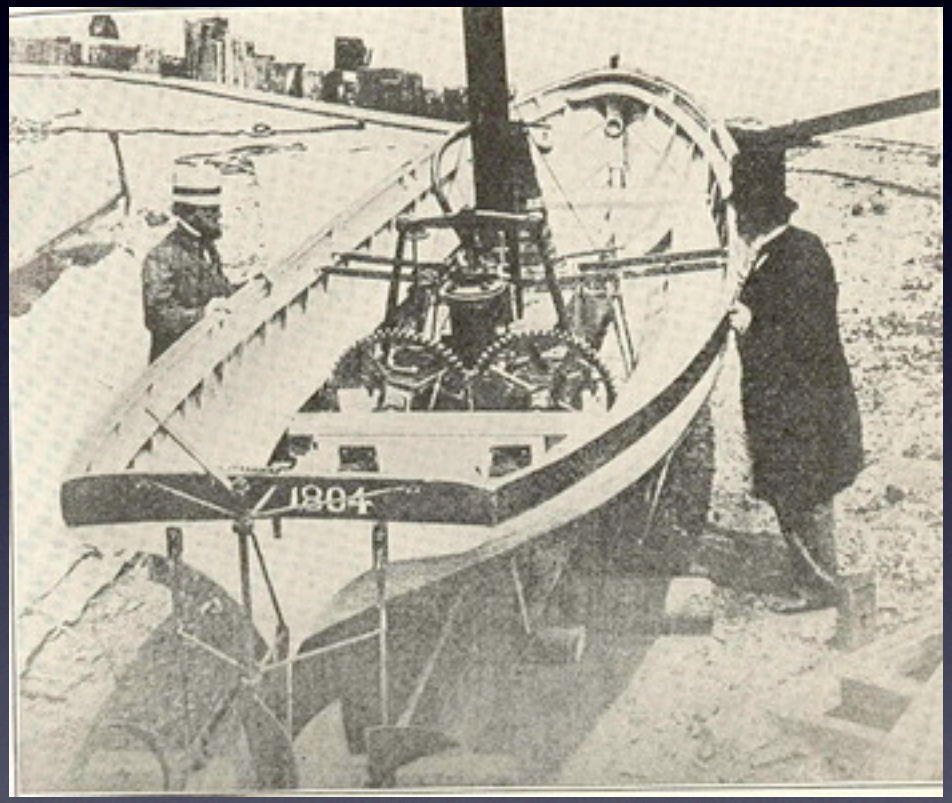
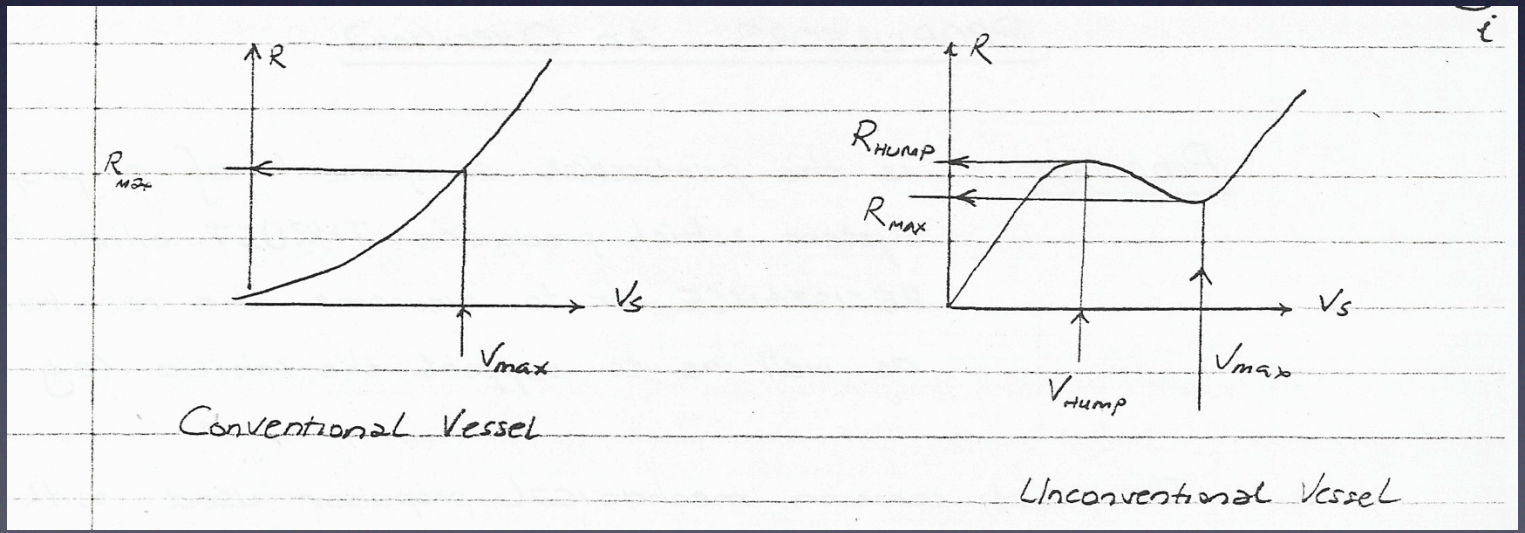
Resistance & Propulsion (1)
MAR 2010

Brief History of Screw Development

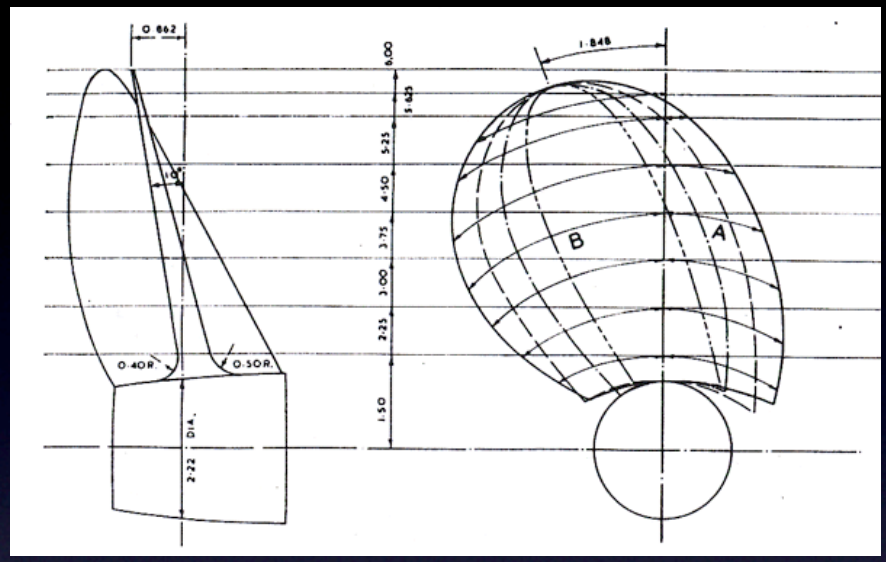


Rod Sampson - School of Marine Science and Technology - 5th February 2008

Vessel powering regime



Modern Propulsor Types



Earliest History

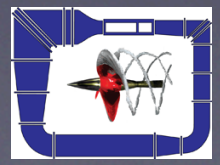
- Early forms of propulsion used ‘sculling’, which involved an oar or pole similar to Gondolas today

Earliest History

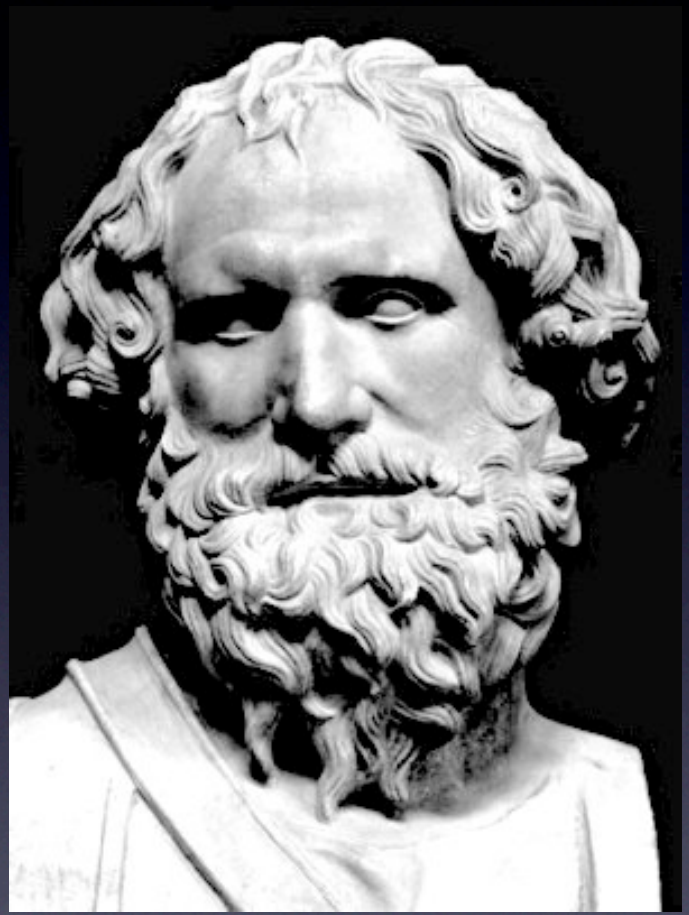
- 945 B.C. Egyptians using screw like devices for irrigation

Archimedes Screw

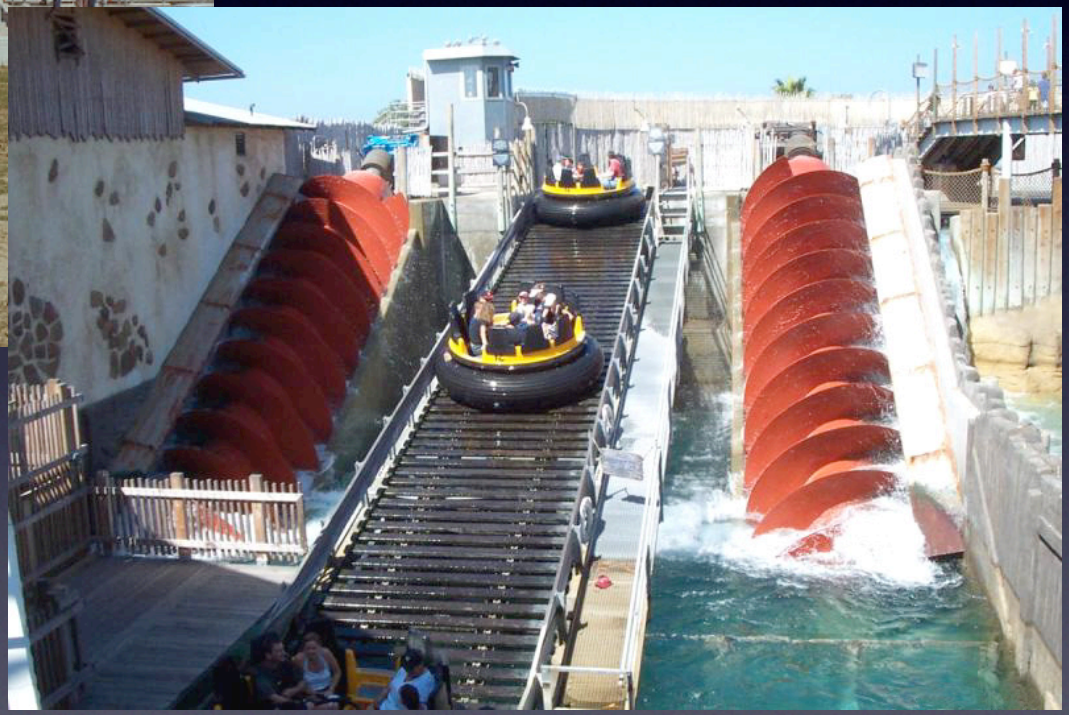
- Archimedes invented - Archimedian screw pump
- Pump used to empty ship's bilges
- Device later used in irrigation
- Design still in existence and use today
- Design paved the way for the development of the screw propeller



Archimedes Screw

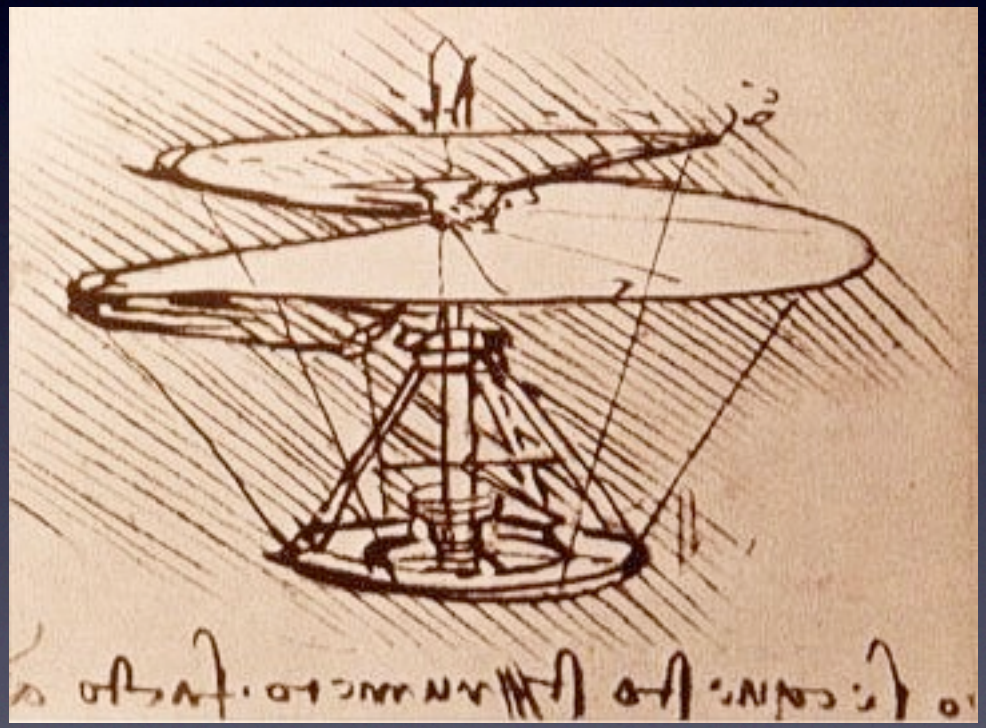


Archimedes Screw



Leonardo da Vinci

- Da Vinci created sketches of screw principle to use as a helicopter rotor
- Design representative of modern screw designs



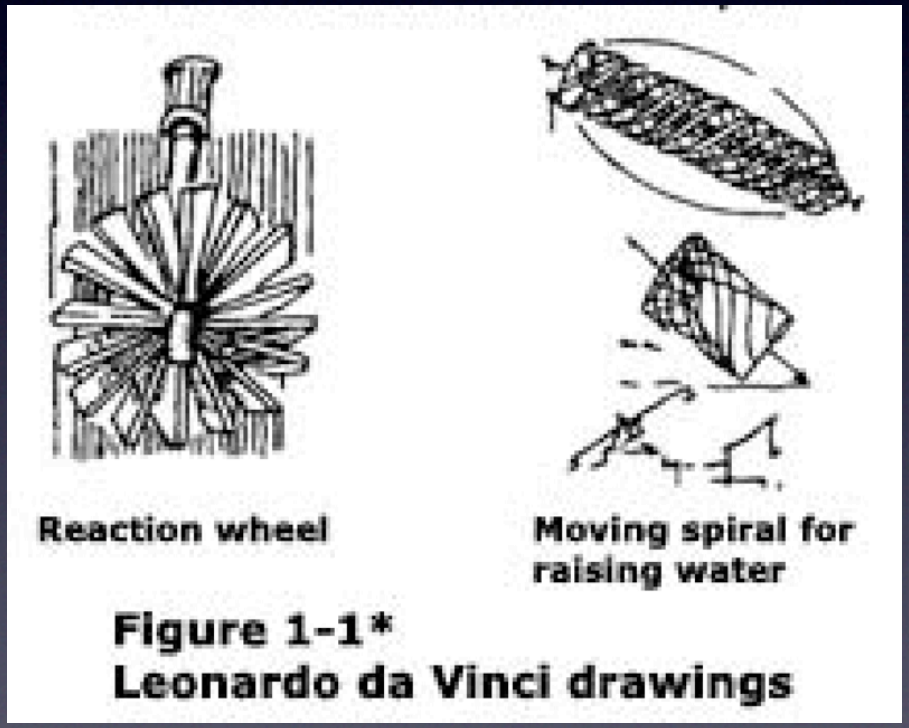
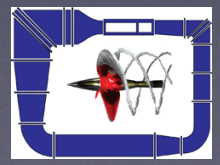


Figure 1-1*
Leonardo da Vinci drawings

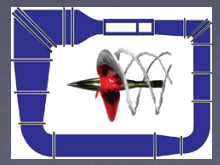
Toogood & Hays (1661)

In 1661, Toogood and Hays adopted the Archimedian screw referred to as "helical surfaces," as a ship propeller, although their boat design appears to have involved a type of water jet propulsion.



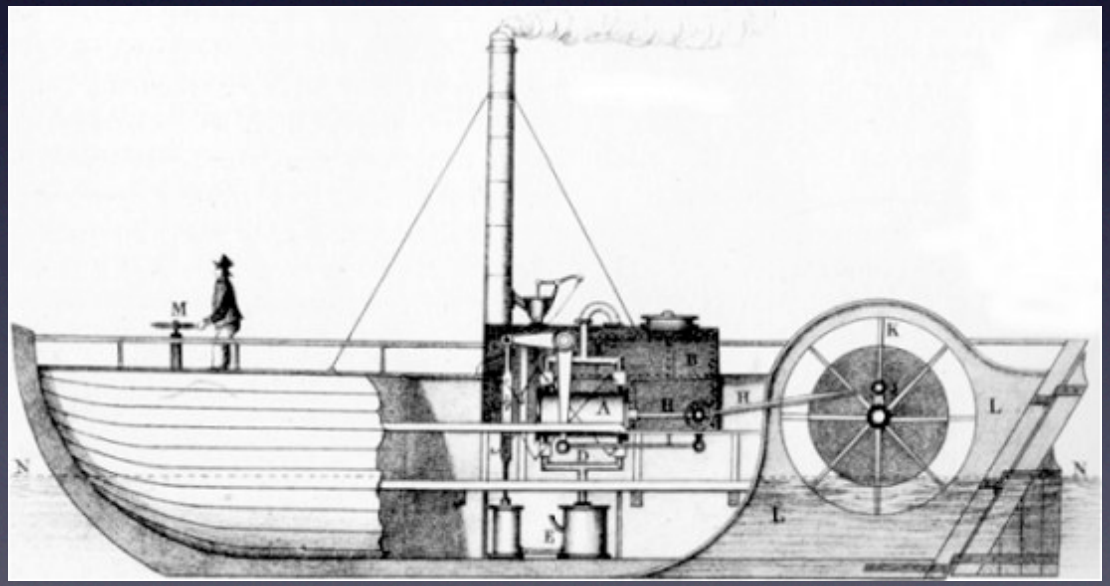
Robert Hooke (1680)

Robert Hooke, an English Physicist proposed a method to propell a vessel using a windmill like device.



Steam Engine Technology

- Steam powered vessels proposed as early as 1645
- Early Newcomen engines proved unsuccessful
- James Watt invents double acting steam engine 1769
- Charlotte Dundas operating on the Clyde Canal, Scotlann in 1801- first practical steamer

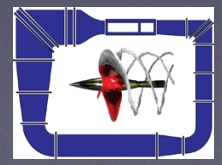


Steam Engine Technology

1770 James Watt whilst working on the Monkland Canal wrote to his friend Dr. Small a letter in which he says,

"Have you ever considered a spiral oar for the purpose of propulsion, or are you for two wheels?"

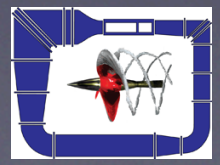
He gave a rough sketch of the screw propeller, with four turns as used to-day.



Joseph Bramah

Joseph Bramah, in 1785, patented the idea of a "screw propeller", but never tried it in practice.

He proposed the concept of moving ships by means of screws. His suggestion was the first step toward the replacement of the paddle wheel with propellers for improved and faster movement of ships.

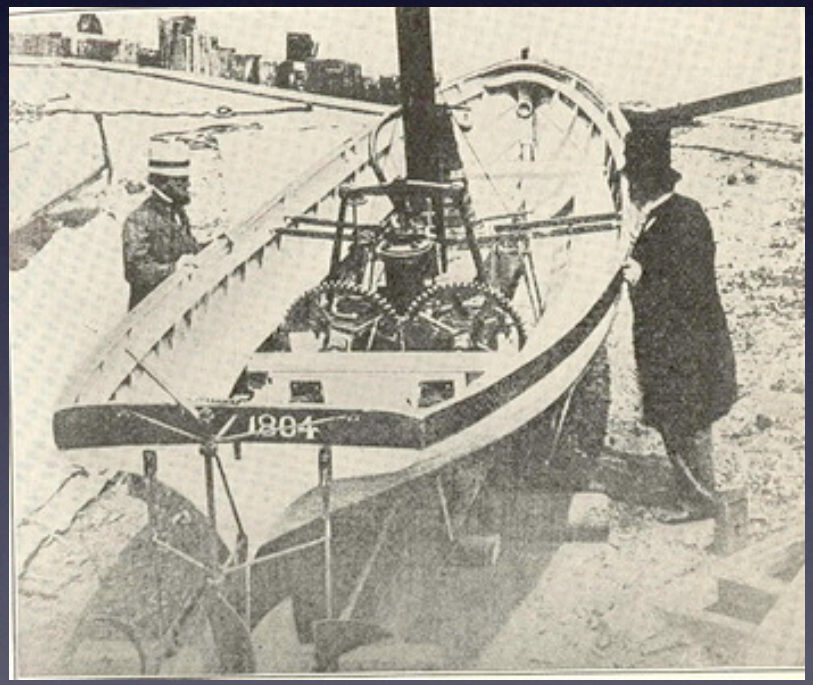


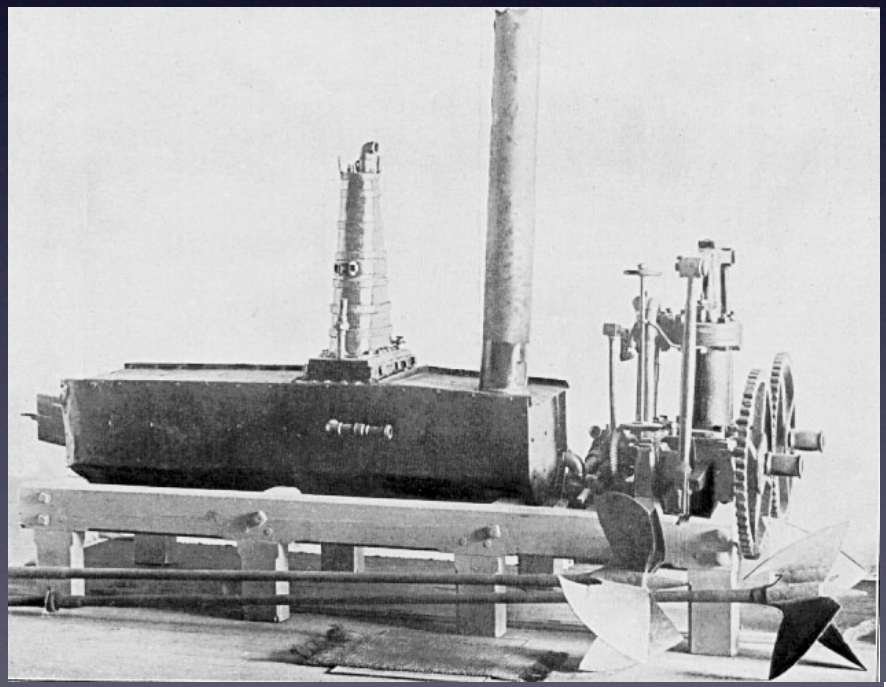
Colonel Stevens (1804)

- Colonel John Stevens built and experimented with screw propellers
- Propeller design recognisable today
- Performed trials with a 25’ Length by 5’ Beam vessel
- Achieved speed of 4 miles an hour

Colonel Stevens (1804)

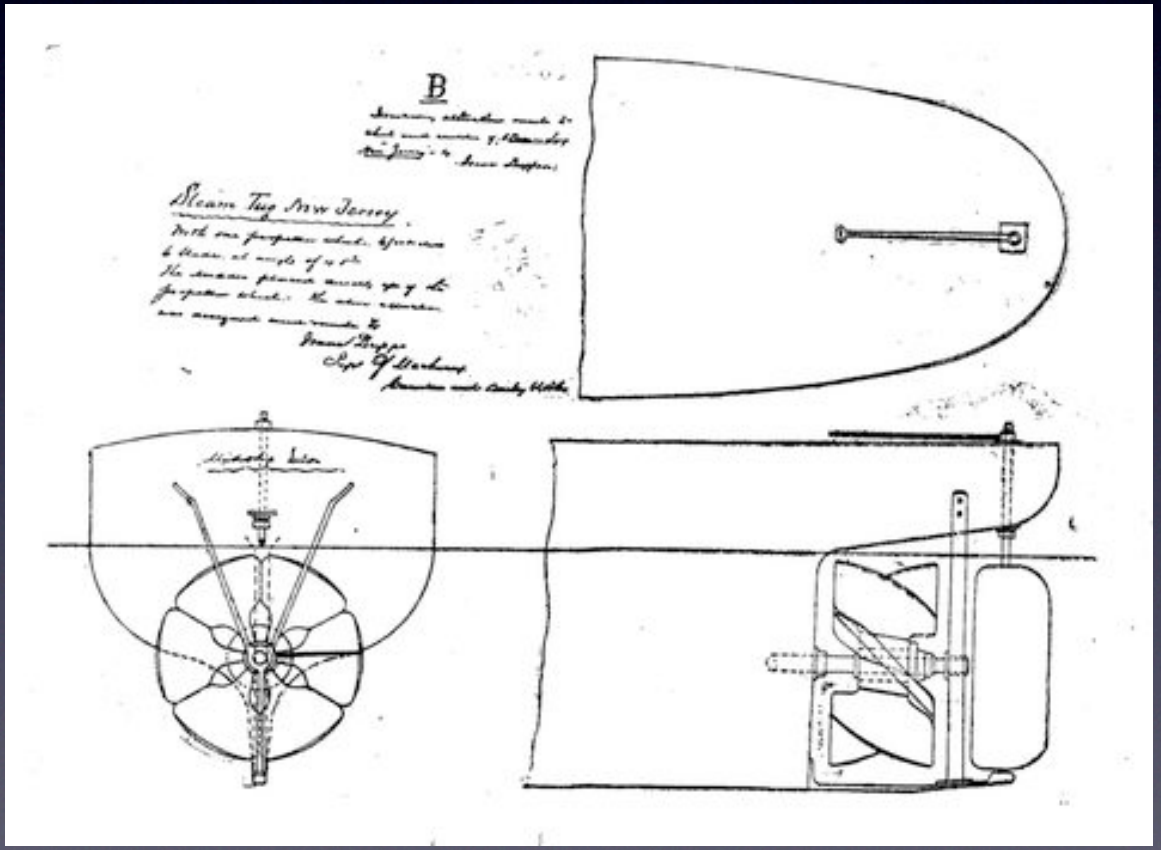
- Developed the first multi-tube boiler allowing a high pressure steam engine to operate
- Achieved a top speed of 7-8 miles an hour
- Test repeated with oarsmen - the propeller won





Colonel Stevens (1804)

- One of the first to correctly place the propulsor
- Understood the angle of attack of the blades
- Recognised the need for blade curvature (camber)
- Design not accepted nor taken up

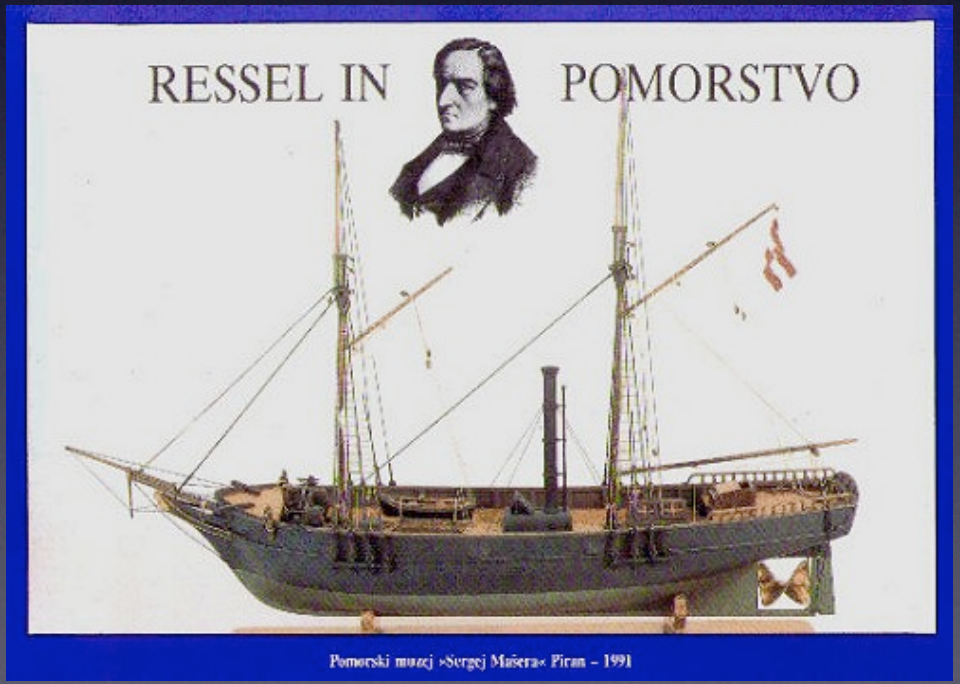


R. Wilson (1828)

- Invented a propeller from watching a windmill
- Trialled the design on the Union canal in 1828
- Design not accepted nor taken up
- In 1880 Admiralty used his ideas on fish torpedos

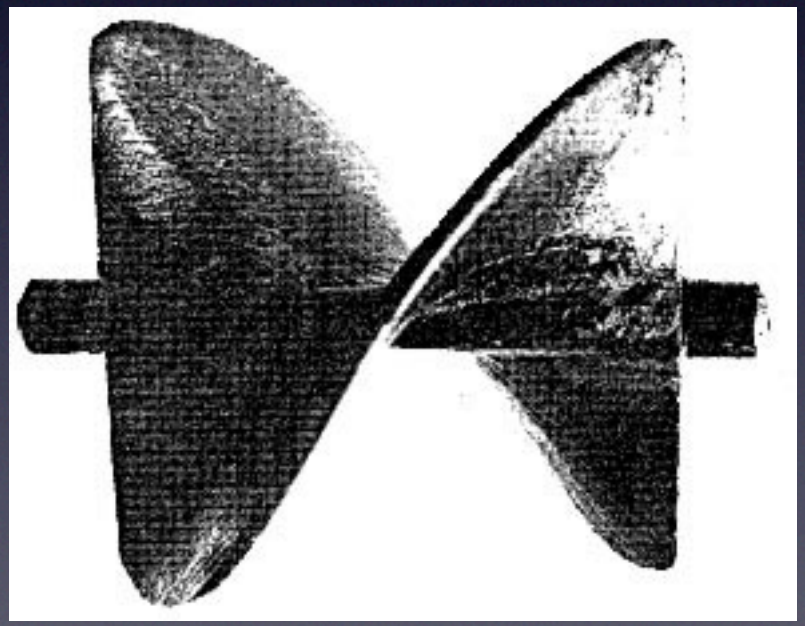
J. Ressel (1828)

- Patented a, "Never ending screw" in 1827
- First person to use a screw in civil navigation
- Trialled the design in Trieste
- Modified small vessel "Civeta"
- Carried 40 passengers at 6 knots for 0.5 NM
- Boiler failure resulted in the trial being abandoned



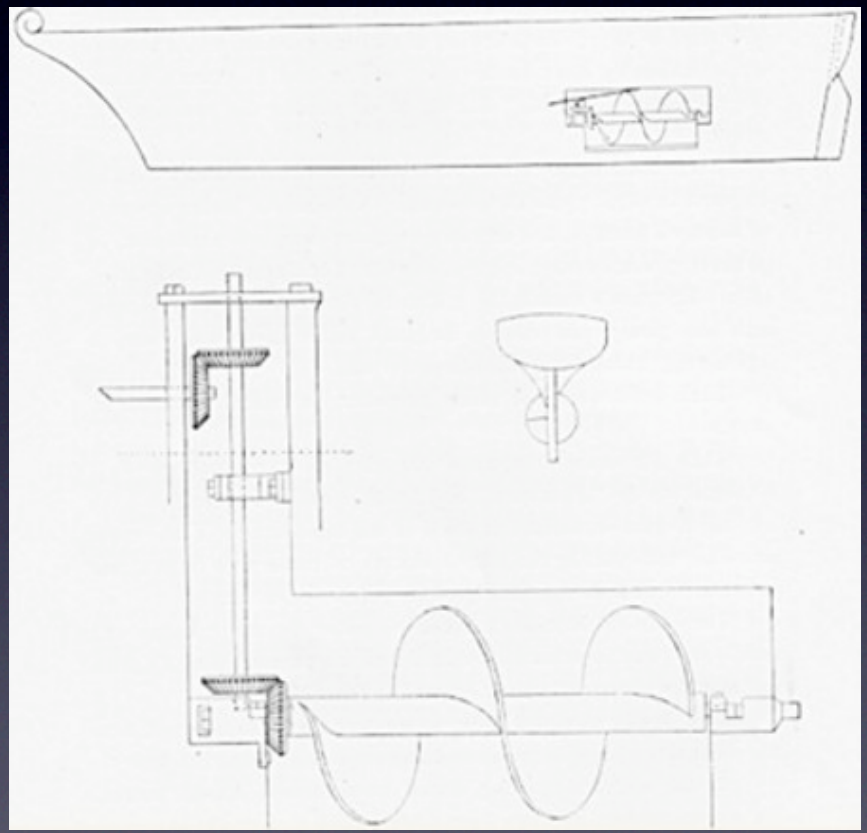
J. Ressel (1828)

In a suspicious coincidence in 1836, Englishman Francis Petit Smith tested a screw propeller that was similar to Ressel's. It is believed now that someone might have secretly sold Ressel's invention to Great Britain!



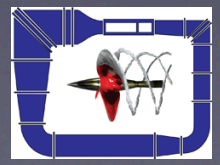
Francis Petit Smith (1836)

- Credited with the first practical application
- Manufactured a wooden 2 turn Archimedes screw



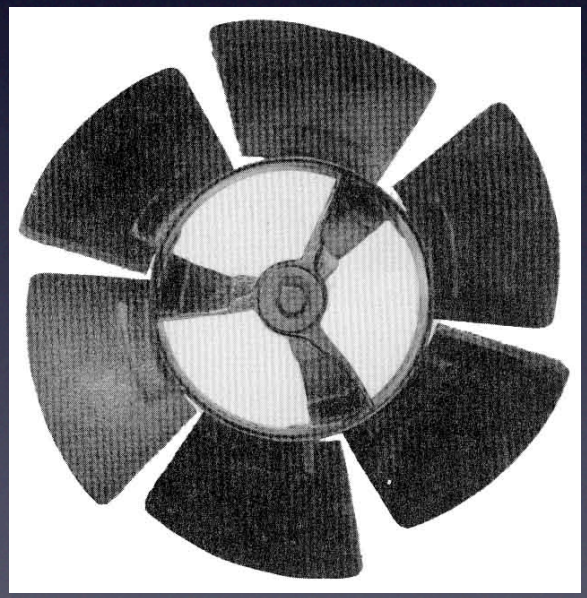
Francis Petit Smith (1836)

- "Screw-Smith" Credited with the first practical application of a propeller
- Manufactured a wooden full turn Archimedes screw
- Trials conducted on 10 Ton 6HP vessel in the Thames
- Vessel suffered favourable propeller damage
- A single turn screw was fitted
- Vessel achieved seven miles an hour in open sea



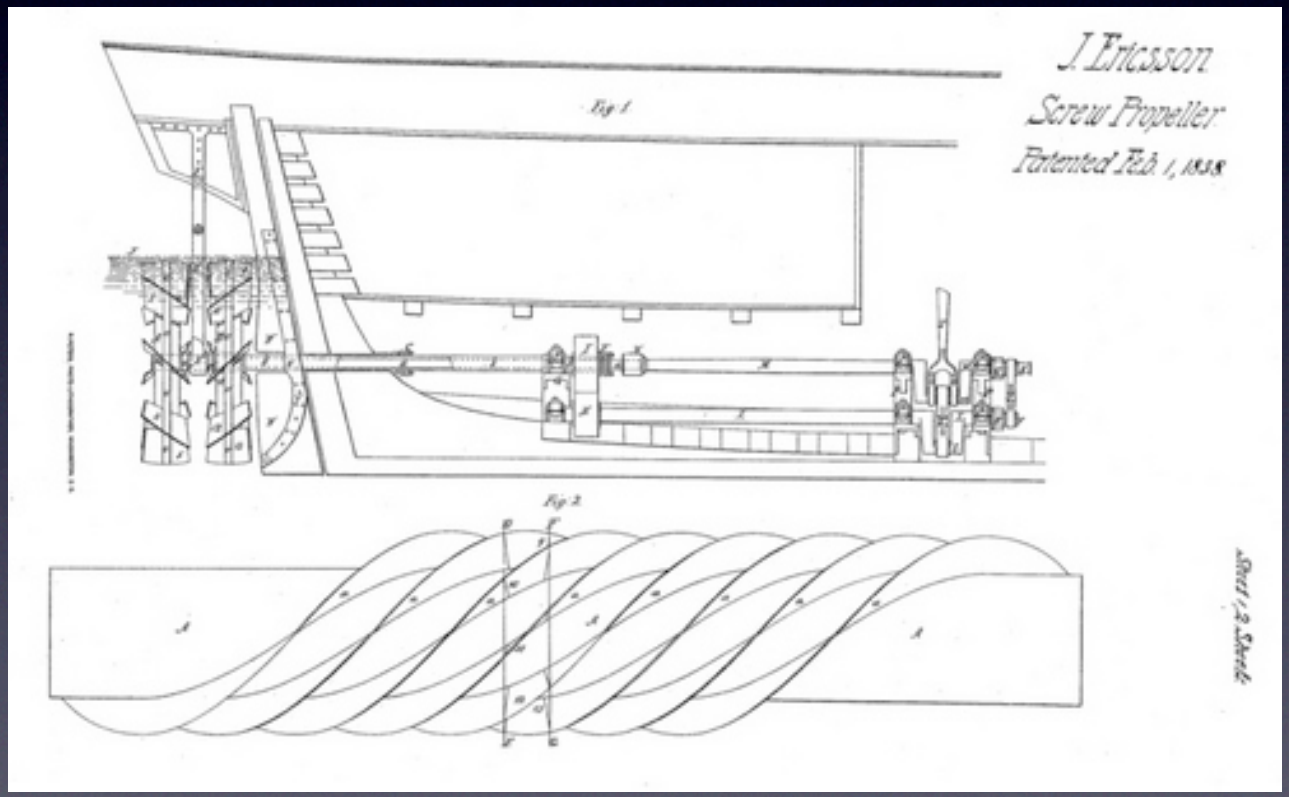
J. Ericsson (1836)

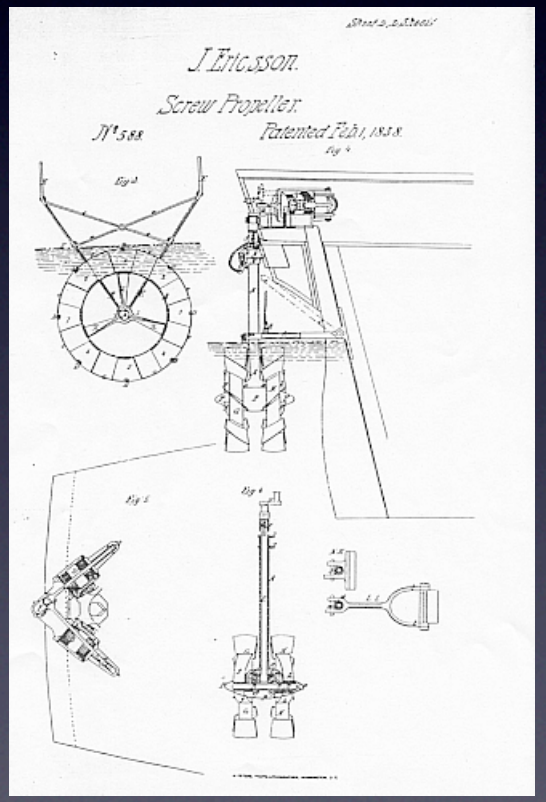
- Contemporary of Smith
- Designed a complex Contra-rotating design
- Built the Francis B Ogden which achieved 10 mph
- Admiralty shunned the design fearing aft propulsion would be un-steerable



J. Ericsson (1836)

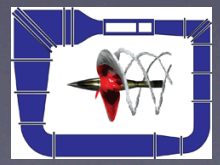
- Ericsson moved to America where he enjoyed great success in propulsion
- Better known for the vessel - Monitor





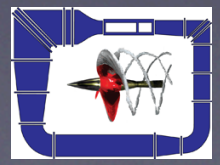
Francis Petit Smith (1839)

- The shipbuilding world regarded propelling a vessel by screw as visionary and preposterous.
- Smith built the 237 Ton Archimedes
- Twin 80HP engines fitted
- Service speed required was 4-5 knots
- Archimedes achieved 9 knots
- Trials led to the acceptance of screw propellers



Screw versus Paddlewheel (1844)

- First Navy vessel HMS Rattler
- Extensive research programme into the propeller
- Paddlewheel vessels still being produced
- HMS Prometheus paddle vessel of similar dimensions
- Rattler won on 2 occasions
- The admiralty accepted the screw propeller
- Brunel adopted the design on the ss Great Britain

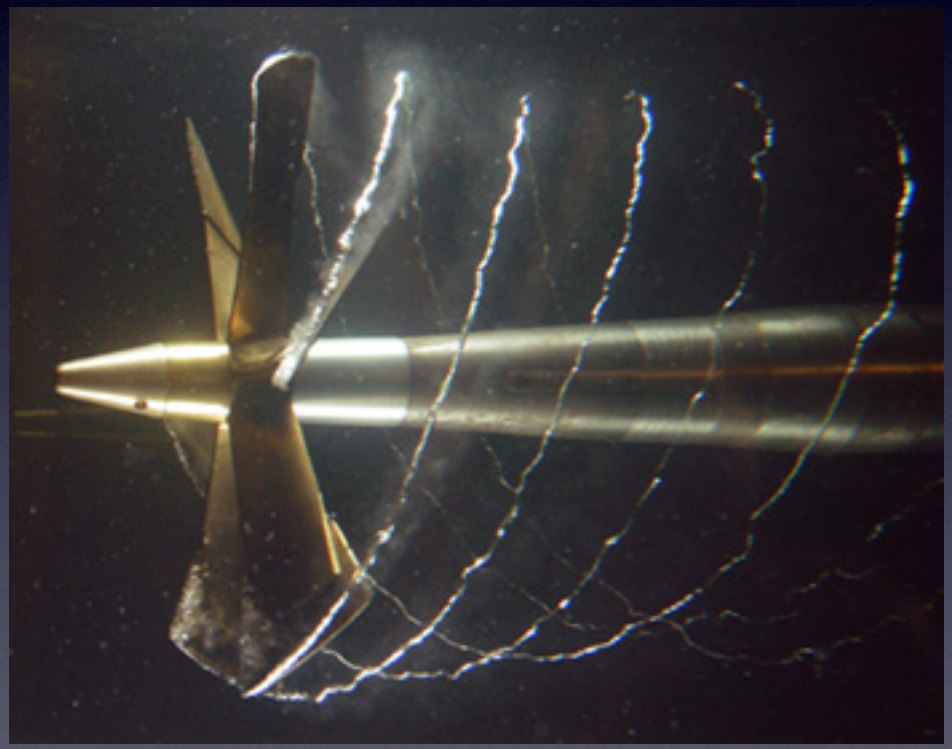


Isambard Kingdom Brunel (1845)

- Distinguished Victorian engineer
- Adopted screw propeller on the ss Great Britain
- Collaborated with Petit-Smith on the design

Isambard Kingdom Brunel (1845)

- Sucess of the Archimedes led to the use of screws
- First screw vessel to cross the Atlantic
- Propeller tested in 2004 at 65% efficient

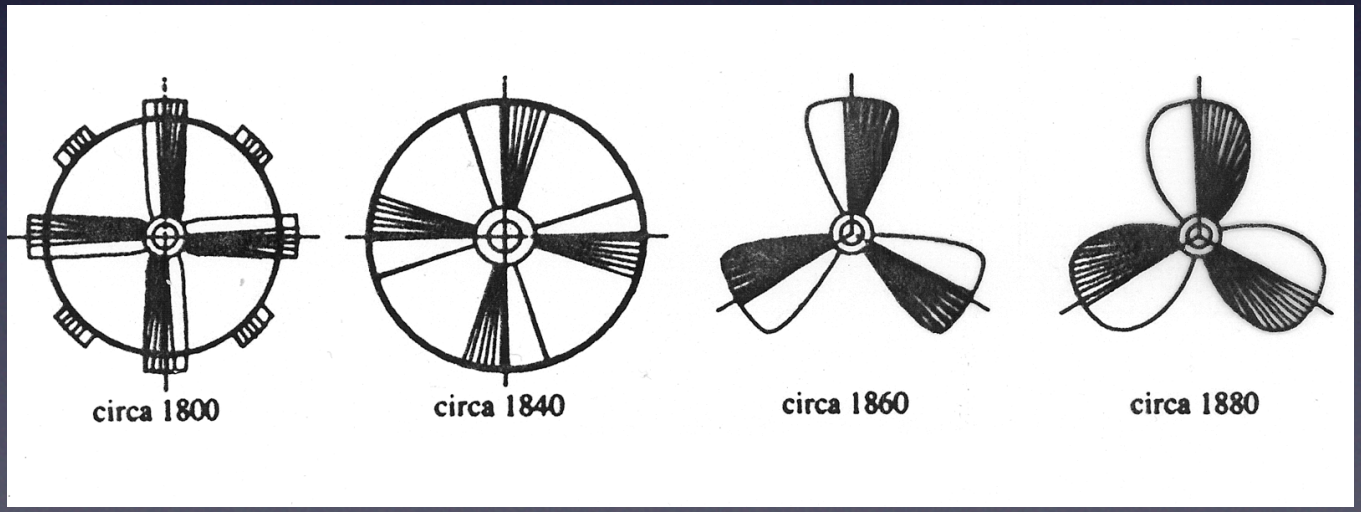


ss Great Eastern (1858)

- Fitted with paddle wheels and propellers

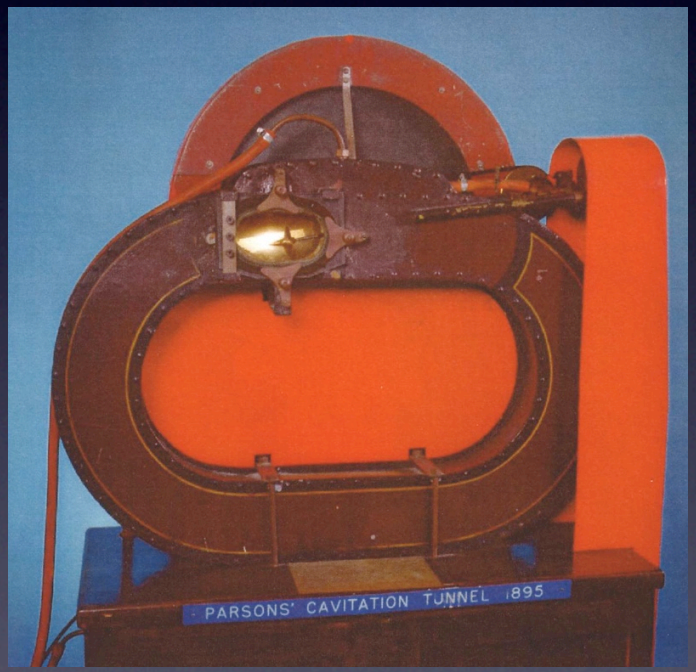
1880 - 1970

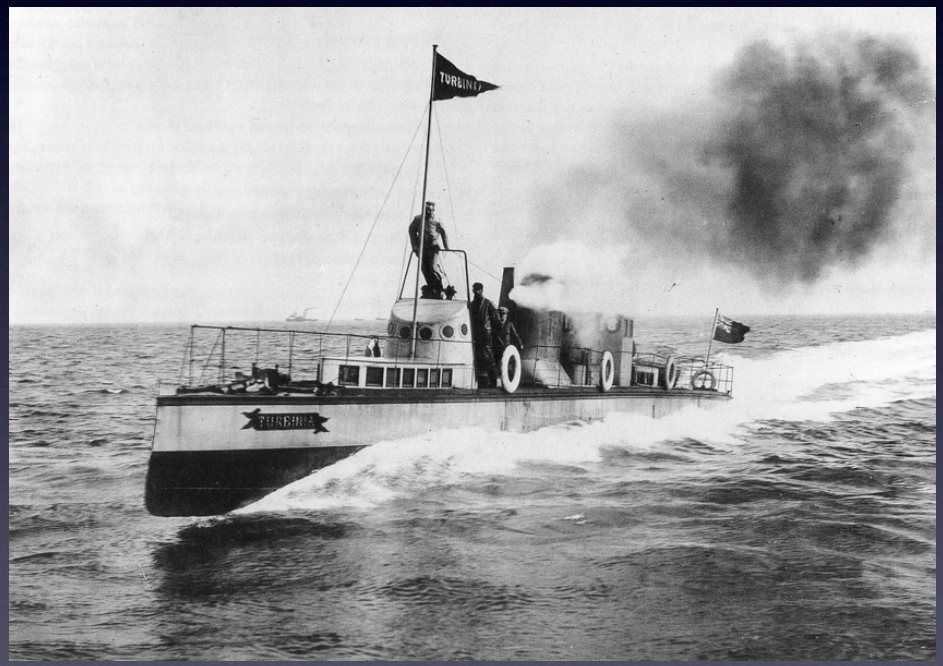
- Thorneycroft designs propellers similar to todays propellers
- Axial momentum and blade element theories published
- Blade sections remain similar to those pre 1970



Discovery of Cavitation

- R.E. Froude discovered cavitation in 1895
- Charles Parsons builds first Cavitation tunnel
- Turbinia launched and acieved 32 knots

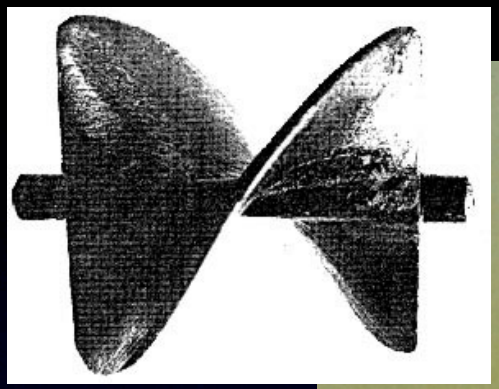


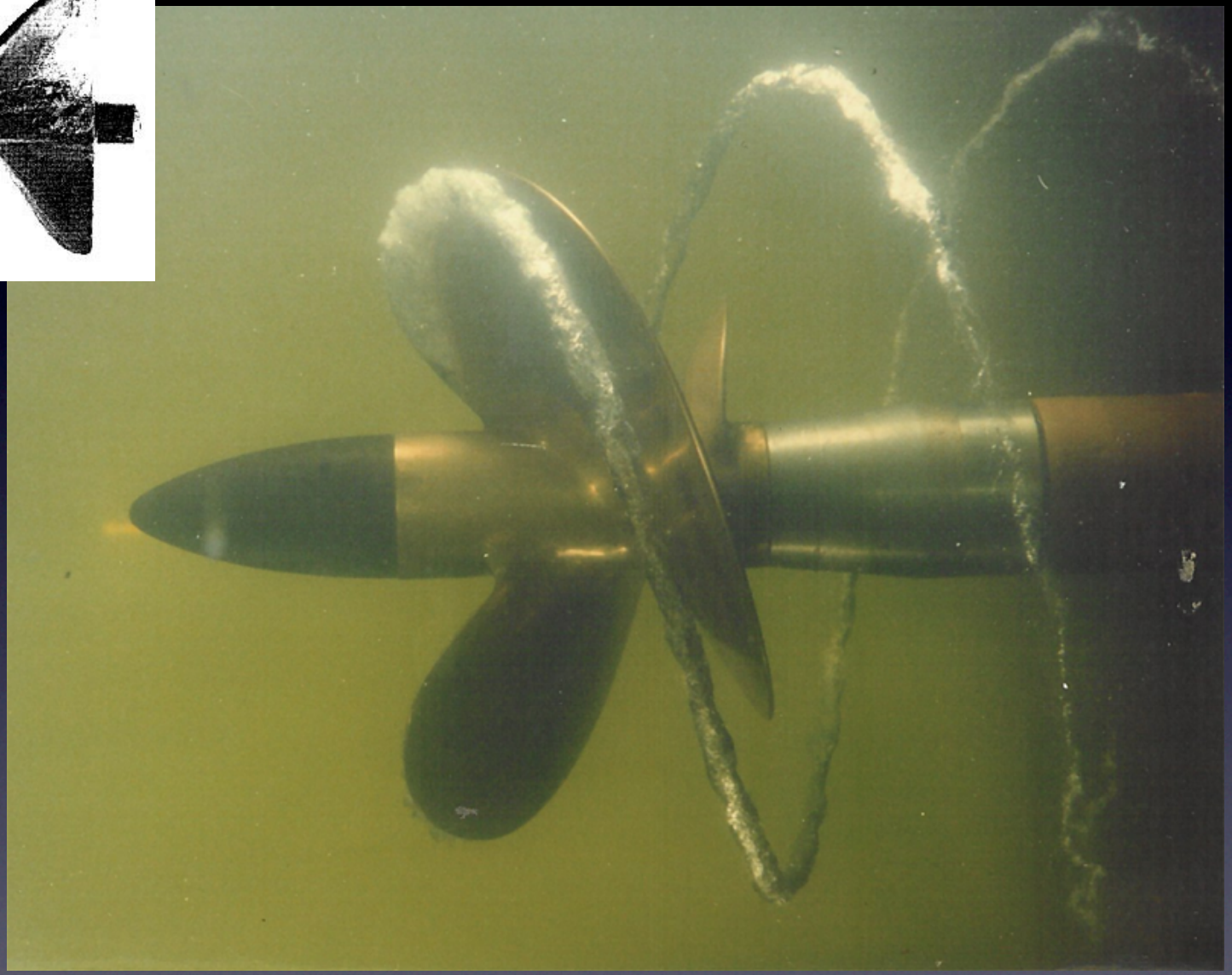


1970 - Present

- Fuel crisis radically changed propeller designs
- Vessel speed reduced and designs more efficient
- Environmental parameters optimised
- Knock on effect on the stern shape and unconventional propulsor design

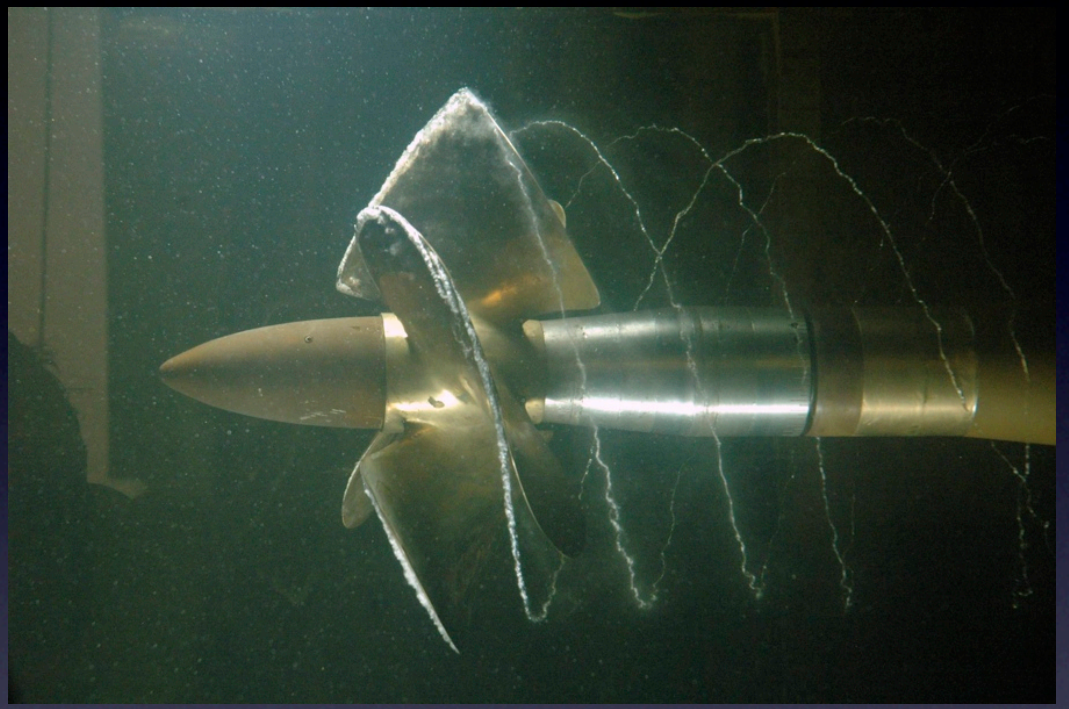
Lessons Learned?





End of Presentation

Addendum



Are they so different?