



A Brief History of Ultrasound



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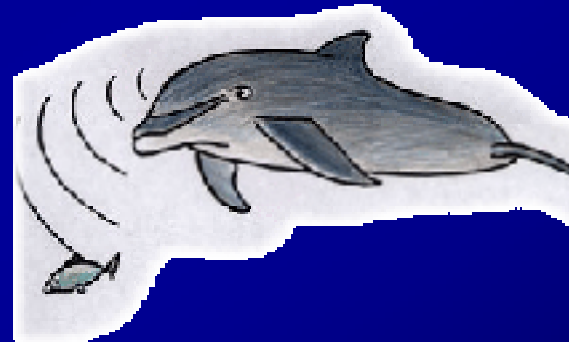
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History of Ultrasound

The Animal World



Audible Range varies amongst Species

Humans: 20 – 20000 Hz

Cats: 100 to 60,000 Hz

Dolphins: up to 150,000 Hz

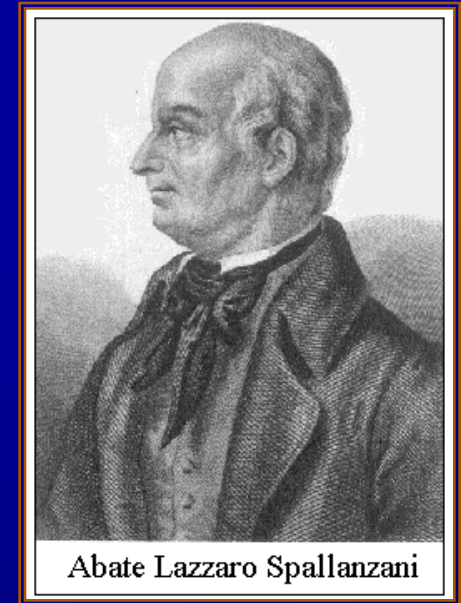
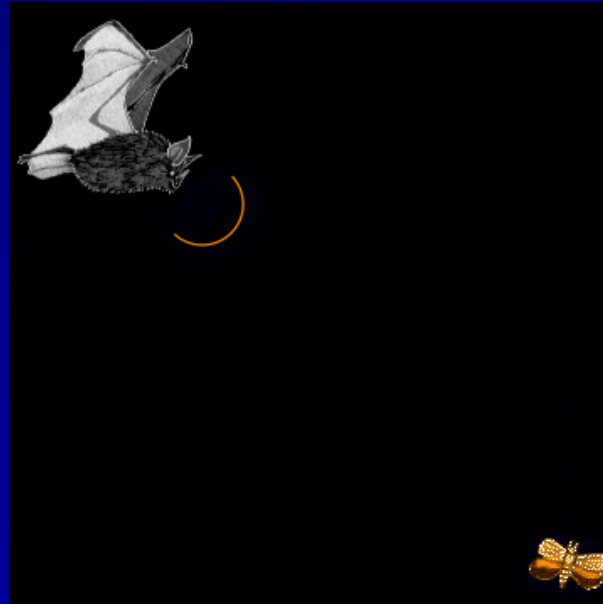
Dogs: up to 40,000 Hz

Bats: 1,000 to 100,000 Hz

Elephants: 0.1 - 25 Hz (Infrasound)

History of Ultrasound

The Sixth Sense



- Lazzaro Spallanzani (1729-1799) Italian priest and physiologist
- 1st to provide experimental evidence that non-audible sound exists around us
- Spallanzani demonstrated that blind folded bats could navigate around obstacles in the dark but bumped against them when their mouths were covered (1794)
- Hypothesised that bats navigated using sound waves rather than light
- Remained a scientific mystery termed - “Spallanzani’s Bat Problem”



History of Ultrasound Echolocation

- Charles Jurine, Switzerland

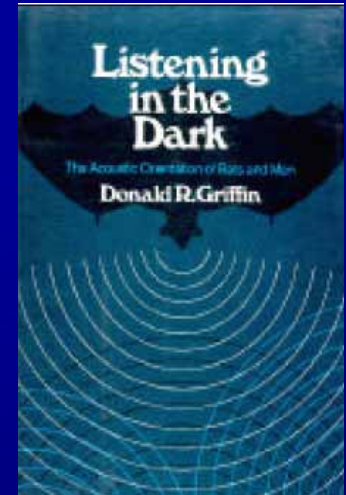
Experiment: Plugged ears of bats with wax and found the bats bumped helplessly into obstacles.

- Spallazani and Jurine concluded – “bats require their sense of hearing in order to find their way”

- Donald R Griffin and Robert Gallambo – Harvard, USA

“Recorded directional noises emitted by bats in navigating flight” using a Sonic Detector in 1938

- Conied the term - Echolocation

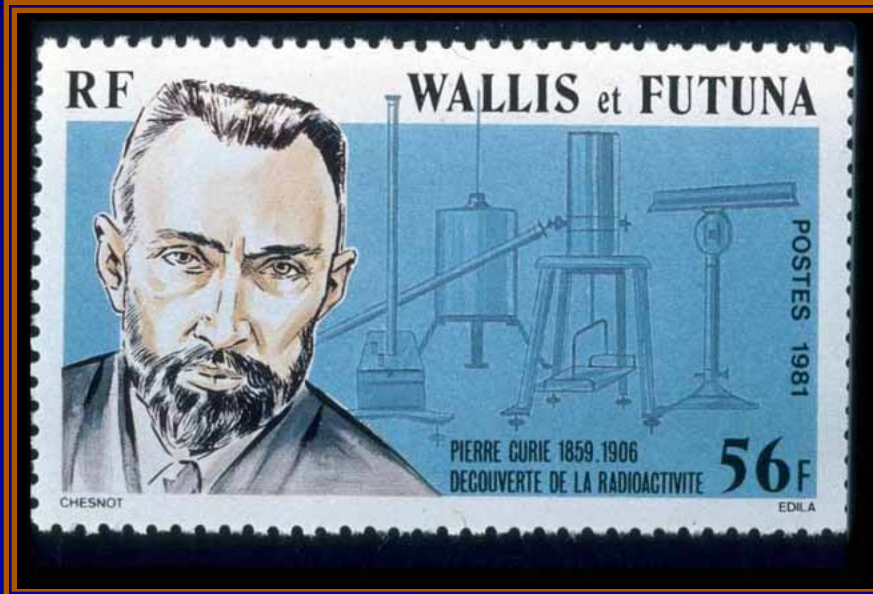
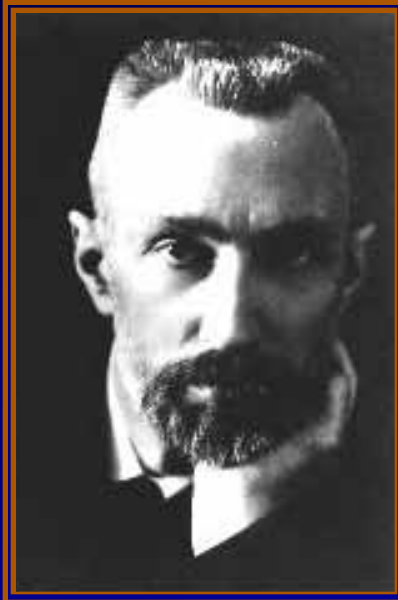


D.R.Griffin. Listening in the Dark – The Acoustic Orientation of Bats and Men, Yale University Press 1958



History of Ultrasound

Piezo-electric Effect



- 1880 - The real Breakthrough in ultrasound technology
- Discovery of the “**Piezo-electric Effect**” in certain crystals
- Pierre and Jacques Curie – Paris ,France
- Led to the development of the ultrasound transducer
- Transducer - The backbone of any Ultrasound device

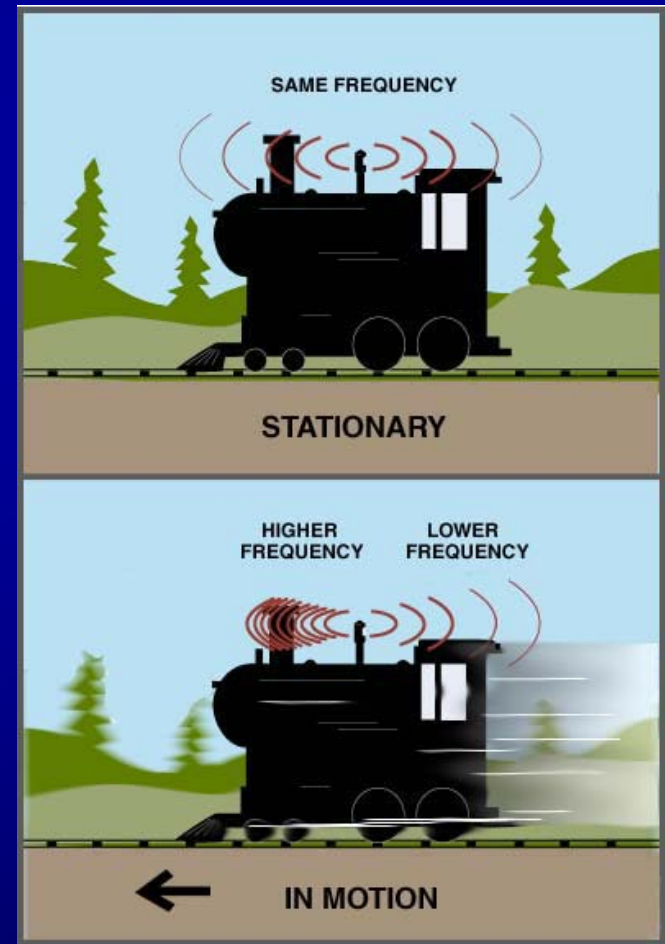


History of Ultrasound

The Doppler Effect



- Johann Christian Doppler (1803-1853) Austria
- “Hypothesised that the pitch of a sound would change if the source of the sound was moving”
- Color doppler ultrasound an important tool in ultrasonography today





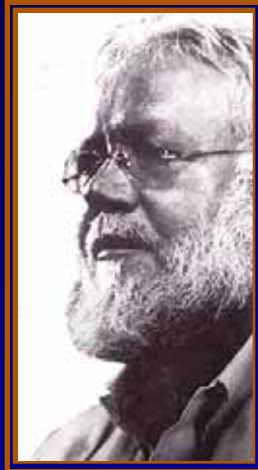
History of Ultrasound Submarines and Battleships



- Sinking of the Titanic 1912 was the impetus for the development of echolocating devices for nautical purposes
- SONAR (sound navigation and ranging)



History of Ultrasound Sonar

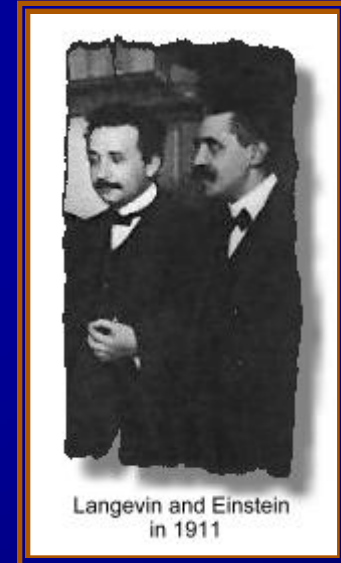
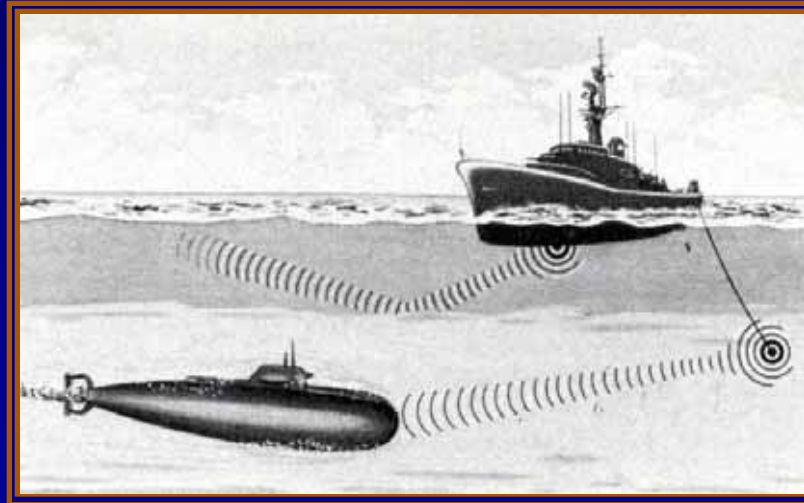
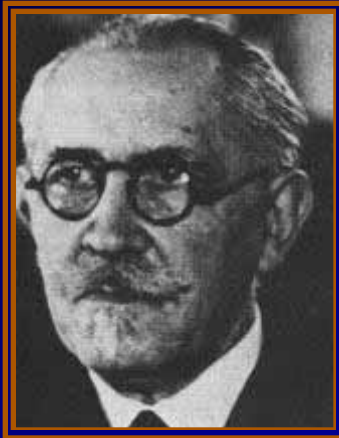


- Reginald Aubrey Fessenden (1866-1932) from Quebec, Canada
- Designed and built the first working SONAR system in the USA
- It was an electromagnetic moving-coil oscillator
- Capable of detecting an Iceberg 2 miles away
- Also the first person to prove that voices and music could be heard over the air without wires



History of Ultrasound

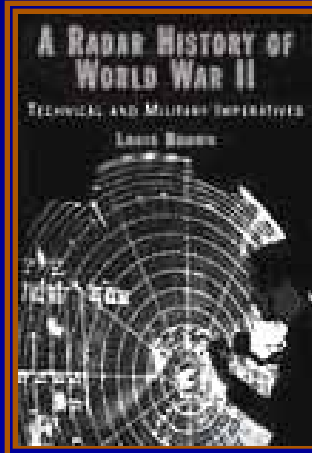
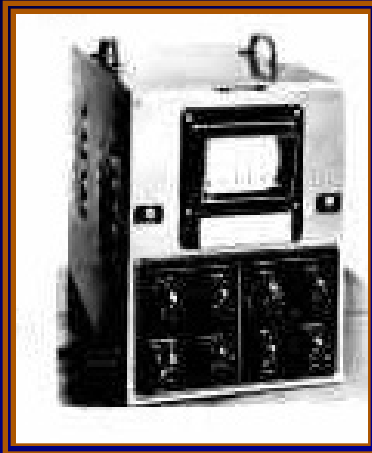
World War I & II



- Paul Langévin - Paris, France
- 1915 - Invented the underwater Sonar for submarine detection (World War I)
- Name of the device – “Hydrophone”
- 23rd April 1916 – first recorded detection and sinking of a German U-boat (UC-3) using a hydrophone
- Ultrasound technology was refined and used to protect the North Atlantic convoys during World War II



History of Ultrasound Radar and Flaw Detectors



- Sergei Y Sokolov – 1928 suggested the concept of ultrasonic metal flaw detection
- “Reflectoscope” or “Flaw detectors”
- Metal Flaw detector - used to detect flaws in metal (ships and aircrafts)
- Radar (Radio Detection and Ranging) – electromagnetic waves, 1935
- Robert-Watson Watts – UK, Father of Radar



History of Ultrasound

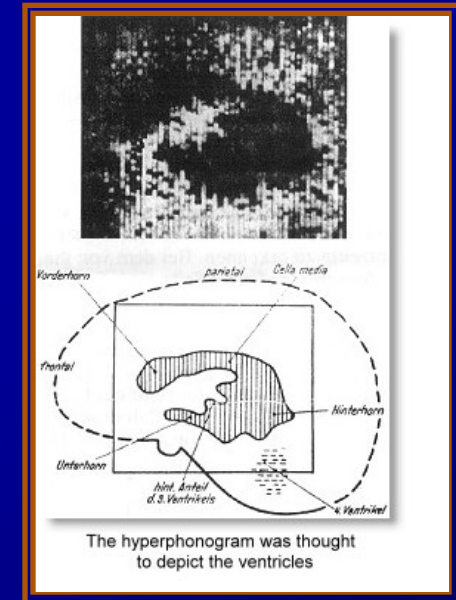
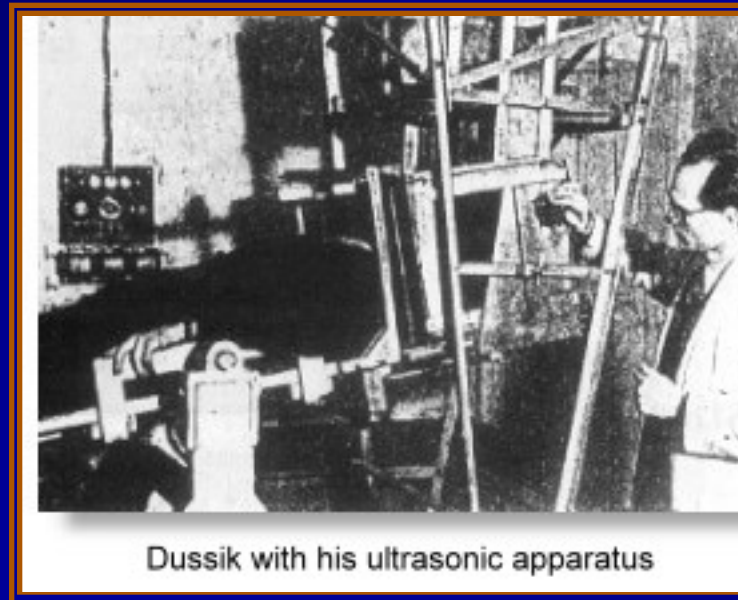
Medical Physical Therapy



- Use of ultrasound for physical therapy dates back to the 1940's
- Thermal energy generated from ultrasound is used in ultrasonic therapy
- Once thought – “Ultrasound is a "cure-all" remedy”
- Used to treat conditons such as arthritic pains, gastric ulcers, eczema, asthma, thyrotoxicosis, haemorrhoids, urinary incontinence, elephantiasis and even angina pectoris!



History of Ultrasound Medical Diagnostic Tool



- Karl Dussik (1908 – 1968) a neurologist from the University of Vienna
- In 1942 – first to use ultrasound as a diagnostic tool
- To locate Brain Tumors and the Cerebral Ventricles
- Term – “Hyperphonography”



History of Ultrasound

Musculoskeletal Ultrasonography

- First report of Musculoskeletal Ultrasonography 1958
- K.T.Dussik (Dussik KT et al. Measurements of articular tissue with ultrasound. *Am J Phys Med* 1958; 37:160-5)
- 1972 – McDonald and Leopold published the first B-mode scan of a human joint. *Br J Radiol.* 1972; 45:729-32
- Led to widespread use in Rheumatology for musculoskeletal examination
- Cooperberg PL et al 1978 – first demonstration of synovitis in Rheumatoid Arthritis. *Radiology* 1978; 126:759-63
- Gompels and Darlington 1981 – first report on Ultrasound guided joint aspiration. *Ann Rheum Dis* 1981; 40: 609-11



History of Ultrasound Obstetrics



Professor Ian Donald
1910 - 1987

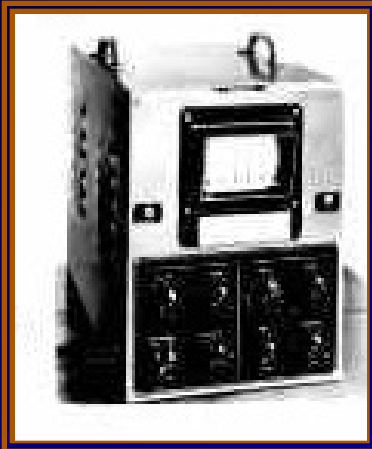


The prototype scanner made from 2 flaw detectors

- Professor Ian Donald, Glasgow, University Department of Midwifery
- Exposed to Ultrasound and Radar technology in the RAF (Royal Air Force)
- 21 July 1955 – first put into practice using two metal flaw detectors to scan specimens of fibroids and ovarian cysts
- Quoted – “finding flaws in women”
- Ian Donald, J. Macvicar and T. G. Brown. The Investigation of Abdominal Masses by Pulsed Ultrasound. **Lancet**, Vol 271, Issue 7032, 7 June 1958, Pages 1188-1195
- Rest is History



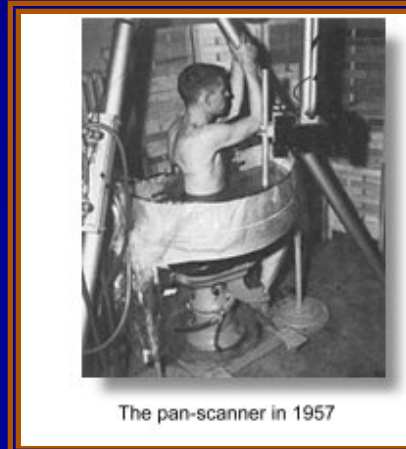
History of Ultrasound Flaw Detectors to Hand Carried Devices



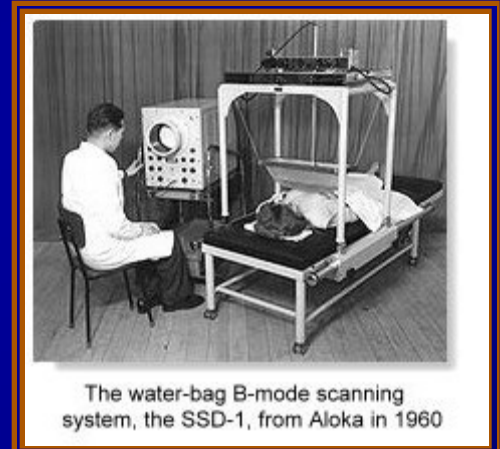
Metal Flaw Detectors



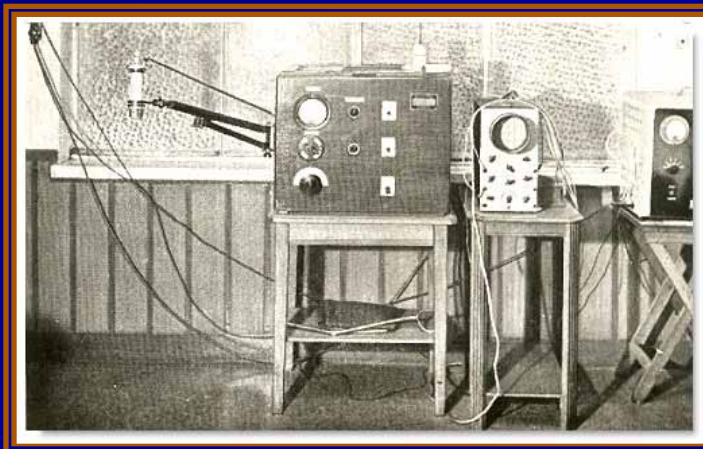
Metal flaw detector in use **
(Kretztechnik, Austria)



The pan-scanner in 1957



The water-bag B-mode scanning
system, the SSD-1, from Aloka in 1960



Deneir's ultrasound apparatus 1946



Early Aloka machine



Machine from China



History of Ultrasound

Cart Based Machines of Today



Phillips HD11XE



GE Vivid Five



History of Ultrasound

Hand Carried Devices of Today



Sonosite - Micromaxx



Sonosite - Titan



Sonosite - Micromaxx



Sonosite - 180



Sonosite - I Look



Sonosite - 180



History of Ultrasound

Medical 3D - Ultrasound



What is 3D ultrasound?

3 dimensional -or "3D"- ultrasound machines allow multiple 2D images to be acquired and rendered as a 3D image of the fetus.

These machines can provide fascinating images of the fetal face and body.



History of Ultrasound

4D - Ultrasound

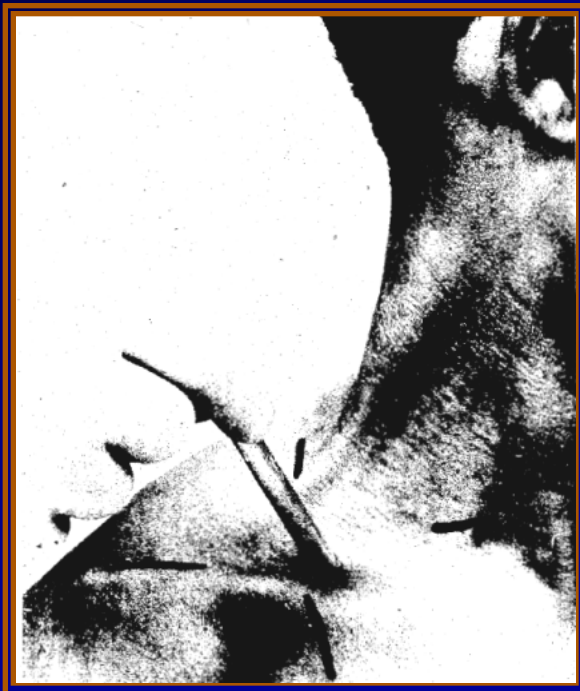


What is 4D ultrasound?

The 4D ultrasound adds a fourth dimension to the ultrasound: time. 4D takes 3-dimensional ultrasound images and adds the element of time to the process. The result: Live action images.



History of Ultrasound Anaesthesia



- La Grange P in 1978 described the use of Doppler ultrasound for supraclavicular brachial plexus block
- La Grange P et al. Application of the doppler ultrasound flow detector in supraclavicular brachial plexus block.

Br J Anaesth 1978; 50: 965-7



History of Ultrasound

Applications in Anaesthesia

- Vascular Access
- Echocardiography: Transthoracic / Trans oesophageal
- Peripheral Nerve Blocks
- Spinal Sonography
- Airway: Documentation of airway anatomy, position of endotracheal tube, airway assessment in patients with large thyroid mass
- Chest: Detect isolated loculated fluid for drainage, Hemothorax, Identify Rib and sternal fracture, pericardial effusion
- Pain clinic: identify neuroma, tumour infiltration, myofascial trigger point injection
- Indications are expanding day by day



Acknowledgement

A Philatelic History of Radiology

http://www.xray.hmc.psu.edu/rci/ss4/ss4_12.html

The Authors would like to thank Dr Joseph Woo for allowing them to reproduce most of the material in this presentaion from the following web publications:

A short History of the development of Ultrasound in Obstetrics and Gynecology.
Dr. Joseph Woo (A Must Read Article)

<http://www.ob-ultrasound.net/history1.html>

Obstetrics Ultrasound – A Comprehensive Guide. Woo, Joseph.

<http://www.ob-ultrasound.net/>

D Kane et al. A brief history of musculoskeletal ultrasound: “From bats and ships to babies and hips” Rheumatology 2004; 43:931-933



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