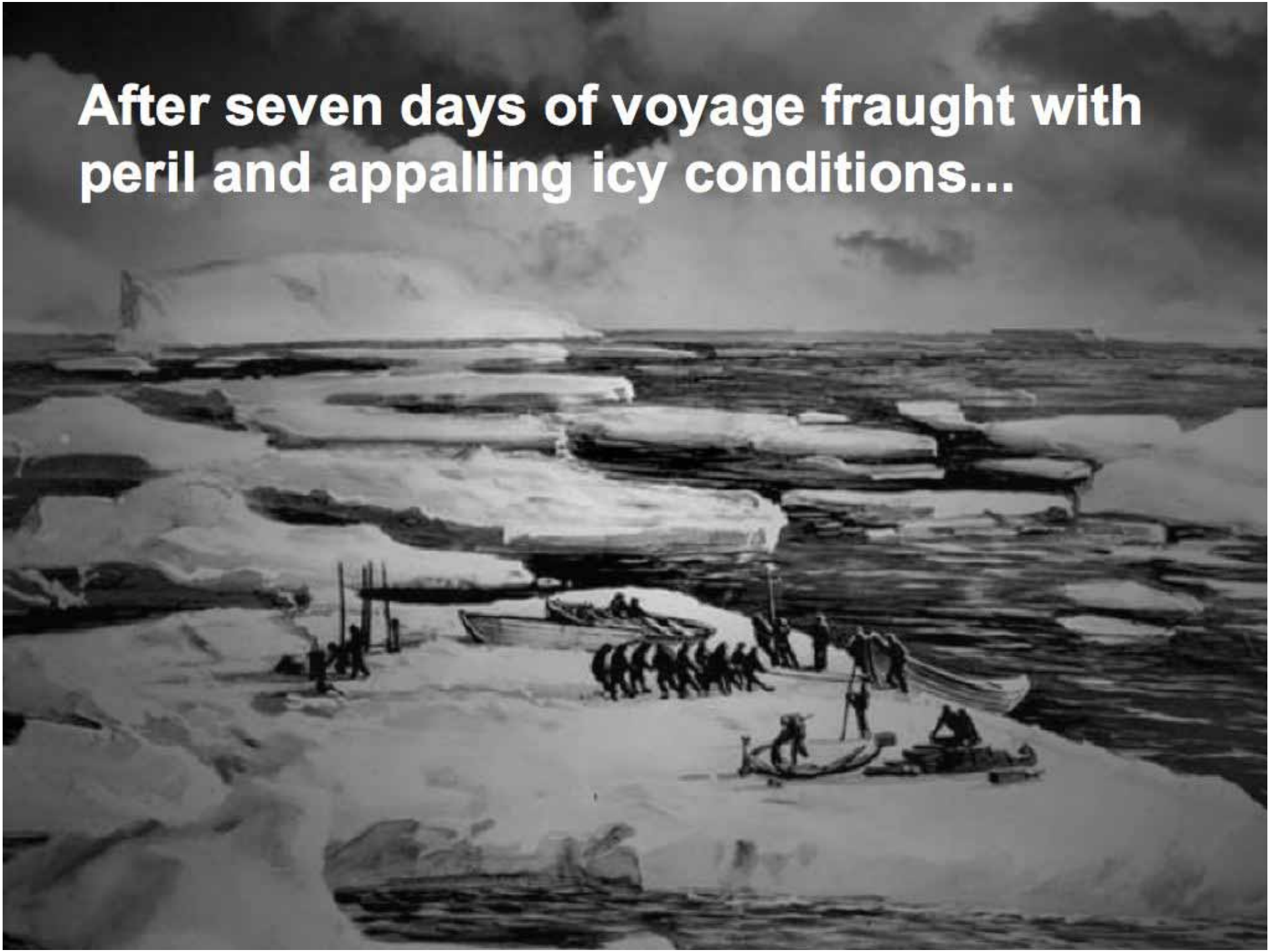
The *Endurance* was soon crushed and sank.

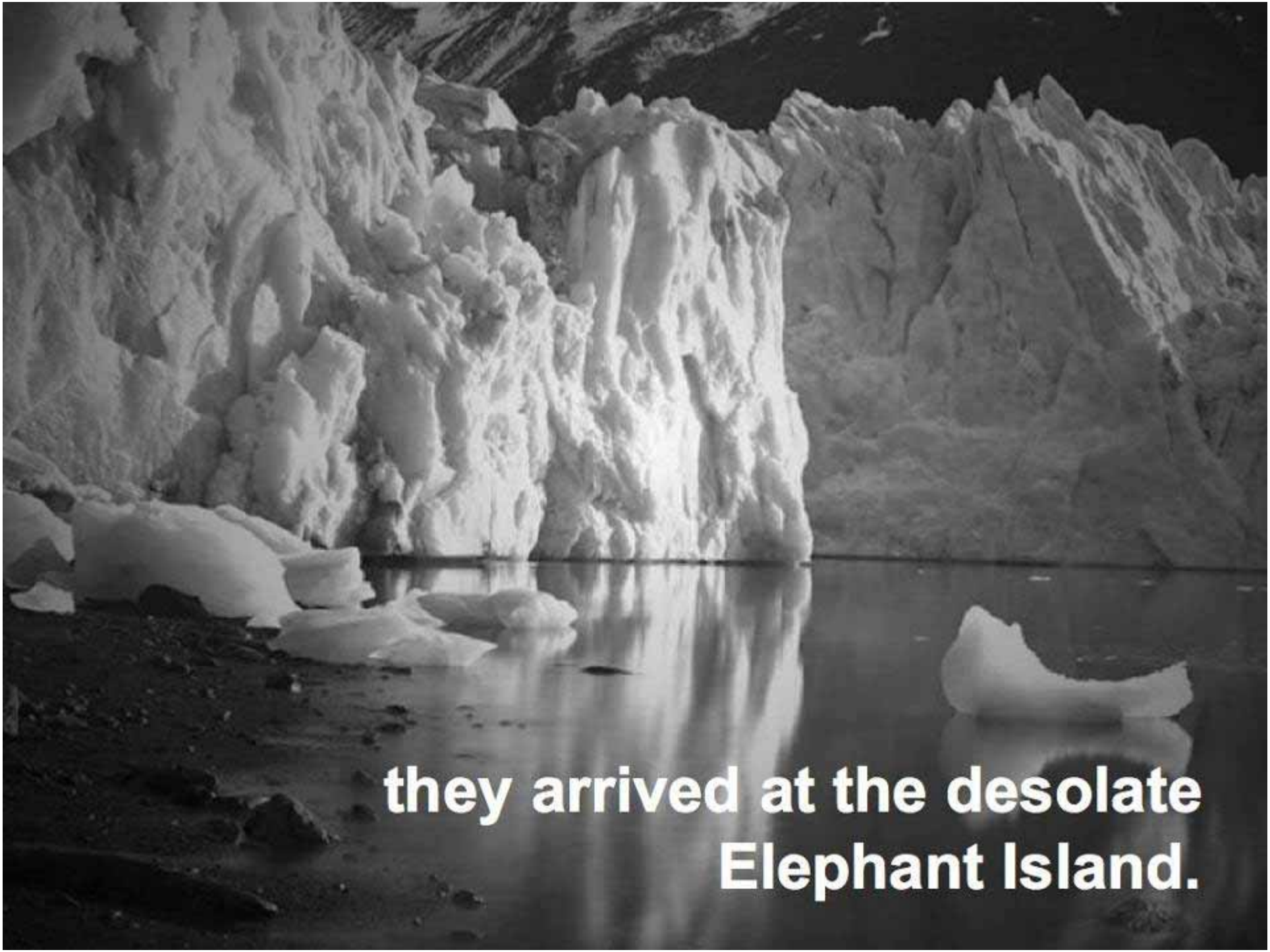

Not good.


The crew survived for…
9
months
No heat
No shelter
No internet


They were tough.


When the ice thawed, the crew hastily abandoned all non-essential supplies and headed for land in 3 lifeboats.

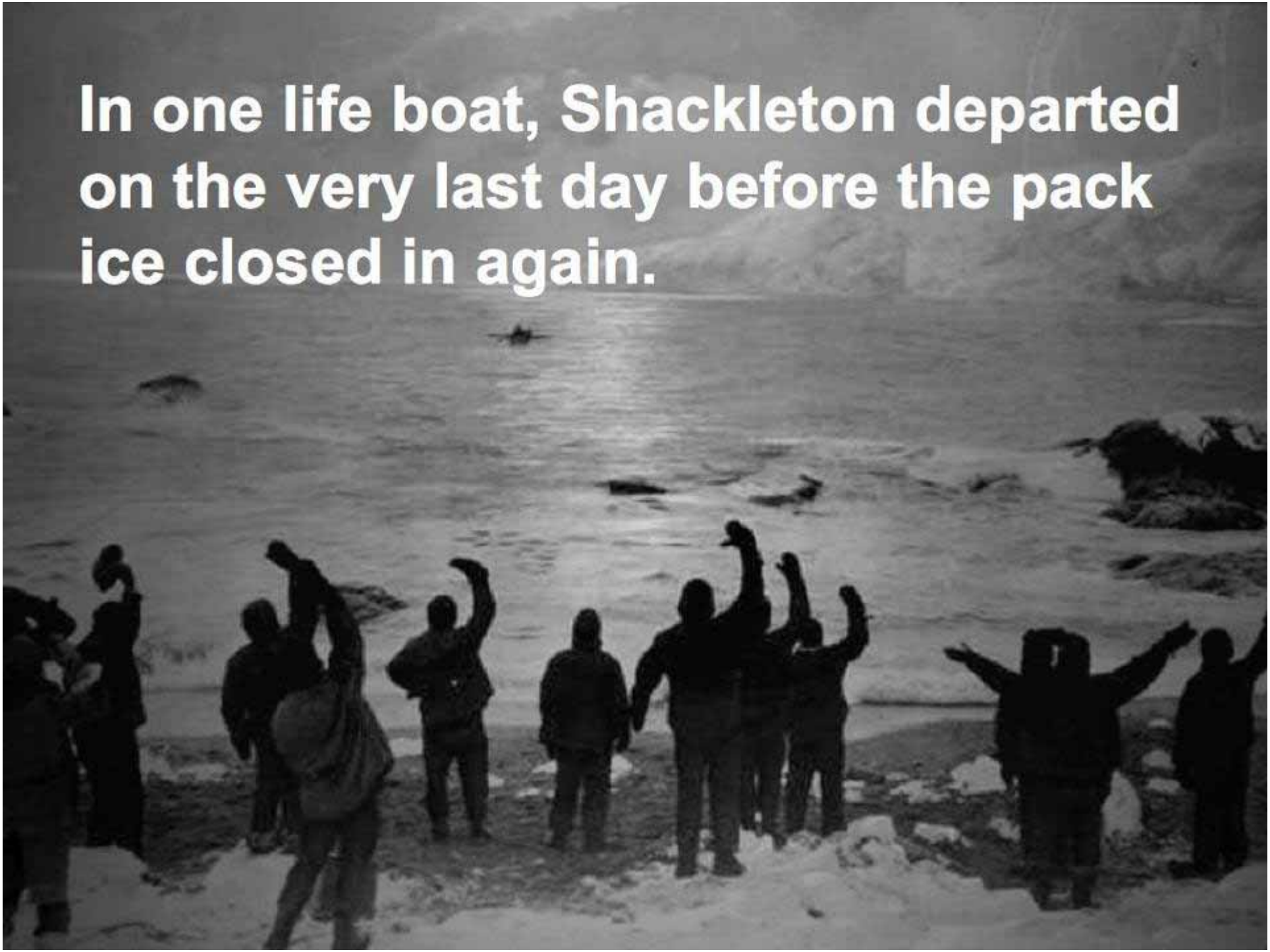

After seven days of voyage fraught with peril and appalling icy conditions...

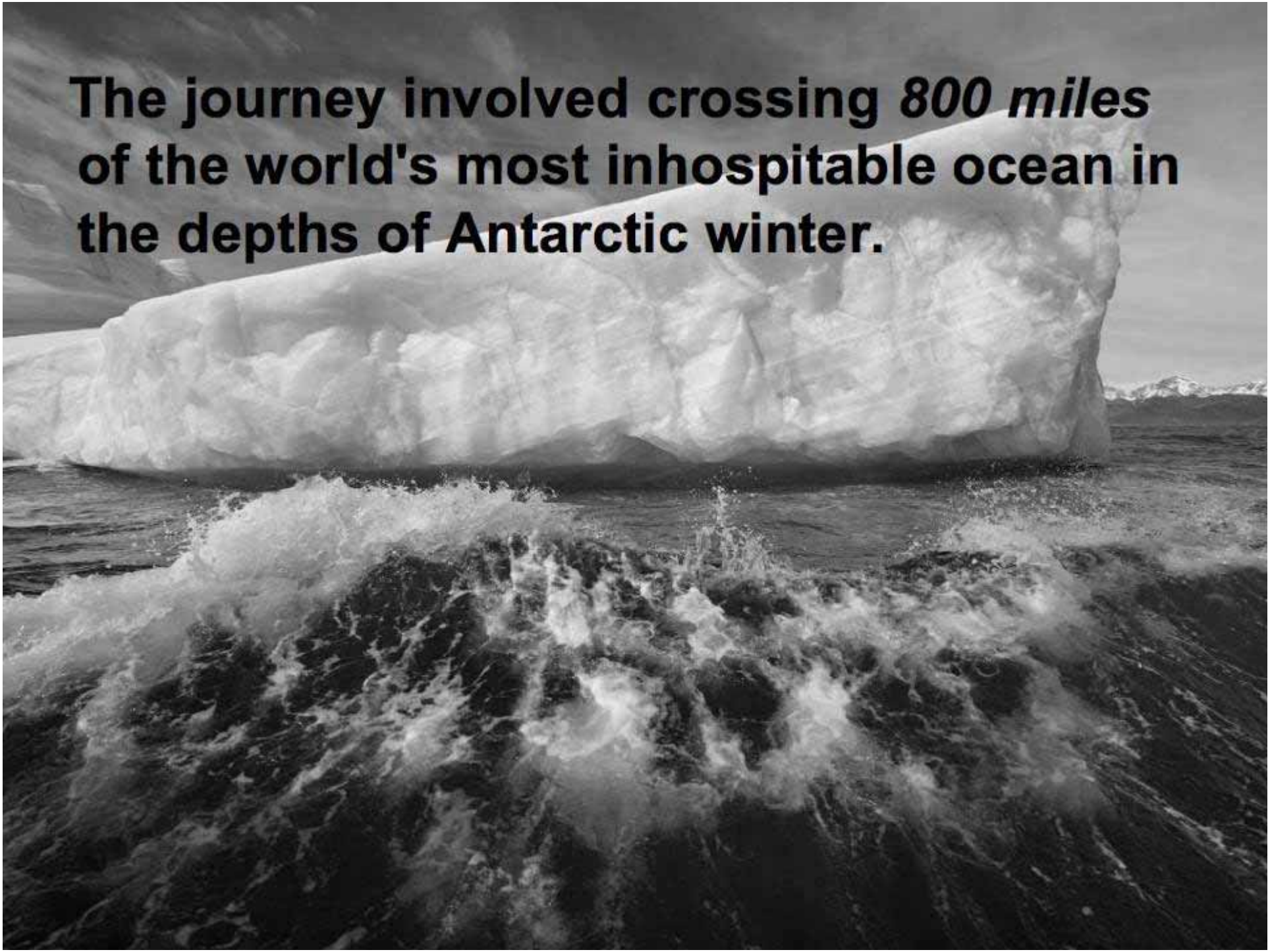

they arrived at the desolate
Elephant Island.

It was the first time they had set foot on land since leaving South Georgia nearly 1½ years earlier, but…

Elephant Island was a (seriously) *inhospitable* place far from any shipping routes and thus a poor location to await rescue.

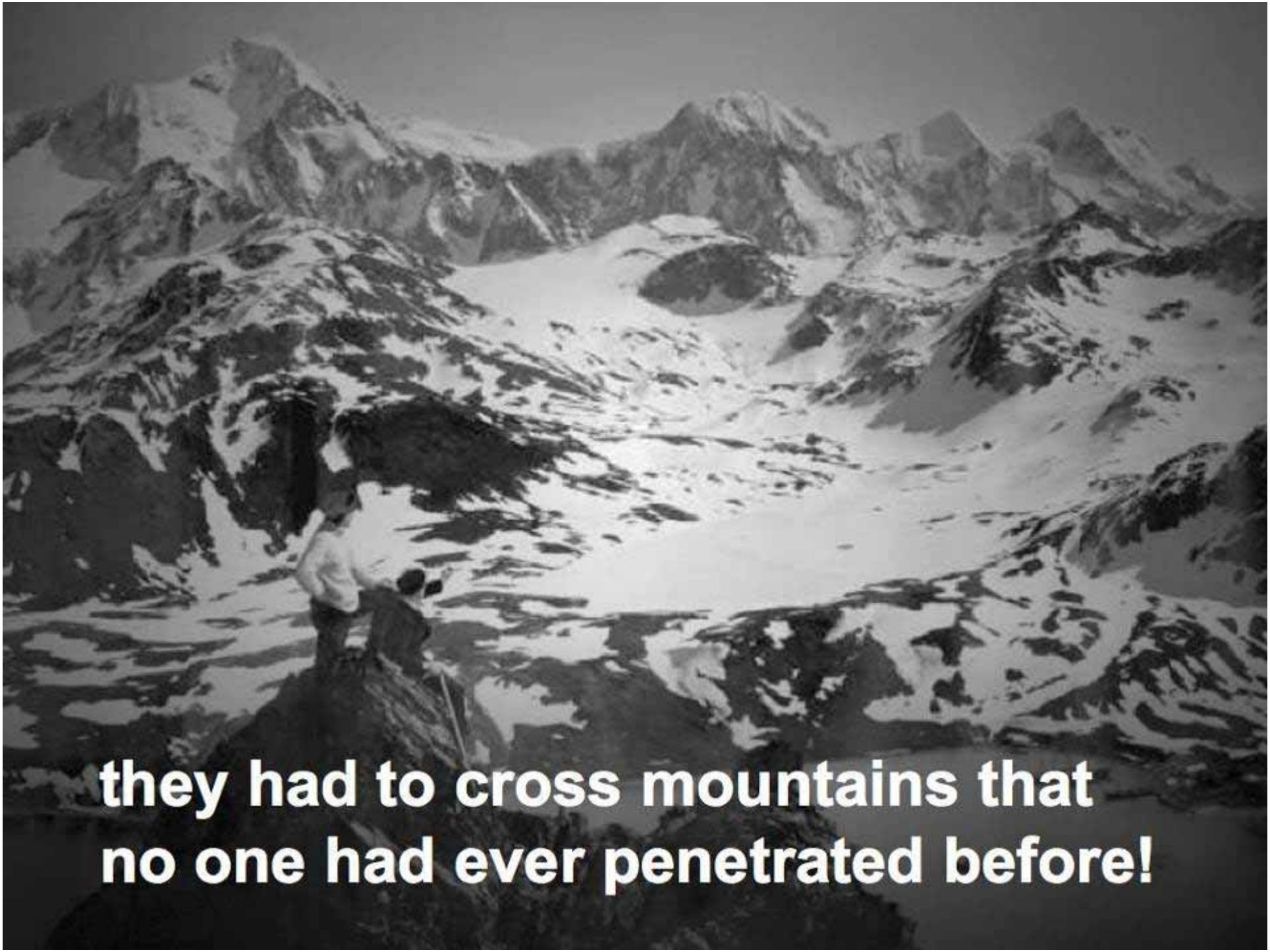

Within a few days of their arrival
Shackleton decided to fetch help.


In one life boat, Shackleton departed on the very last day before the pack ice closed in again.


The journey involved crossing *800 miles* of the world's most inhospitable ocean in the depths of Antarctic winter.


After 16 days, they arrived off South Georgia during **hurricane** conditions.

Help was now only 20 miles away, at the whaling stations on the east side of the island, but...


they had to cross mountains that
no one had ever penetrated before!

Against incredible odds

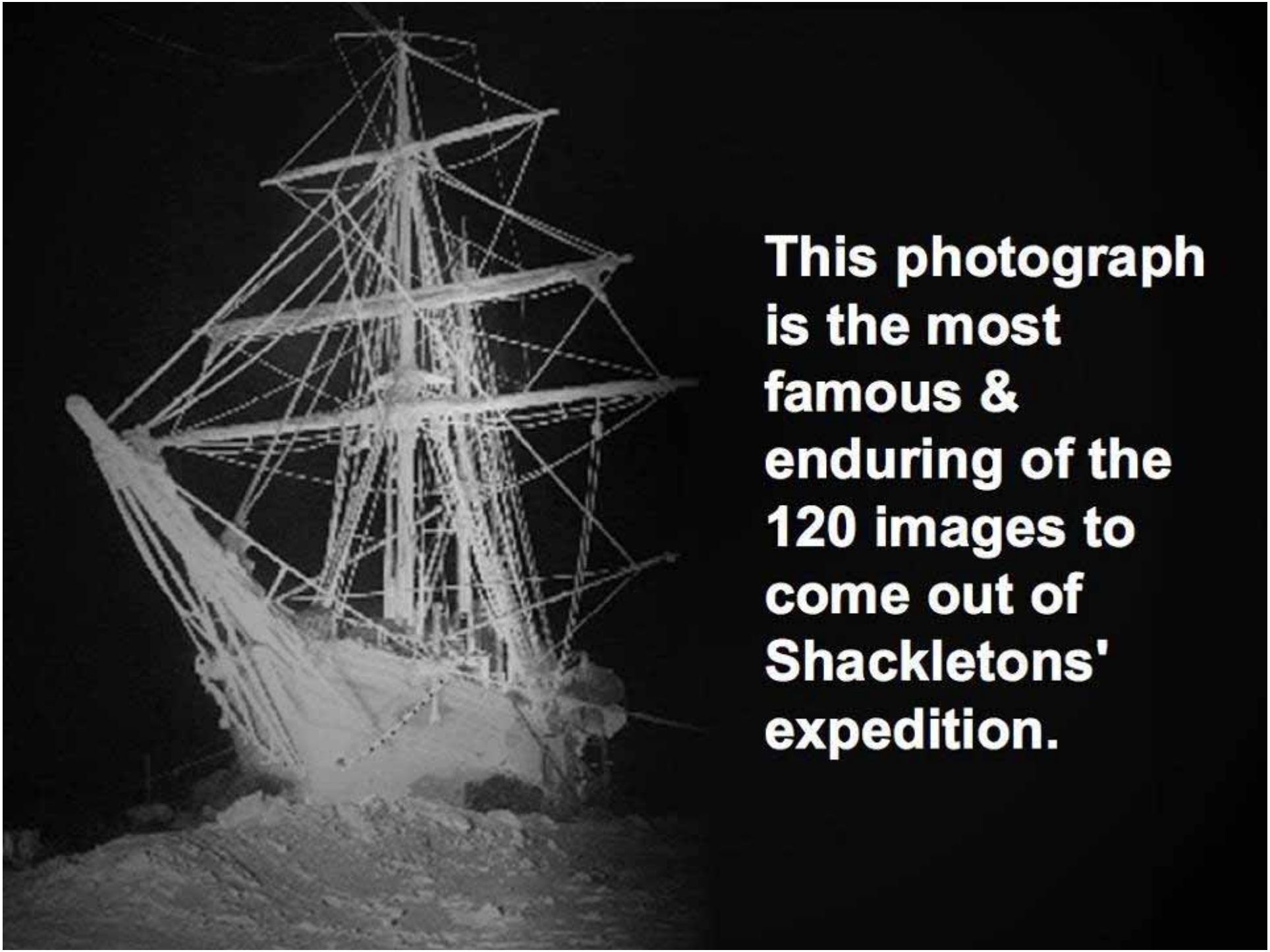
and on the *only* moonlit night
before bad weather closed in again

Shackleton made it to the whaling station of Stromness in 36 hours.

It took 4 months & 4 attempts before Shackleton rescued the remaining men.

Including…

Frank Hurley, the expedition photographer.


This photograph is the most famous & enduring of the 120 images to come out of Shackletons' expedition.

120 photographs of people doing the impossible.

Exploration is about people doing the impossible.


"Men wanted for hazardous
journey. Low wages, bitter cold,
long hours of complete darkness.
Safe return doubtful. Honour and
recognition in event of success."

Moral of the story:

Don’t get stuck in Antarctica?

Exploration isn't easy.

There is no turning back.

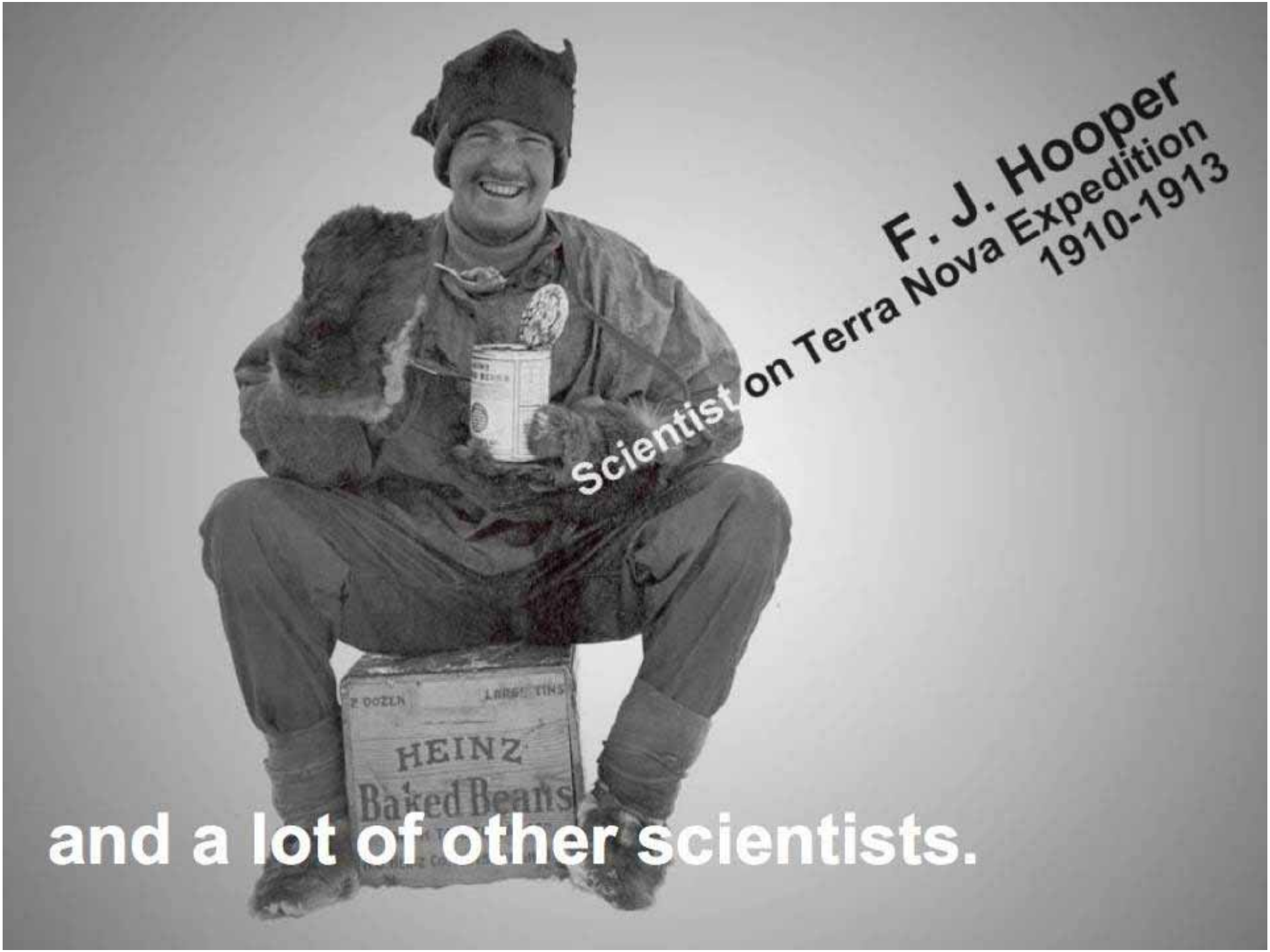

But, what about science?

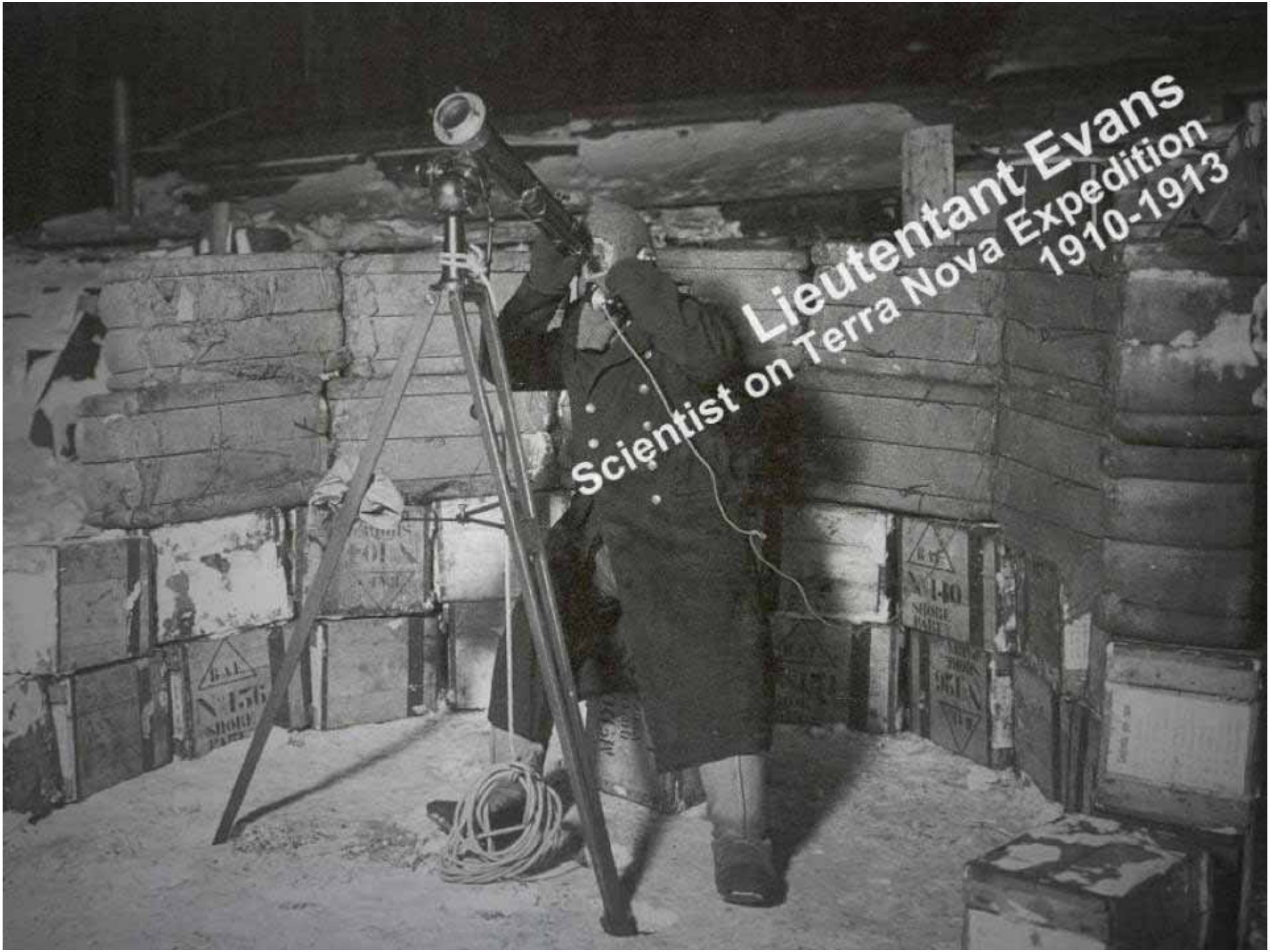
These boots were most likely those worn by James Mann Wordie during Shackleton's expedition.

Wordie was a geologist aboard *Endurance*.

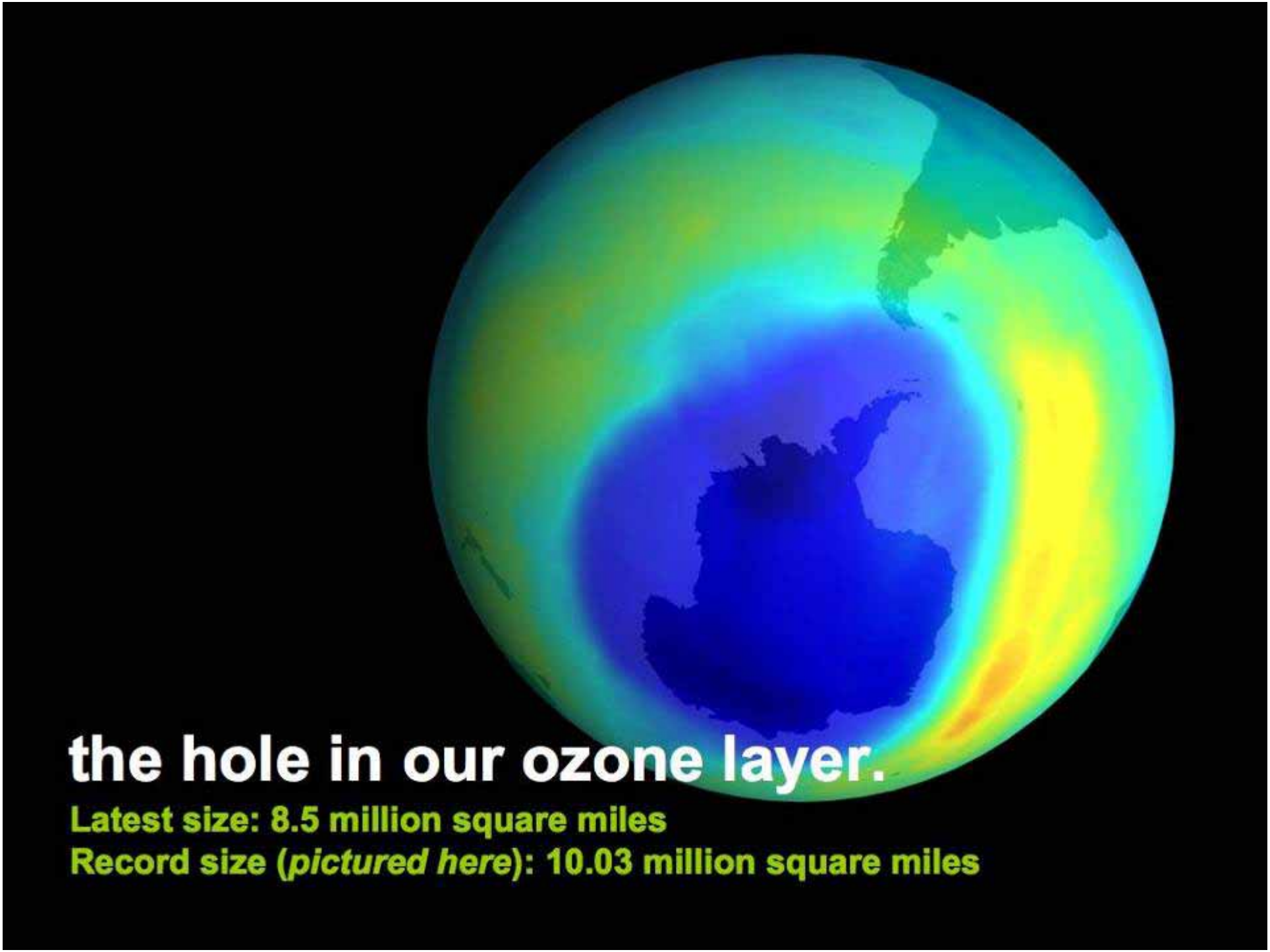
1739	Jean Bouvet (France)
1772-75	James Cook (Britain)
1819	William Smith (Britain)
1820	William Smith and Edward Bransfield (Britain)
1821-22	Nathaniel Brown Palmer (U.S.)
1823	James Weddell (Britain)
1838-42	Charles Wilkes (U.S.)
1839	John Balleny (Britain)
1839-43	James Clark Ross (Britain)
1895	Leonard Kristensen and C.E. Borchgrevink (Norway)
1897-99	Adrian de Gerlache (Belgium)
1901-3	Erich von Drygalski (Germany)
1901-4	Robert F. Scott (Britain)
1903-5, 1908-10	Jean B. Charcot (France)
1908-9	Ernest Shackleton (Britain)
1911	Roald Amundsen (Norway)
1911-14	Douglas Mawson (Australia)
1912	Robert F. Scott (Britain)
1928-30	Richard E. Byrd (U.S.)
1929	George Hubert Wilkins (Australia)
1929 -31	Douglas Mawson (Australia)
1929-33	Hjalmar Riiser-Larsen (Norway)
1933-35	Richard E. Byrd (U.S.)
1935-36	Lincoln Ellsworth (U.S.)
1938-39	Lincoln Ellsworth (U.S.)
1939-4	Richard E. Byrd (U.S.)
1946-47	Richard E. Byrd (U.S.)
1947-48	Finn Ronne (U.S.)
1948	Australia builds first permanent observation stations.
1955-56	Twelve nations set up bases for study during Inter-national Geophysical Year
1957-58	Sir Vivian Fuchs (Britain) *1990* Six-man international expedition
1993	Erling Kagge (Norway)

There were a lot of other expeditions…

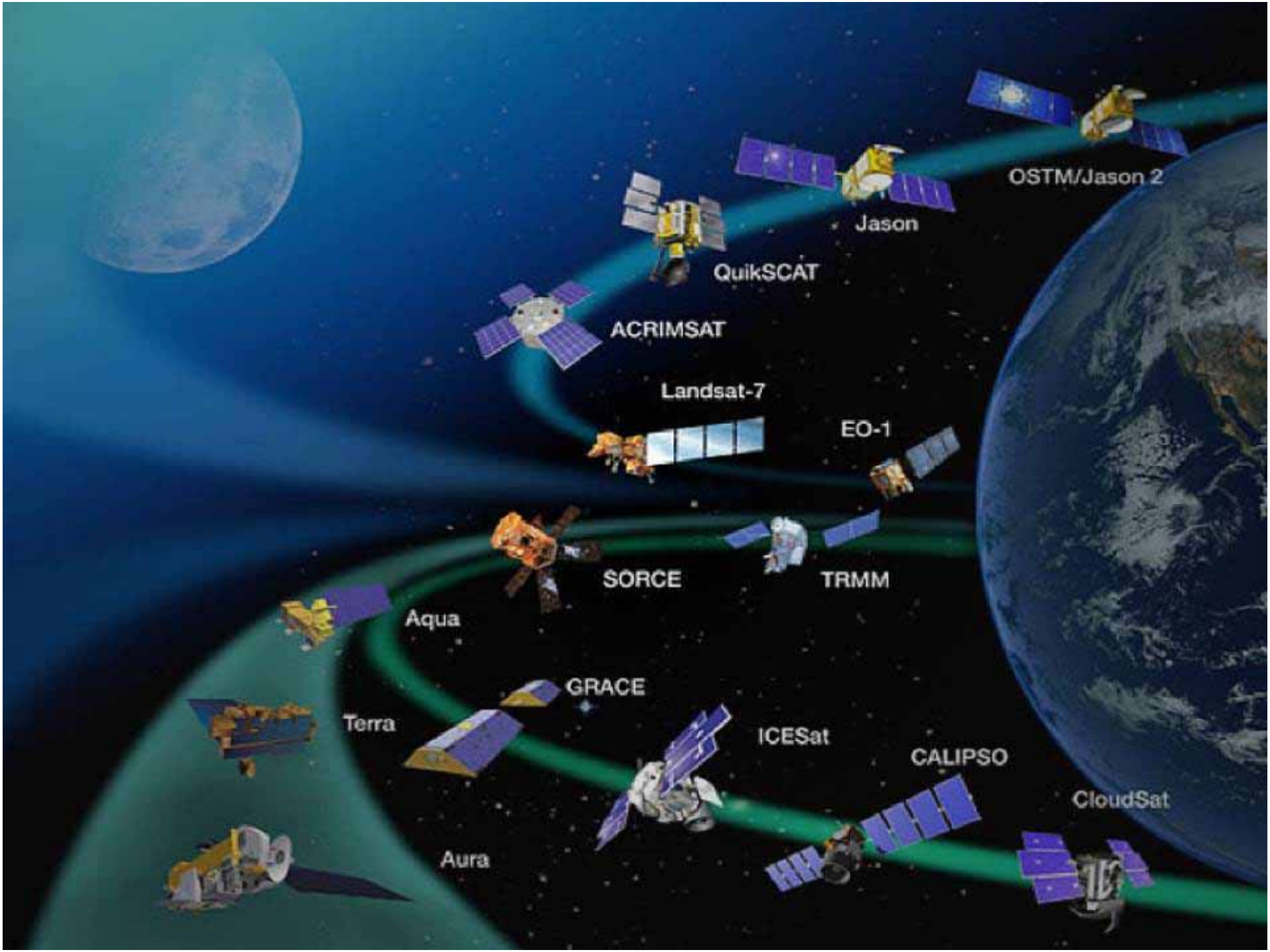

F. J. Hooper
Scientist on Terra Nova Expedition
1910-1913
HEINZ
Baked Beans
and a lot of other scientists.


Lieutenant Evans
Scientist on Terra Nova Expedition
1910-1913

In fact, if it wasn't for the science done on these expeditions, we may never have known about…


the hole in our ozone layer.
Latest size: 8.5 million square miles
Record size (*pictured here*): 10.03 million square miles

Which prompted this…


OSTM/Jason 2
Jason
QuikSCAT
ACRIMSAT
Landsat-7
EO-1
SORCE
TRMM
Aqua
GRACE
Terra
ICESat
CALIPSO
CloudSat
Aura

and gave us a better understanding that…


we live on a very delicate planet.


What did the Spanish explorers discover when they arrived in America?

Among other things, potatoes.

(2008 is the *International Year of the Potato*)

Today, potatoes are one of the most widely consumed crops in the world.

There are many important and unpredictable benefits of exploration.

NASA is currently building the infrastructure that will enable us to work and live on the Moon.

When we get to the

we will do science…

about the moon (geosciences),

from the moon (observation),

and on the moon (life sciences).

There is still a lot to explore,

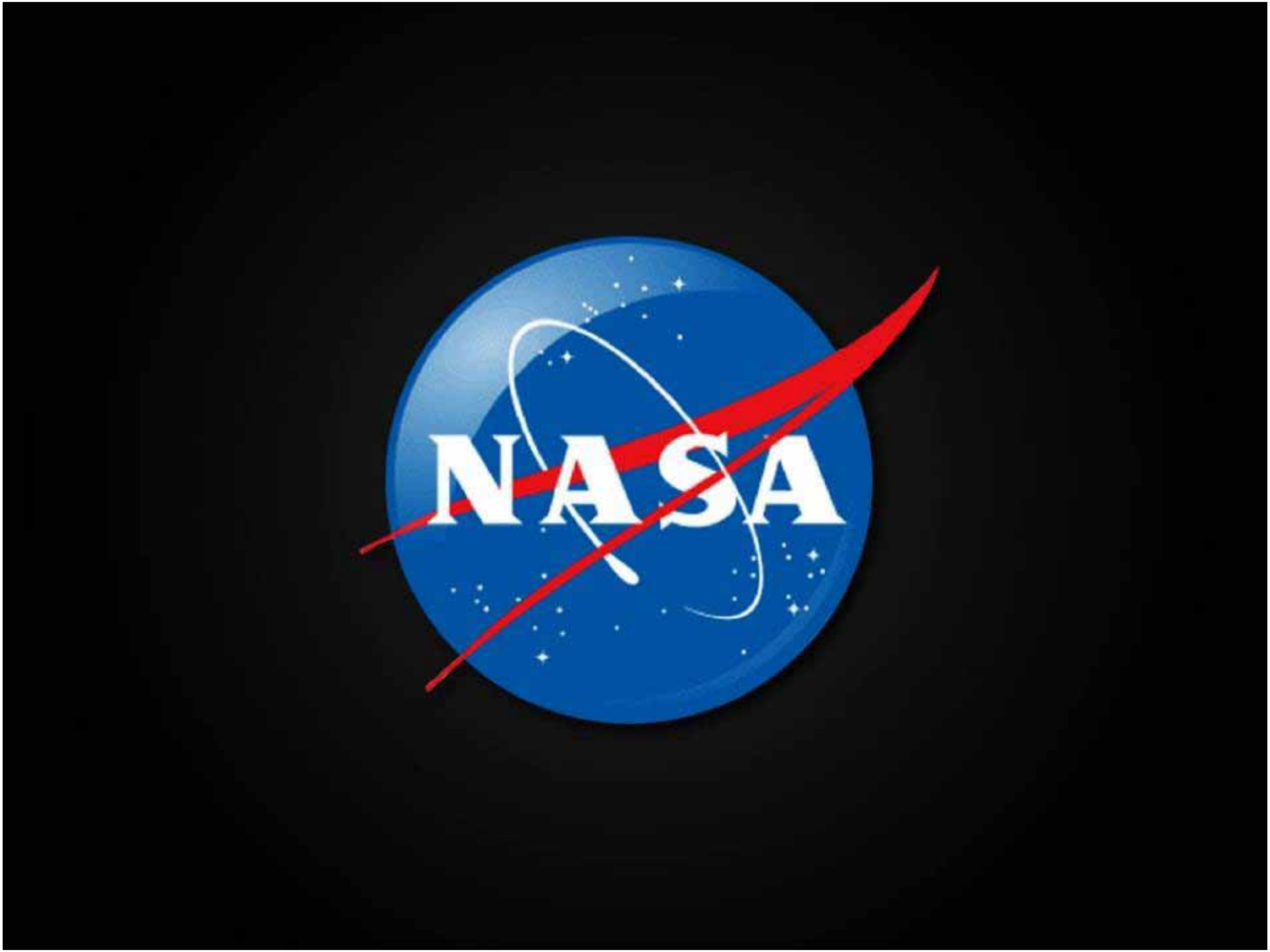
There is still a lot to learn,

There is still a lot to do.

Maybe most importantly, the Moon is…

a stepping stone (literally)  to Mars.

Which is just another story waiting to be told.


NASA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enabling research
and discover

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Image source for slide 38: http://www.jaconsulting.co.uk/iceberg.jpg.
Image source for slide 84: http://wikipedia.org.