

The Power of the Sea

Tsunamis, storm surges, rogue waves, and our quest to predict disasters

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A history of marine prediction

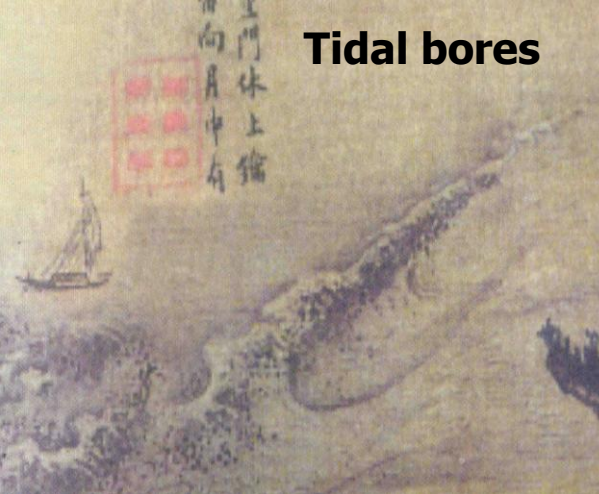
from ancient mankind's strange ideas about the sea
 to our latest technological advances in
 predicting the sea's moments of destruction.

stories of unpredicted natural disasters
 interwoven with
stories of scientific discoveries.



Tides	Storm Surges	Wind Waves	Tsunamis	El Niño	Climate Change
earliest; ancient times but crude	20 th Century; now accurate (deadliest)	World War II; good global models, but not rogue waves	only after the earthquake has occurred	~6-months ahead, but still problems	~global averages, but "uncertainty" about regional predictions

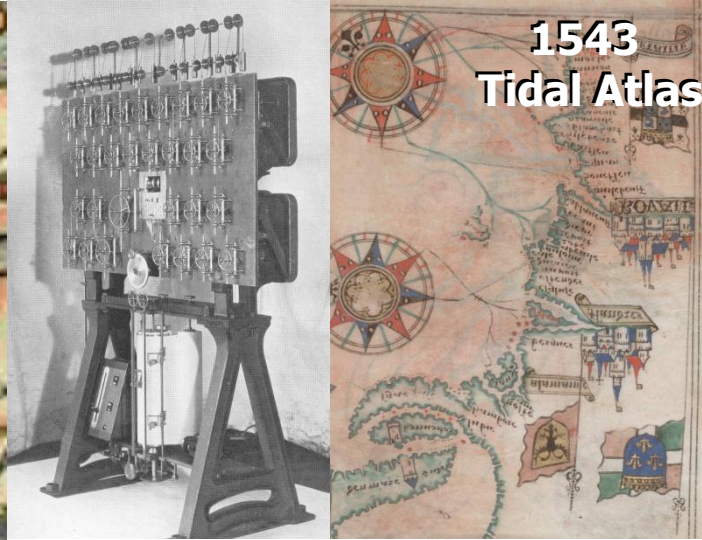
Tidal bores



Tidal whirlpools



**1543
Tidal Atlas**

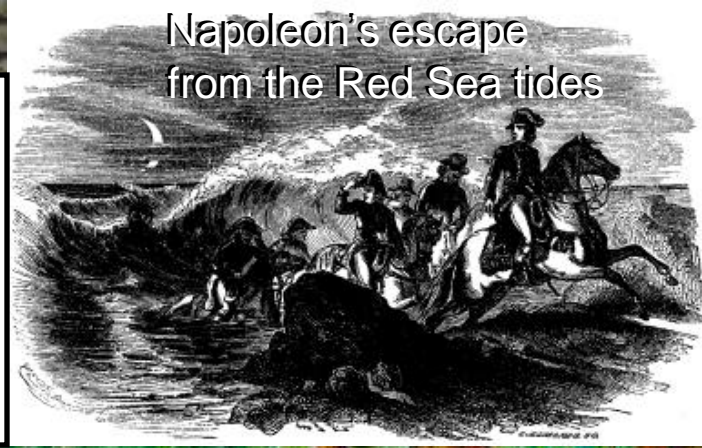


Tide predictions for D-Day



Tide Predictions
**The first
marine predictions**

**Napoleon's escape
from the Red Sea tides**

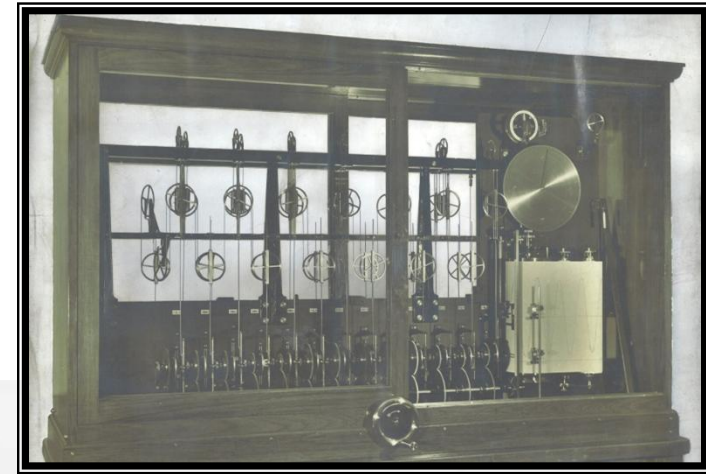


**The "parting"
of the Red Sea**

Tide predictions for D-Day

Normandy Beaches at low tide, 1944

20-foot tidal range; German underwater obstacles;
Rommel: "They will come at High Water"



Storm Surge Prediction



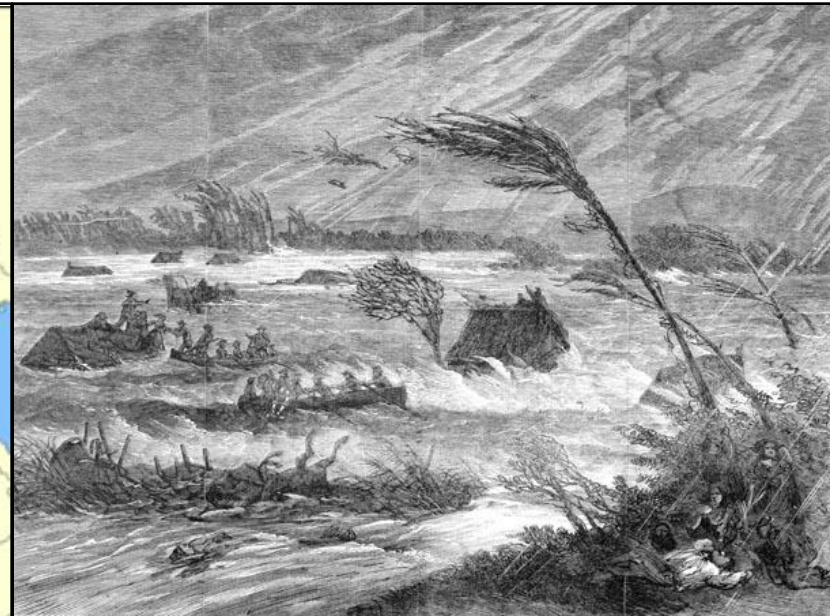
1634 storm surge along the coast of Germany (1683 etching)

The Galveston Storm Surge (1900)



Deadliest natural disaster in U.S. history
(6,000 bodies found, probably 8,000 dead)

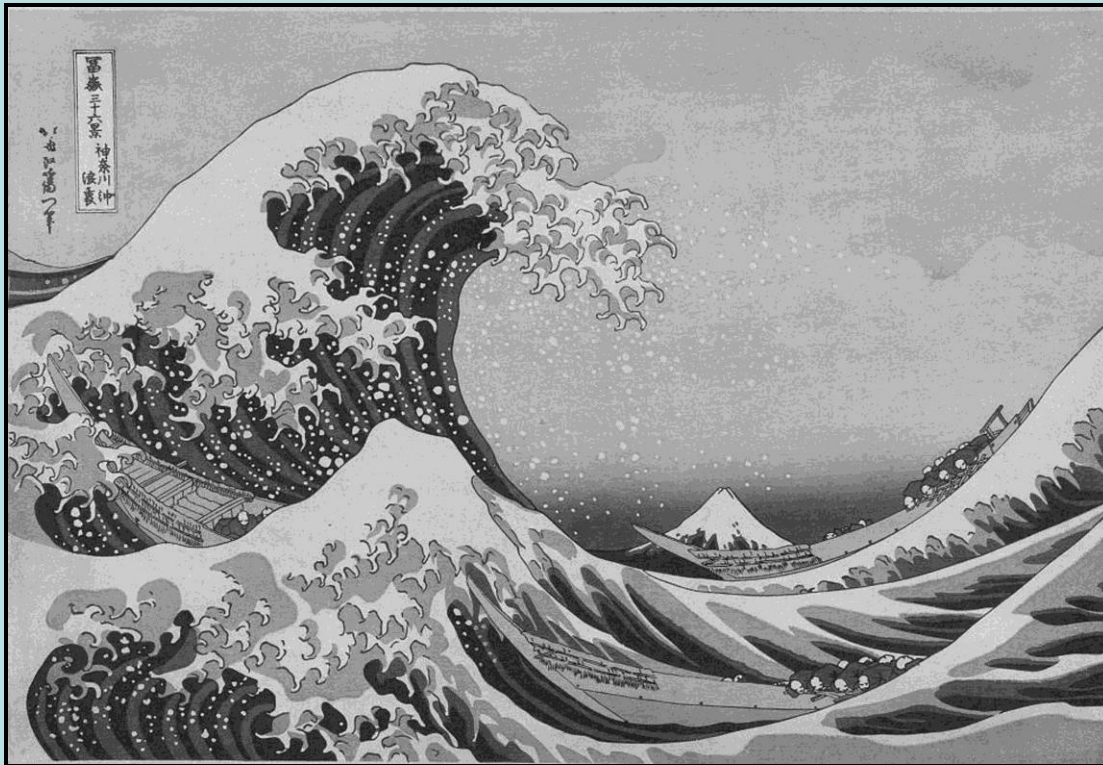
Devastating Storm Surges in the Bay of Bengal (Millions killed over the centuries)



The Storm Surge that led to the Birth of a Nation (1970)



Wave Prediction

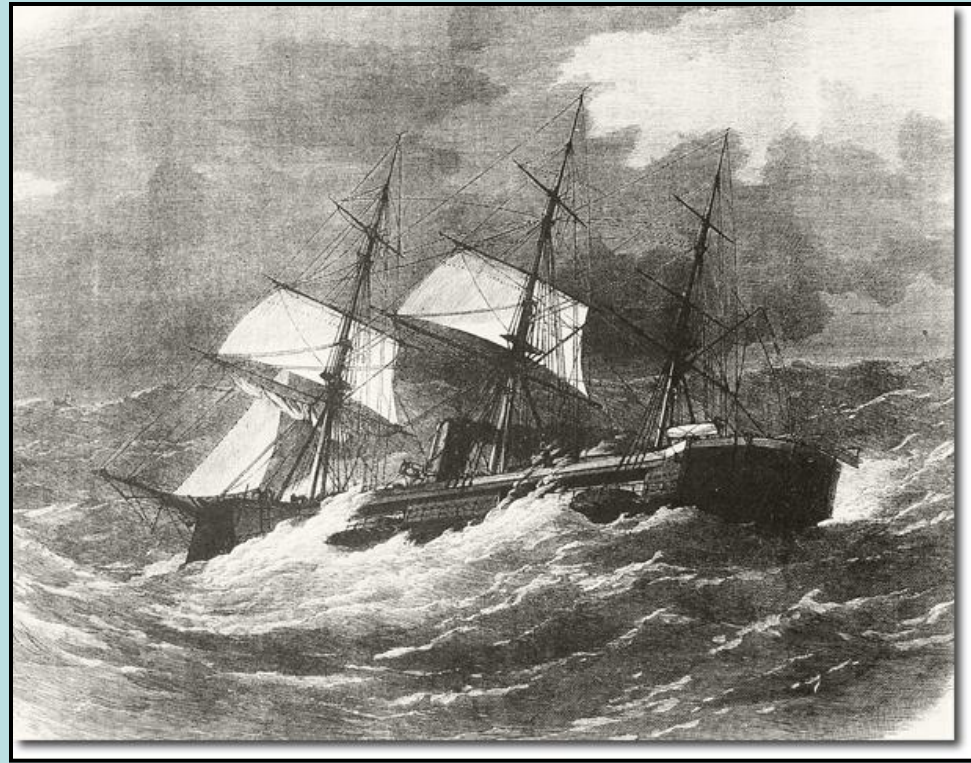
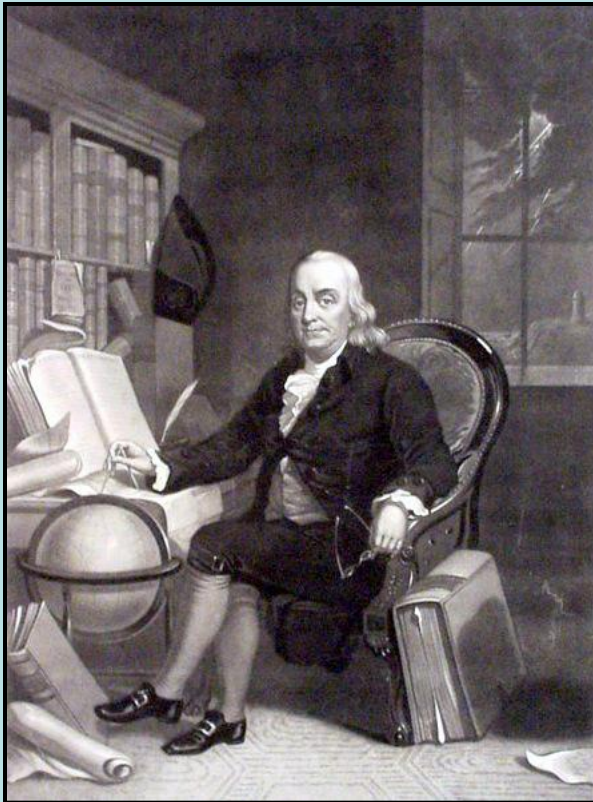


“Great Wave” woodblock print by Hokusai (1832)



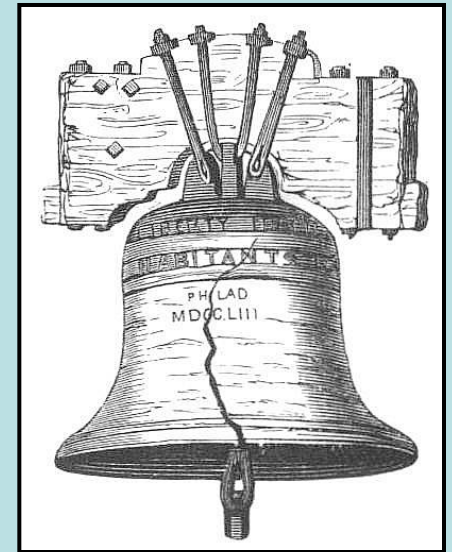
**Eddystone Lighthouse,
first built in 1759.
Totally destroyed 4
times.(1843 etching)**

Benjamin Franklin and the Oil-damped Waves



**Benjamin Franklin's
theory of how the wind
generates waves**

(200 years ahead of his time)

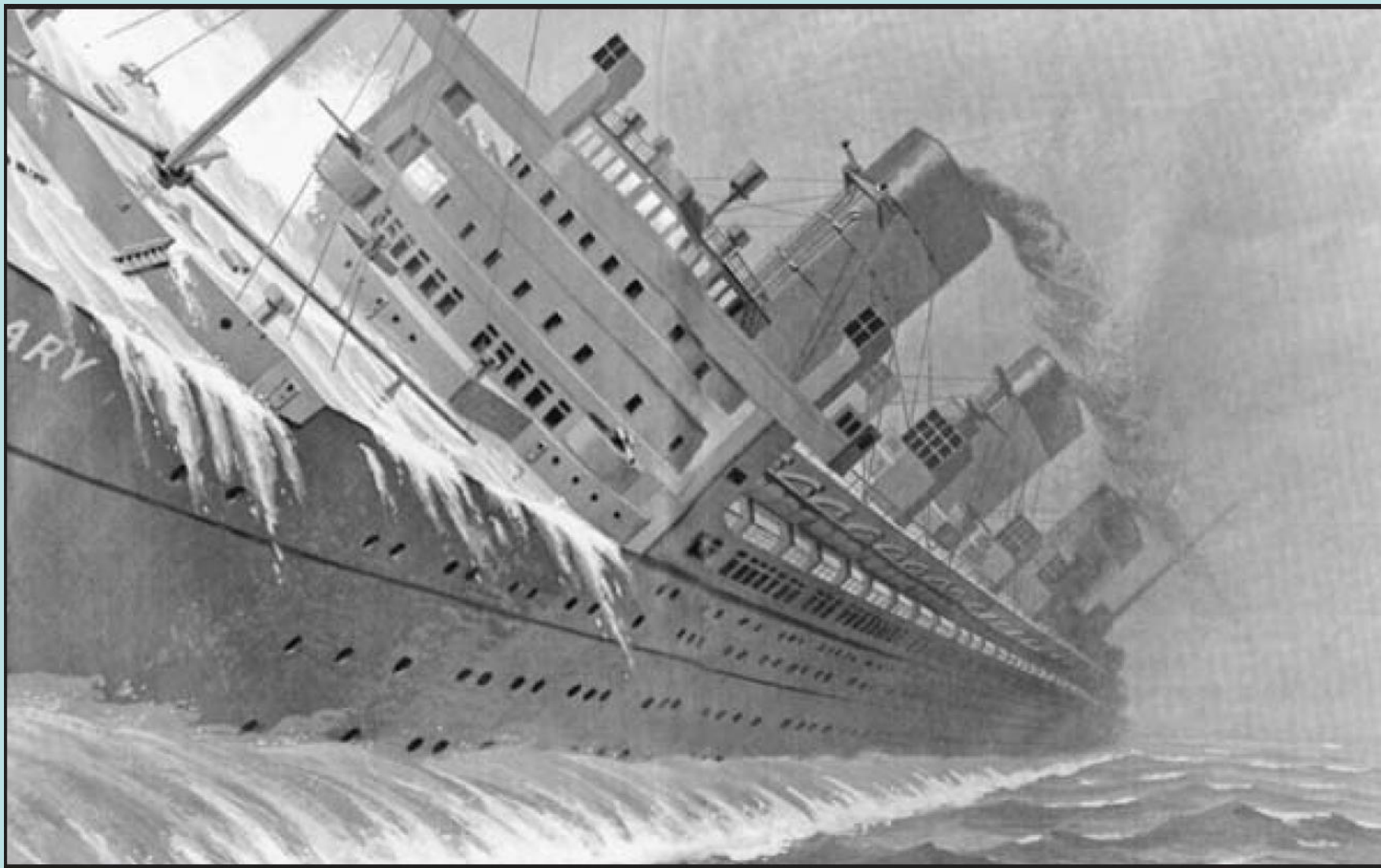


Sea, Swell, and Surf Forecasting

for **D-Day** (and after)
at the Normandy Beaches in World War II

(Munk-Sverdrup)





***Queen Mary* almost capsized by a rogue wave in 1942
(with 16,000 American troops heading for Scotland)**

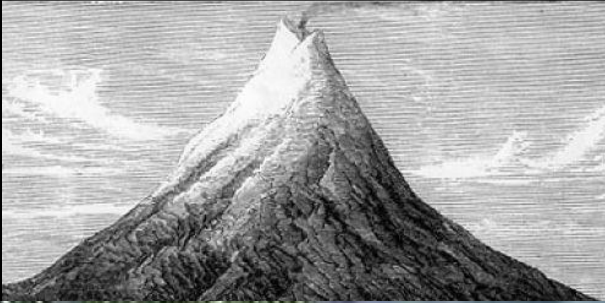


Can we predict Rogue Waves?

Rogue wave striking the container ship *M/V München* in 1978

The supertanker *World Glory* split in half by a rogue wave in 1968





Tsunami “Prediction”



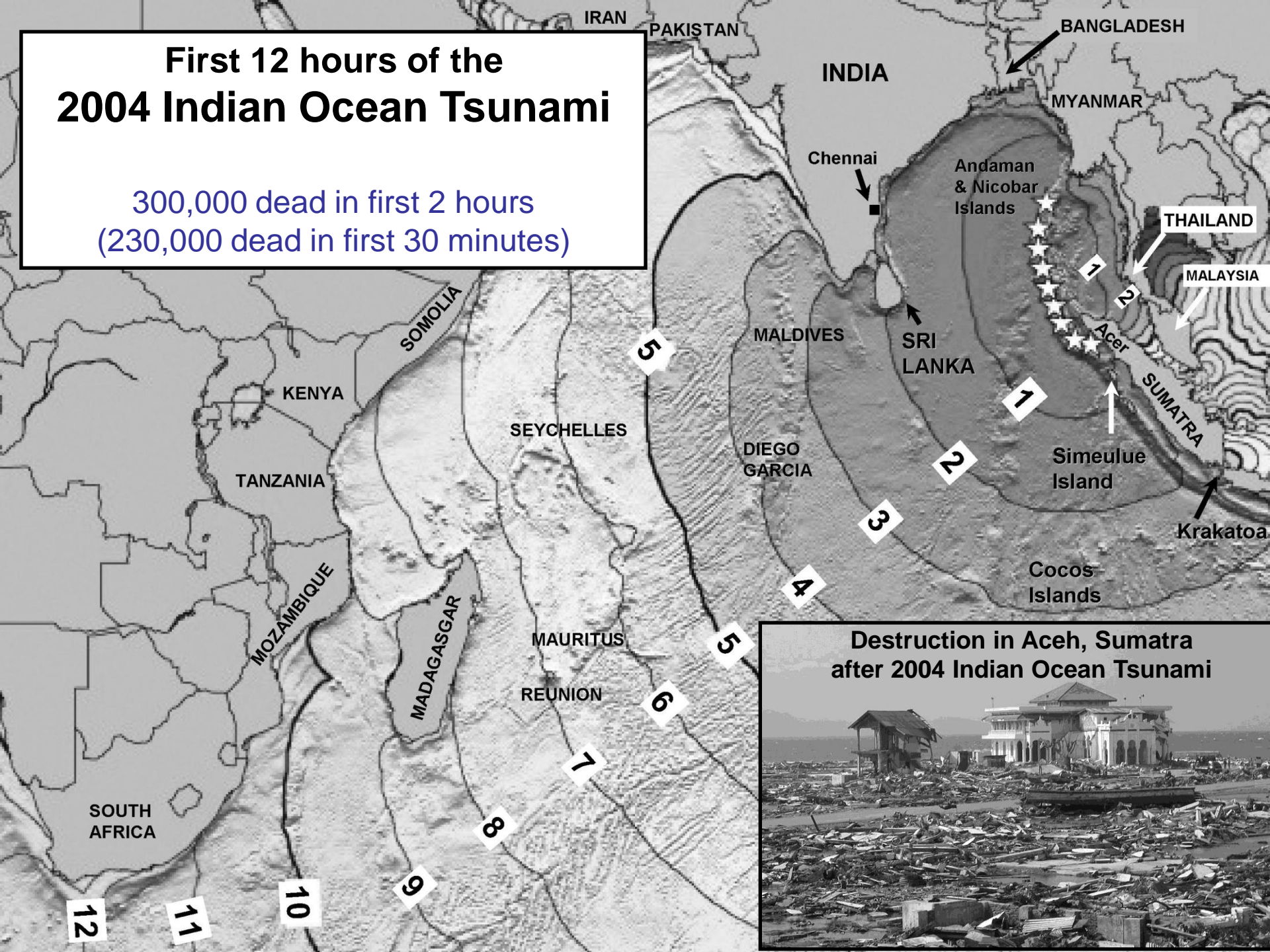
1755 Lisbon Tsunami



Tsunami waves traveled across the Atlantic to islands in the Caribbean.

First 12 hours of the 2004 Indian Ocean Tsunami

300,000 dead in first 2 hours
(230,000 dead in first 30 minutes)



Destruction in Aceh, Sumatra after 2004 Indian Ocean Tsunami



Japan Tsunami

March 11, 2011

“The Unpredictable
and the Unprepared”



Those who cannot learn from history are doomed to repeat it.
(Last deadly tsunami in Japan was in 1933.)

Fukushima Dai-ichi nuclear power plant

The seawall stopped the first tsunami wave,
but **not** the second wave.



The diesel engines for the back-up power, ***at ground level and in the basement***, were flooded.

The fuel tanks, outside the buildings ***at ground level***, were washed away.

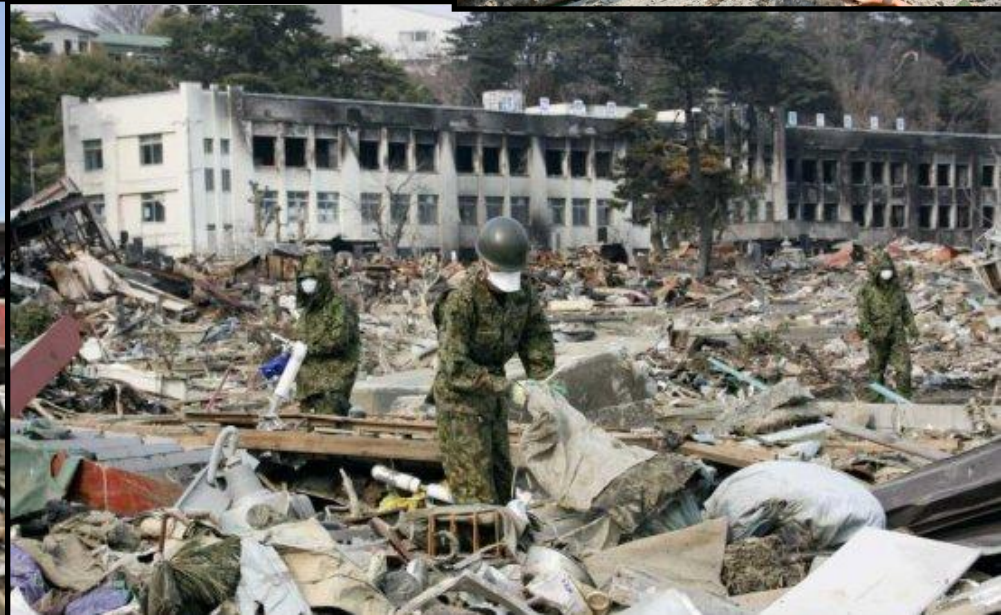
A nuclear disaster that did not have to be.

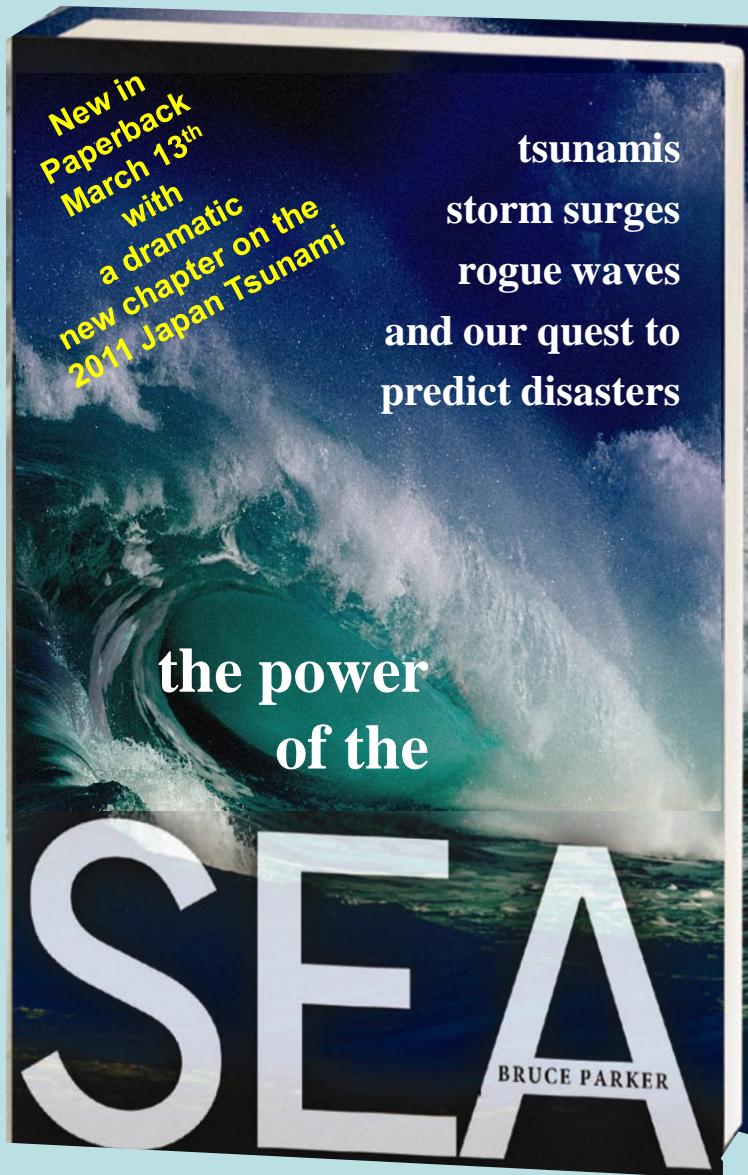


The importance of tsunami preparedness.



**the
Schools**





The Power of the Sea

*Tsunamis, storm surges, rogue waves,
and our quest to predict disasters*

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*When the sea turns its enormous power against us,
our best defense is to get out of its way.*

*But to do that we must first be able to
predict
when and where the sea will strike.*

**Look in the
ENDNOTES**