COMMONWEALTH DEPARTMENT OF HEALTH

ULTRASONICS INSTITUTE

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HISTORY OF THE ULTRASONICS INSTITUTE

A RECORD OF A HISTORICAL EXHIBIT AT THE

WORLD CONGRESS FOR ULTRASOUND IN MEDICINE & BIOLOGY, WFUMB'88

Washington DC, October, 1988

The Ultrasonics Institute and its precursor, the Ultrasonics Research section of the National Acoustic Laboratories played an internationally recognised role in the development of medical uses of ultrasound, commencing in 1959.

In October, 1988 the World Federation for Ultrasound in Medicine & Biology (WFUMB) and the American Institute for Ultrasound in Medicine (AlUM) in conjunction with the Smithsonian Institute held a History of Medical Ultrasound Symposium in Washington DC. The work of the Institute received prominence at the symposium, with 7 staff attending, and 4 on the program either speaking or chairing a session.

There was a historical exhibition at the WFUMB'88 conference in conjunction with the Scientific and Commercial exhibition. The Ultrasonics Institute mounted an exhibition which consisted of three display cases and 9 exhibit panels. This collection includes all of the photographs and descriptive text included in the exhibit.

SOME SIGNIFICANT DATES TO 1976

1955 National Health and Medical Research Council Committee formed to enquire into control of the sale and use of ultrasonic therapy apparatus.

1959 Appointment of full-time ultrasound physicist and clinical adviser to Commonwealth Acoustic Laboratories.

1961 First echoscope construct~d.

1962 Obstetric echoscope installed at Royal Hospital for Women, Paddington.
D.E. Robinson, Engineer; W.J. Garrett, obstetrician.

1964 ophthalmic echoscope installed at Royal Prince Alfred Hospital. .
C.N. Liu (later M.J. Dadd) Engineer, H.L. Hughes, Ophthalmologist.

1966 Breast echoscope installed at Royal North Shore Hospital
J. Jellins, Engineer; T.S. Reeve, Surgeon.

1969 Grey scale processing in breast, obstetrics, eye.

1972 Signal processing computer installed and tissue characterisation commenced.

1973 Annular array system installed for obstetrics.

1974 UI Octoson prototype constructed.

1975 Ultrasonics Institute formed.

1976 UI Octoson commercially available.

1976 Doppler Flow work commenced.

CHARACTER OF THE ULTRASONICS INSTITUTE

The Ultrasonics Institute is unique in its field in several respects: its projects are initiated by a nucleus of engineers and physicists rather than clinicians, and it has enjoyed a stability of staff for almost thirty years. This group of technical experts has close working relationships with a variety of medical specialists.

Projects are generated and assessed from within the Institute, with long-term performance being monitored by a triennial External Review Committee. Funding is from the Budget allocation of the Federal Department of community Services and Health.

Some technical projects are carried out alone. For others the Institute works in collaboration with Universities and similar bodies. Where a clinical research or evaluation component is significant, the Institute enlists a medical specialist with a complementary research interest who has an appointment at a teaching hospital in Sydney. Research Ultrasonographers employed by the Institute and working in the hospitals have made significant contributions to this work.

Despite the emphasis on clinical evaluation, technical advances are at the heart of the Institute's work. Stability of funding over a number of years has allowed the maintaining of a state-of-the-art electronics laboratory, including micro-processor development system and computer aided design facilities, and technical and engineering staff skilled in their use.

CURRENT ACTIVITIES AND STAFF, ULTRASONICS INSTITUTE

(Year of commencement in ultrasound in brackets)

Director (on leave)	George Kossoff (1959)
Acting Director	David Robinson (1961)

Tissue Characterisation

David Robinson (1961) and Fu Chen (1980)

Sound Speed; attenuation and attenuation slope; image texture.

Doppler

Robert Gill (1975), Michael Dadd (1966) and Laurence wilson (1978)

Quantitative flow, fetal umbilical, porta-caval shunt
Spectral waveforms, early, late pregnancy, ovarian.

Imaging

David Carpenter (1968)

STARS - Subcutaneous Tissue Aberration Removal Scheme

Clinical EValuation

Jack Jellins (1966), Kaye Griffiths (1971), Delys O'Connell (1987)

Breast disease evaluation, imaging and Doppler; clinical trials in tissue characterisation, Doppler techniques.

Bioeffects

Stanley Barnett (1970) and Sandra Barnstable (1974)

Stress in rat embryo cUlture, weight reduction in fetal mice, lysis of human blood cells by ultrasound.

Technical Support

Fu Chen (1980), Phil Ho (1986), George Radovanovich (1962), Ian Shepherd (1962), Peter Isaacs (1967) and Graham Lange (1974)

XTC (Experimental Tissue Characterisation scanner); Laboratory experimental apparatus; software, circuit and microprocessor development.

AUSTRALIAN SOCIETY FOR ULTRASOUND IN MEDICINE - ASUM

By 1970 the use of ultrasound had spread sufficiently beyond the confines of the Ultrasonics Institute that an Australian Society for Ultrasound in Medicine was formed. Ultrasonics Institute employees or collaborators comprised the entire inaugural Council:

G. Kossoff	President	Councillors:	H. Hughes
W. Garrett	Vice President		D. Robinson
M. Dadd	secretary		I. Shepherd
C. Sharpe	Treasurer		

The first Annual Scientific Meeting was held in 1971, and have been held annually since that date, culminating in the 1985 WFUMB meeting. ASUM has been particularly active in accreditation, with the establishment of the Diploma of Diagnostic Ultrasound (DDU) for medical practitioners in 1976 and the Diploma of Medical Ultrasonography for ultrasonographers (DHU) in 1979. There are currently 300 DDU and 350 DHU holders. Due to the efforts of ASUM, ultrasound has been recognised as a sectional speciality and the DDU as a qualification for that speciality. ASUM has 500 ordinary and 700 associate members and is now an incorporated body quite separate from the Ultrasonics Institute.

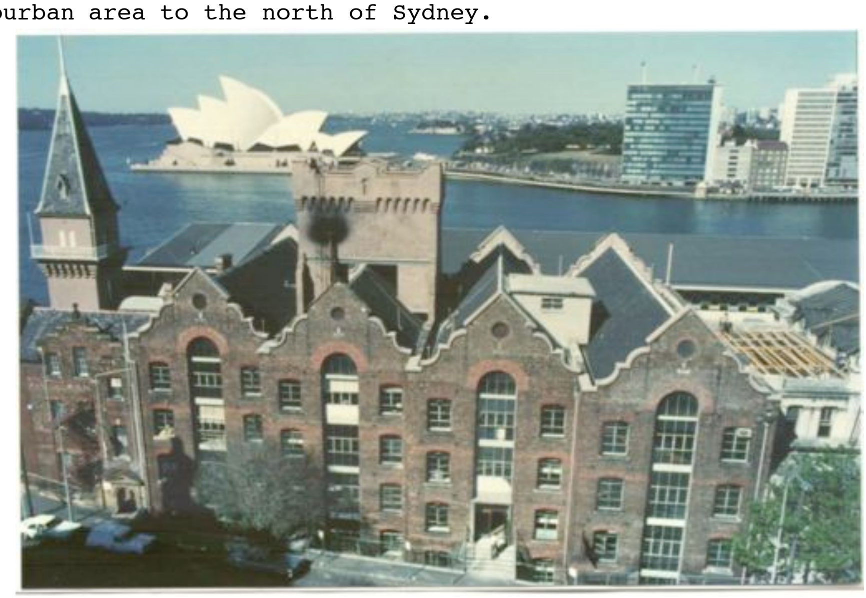
THE INSTITUTE

COMMONWEALTH ACOUSTIC LABORATORIES

The Ultrasonics Research section, Commonwealth Acoustic Laboratories, was housed for the period 1963-1985 in the fourth floor of an old wool-store building in the picturesque "Rocks" area on the Sydney city waterfront. The building was built in 1895, of local hard-wood construction with brick facades. Street access was obtained from the western side of the building, while the eastern side gave access to the dock area. Subsequent land reclamation has moved the water-front away from the building, and there is now an overseas passenger shipping terminal between the building and the water.

During our residency the view of the famous Sydney Harbour was partly occluded by the now equally famous Sydney Opera House. The Sydney Harbour Bridge is out of sight, just behind and to the left of the photographer.

When the section moved into these quarters the area was a somewhat run-down dockside environment. In common with many such areas throughout the world, it has been refurbished and is now a popular and well-known tourist "trap", with restaurants, novelty shops etc. This was far too frivolous an environment for a serious group of researchers, and in any event the building was required to "trap" more tourists, so the Ultrasonics Institute moved to a brand new purpose-built building in Chatswood, a suburban area to the north of Sydney.



ULTRASONICS INSTITUTE & NATIONAL ACOUSTIC LABORATORIES

Planning for a new building for the Ultrasonics Institute and National Acoustic Laboratories began in 1973, and the building was completed and occupied in 1986. The Ultrasonics Institute occupies the wing on the left-hand side of the photograph.

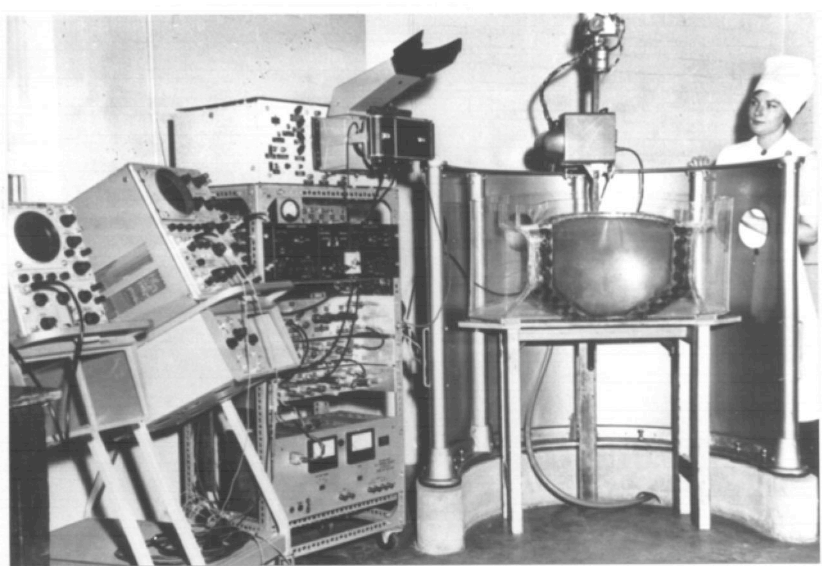
The site, in a wooded valley, was selected to meet stringent criteria for ambient noise and vibration levels. The unique combination of research, development and services within NAL and UI has determined the nature of the facilities provided in the new building.

The special facilities for UI consist of computing equipment for signal and image processing and examination rooms for patient examinations using prototype ultrasonic scanners. Also provided are a transducer/integrated circuit complex with appropriate environmental conditions, and a biology laboratory with provisions for chemistry, histology and animals. In support of the special facilities, an infrastructure of mechanical and electronics laboratories, test rooms, research laboratories, and administrative areas is provided. Where appropriate these are linked by data links and co-axial cables. These extended facilities have made possible increased co-operative activities with Universities and other research organisations.

FIRST ECHOSCOPE ~96~

The Commonwealth Acoustic Laboratories of the Australian Department of Health, under the directorship of Norman Murray, became interested in ultrasonic imaging in the late ~950's, as a result of concern about the use of x-rays in examination of the fetus. A full-time research physicist (George Kossoff) was appointed with William Garrett providing clinical advice.

Simultaneously, research programs in ultrasonic treatment of Meniere's disease began. The first images were obtained in 1962, and were acknowledged to be state-of-the-art for their time. This was the first step in establishing the international reputation of the Ultrasonics Research Section of the Commonwealth Acoustic Laboratories, later to become the Ultrasonics Institute.



ORIGINAL NOTEBOOK 1962

The note-book shows signs of age and wear and tear. In 1962 its historical significance was not apparent!

Left

The first patient scanned using the MKI abdominal echoscope was on 11 May 1962. The echograms taken one week later on 18 May showed that the fetus could be clearly displayed and some echoes were seen within the fetal boundary. In the echogram marked D, the fetal spine was seen but not recognised. Good penetration through the fetus is evident. Examples of this work were shown by George Kossoff at a symposium held at the University of Illinois in June 1962. (See note at bottom of page).

Top

As suggested by the. scribbled diagram, there was considerable excitement at the detail seen. The series of echograms was published in the reference below. The handwriting is by David Robinson and William Garrett.

1965 An ultrasonic echoscope for visualising the pregnant uterus; Kossoff, Garrett and Robinson. In Ultrasonic Energy, Biological Investigations and Medical Applications, E. Kelly Ed. Univ. of Illinois Press.

Margaret Hansen 14-8-62

1. Rubber Echo only 1000 g.

Without 7cm BWL.
2. Pattern 7cm BWL

3. 9.5cm BWL

4. 12cm BWL

5. 14.5cm BWL

AP. Lateral Xray taken. Fracture Right leg
Notably fontanelles abnormal.
Scale of Xray 1/2" = 1 cm.

7. Interpretation

Vertebrae at level T12-L1

Section Lateral from Right Shoulder ~~[illegible]~~ to Left Iliac crest;
Iliac crest near here

B. Barbara Shaft 35 weeks 18/5/62

1 } 2 }	22 cms BWL	2 pictures [illegible] 3 scans
3		1 .. one scan
4	24 cms BWL	3 scans
5		Sat down!
6 } 7 }	20 cms BWL	3 scans
8		1 scan.
9 } 10 }	18 cms BWL	2 pictures 3 scan
11 } 12 }		1 scan
13 } 14 }	Vertical	3 scans < Sat down.

1 [illegible] 2

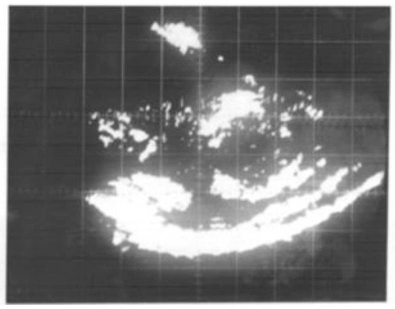
LOA - Head not engaged.

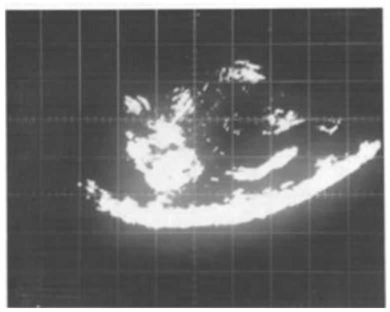
umbilicus approx 22 cms BWL

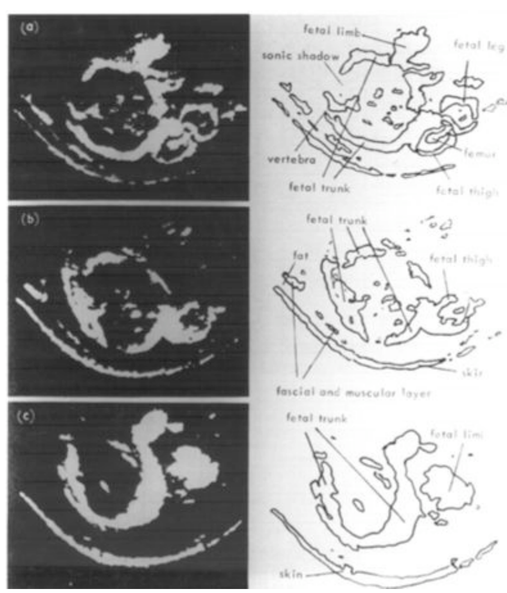
∴ Pictures of lower 1/2 of [illegible] ?

new position for patient (tank tilted),

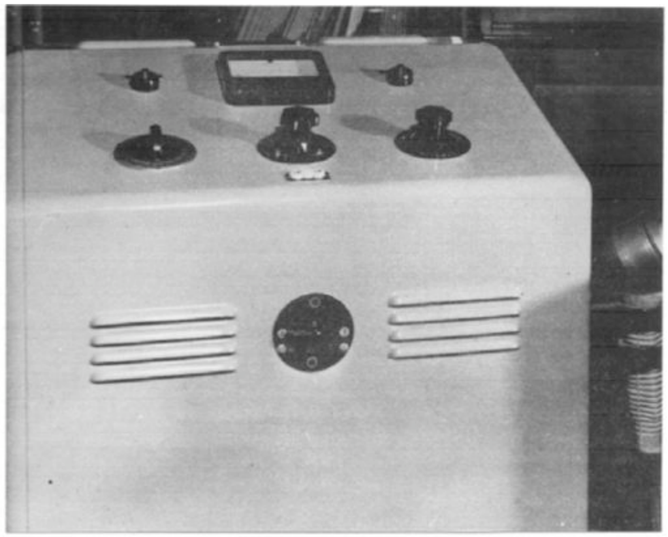
most sent to George.






(a)
fetal limb
sonic shadow
fetal leg
vertebra
femur
fetal trunk
fetal thigh
(b)
fetal trunk
fat
fetal thigh
fascial and muscular layer
(c)
fetal trunk
skin

MENIERE'S DISEASE THERAPY 1962



THE FEDERICI ULTRASONIC GENERATOR

This instrument was the first one used to irradiate the semi-circular canal.

CAL ULTRASONIC GENERATOR AND APPLICATOR - 1962

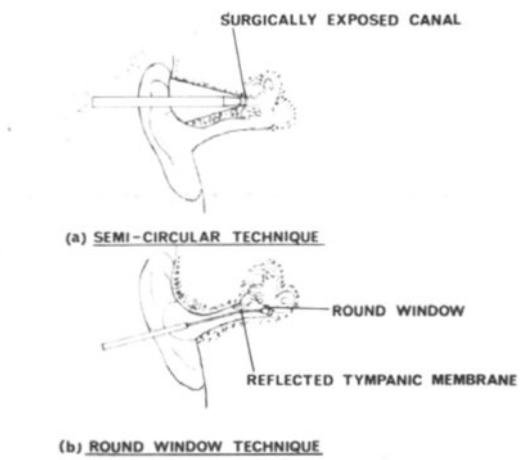
In contrast to surgical therapy, ultrasound treatment preserved the patient's hearing because the ultrasound was directed selectively at the balance organs in the vestibule, and away from the cochlea. Debilitating vertigo was alleviated in many patients who were beyond help from conservative chemotherapy.

The original approach via the semi-circular canal was suggested by Prof. Arslan in Padua. The CAL applicator probe developed by the Ultrasonics section was considerably smaller and easier to manipulate. It housed a 3 MHz focused transducer inside a metal nose cone used for water coupling to the surgically exposed semicircular canal.

CAL ROUND **WINDOW** ULTRASONIC IRRADIATOR - 1965

A major breakthrough in the treatment of Meniere's disease came with the development of a surgical approach which allowed coupling of ultrasound into the inner ear via the round window. This simple surgical technique obviated the need for general anaesthetic thereby reducing the surgical trauma and operation time. Results showed a 70% success rate in reducing Meniere's disease symptoms in patients treated with this technique.

The irradiator used in the therapeutic procedure described, has a 1 mm diameter transducer fitted into a hypodermic tubing housing, and operated at a frequency of 4 MHz.



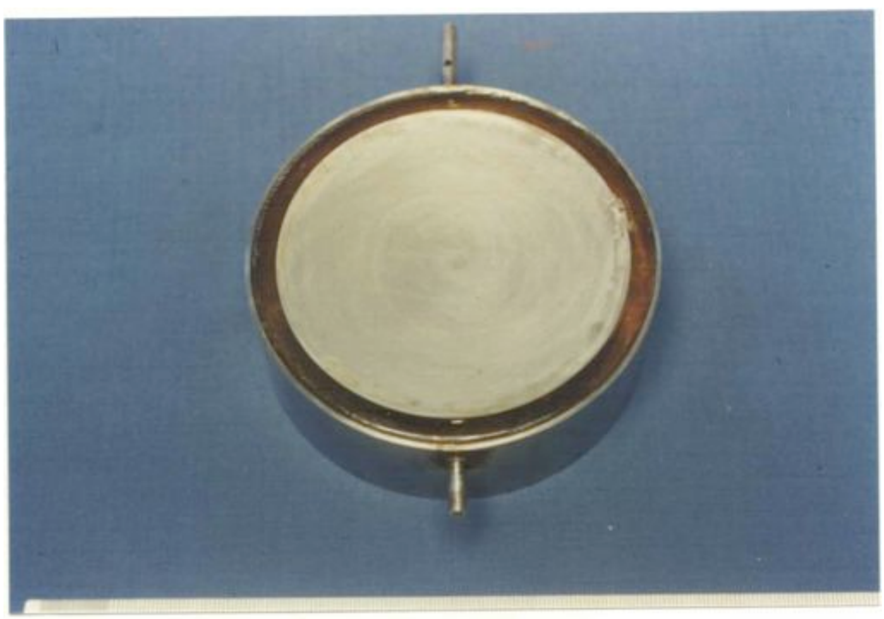
ULTRASONIC TREATMENT OF MENIERE'S DISEASE

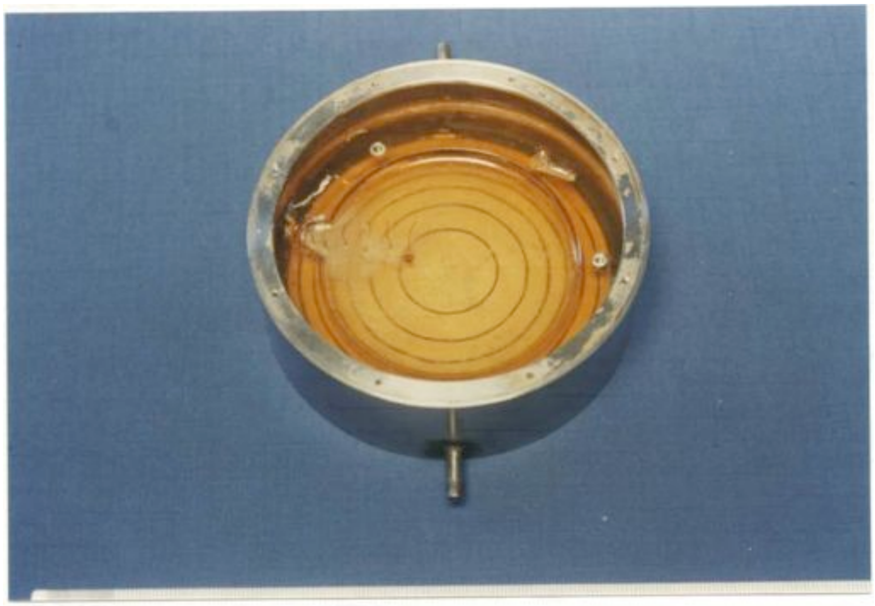
ANNULAR ARRAY 1972

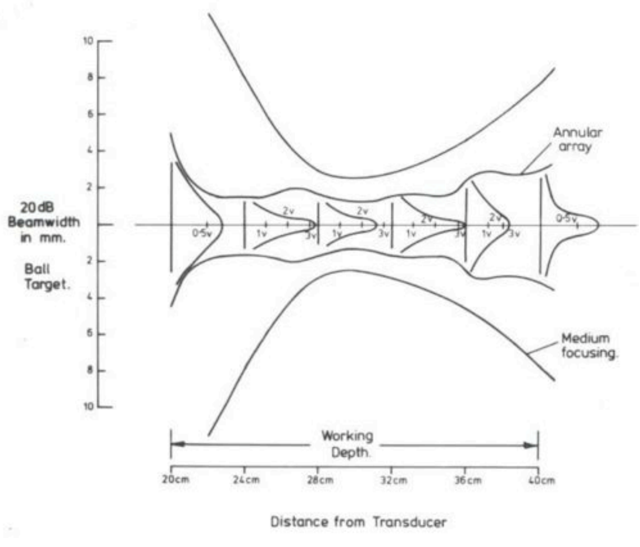
Development of this 8 element annular array transducer started in 1972 and it was put into service in 1973. It operated at 2 MHz, was 130 mm in diameter with a mechanical focus of 260 mm. It was installed on the MKII abdominal eChoscope, used a 40 mm aperture weak focus on transmission and full dynamic focus on reception. The dynamic focus was achieved by analogue delay lines using varactor diodes as variable capacitors to control the delay. To compensate for the variation in de~ay line impedance, variable resistance drive and termination elements were used.

The beamwidth of 4 mm was significantly less than that used in fixed focus transducers because of its increased aperture, and the dynamic focus extended the focal zone as shown. The improvement in image quality was dramatic, as the echograms on display show.

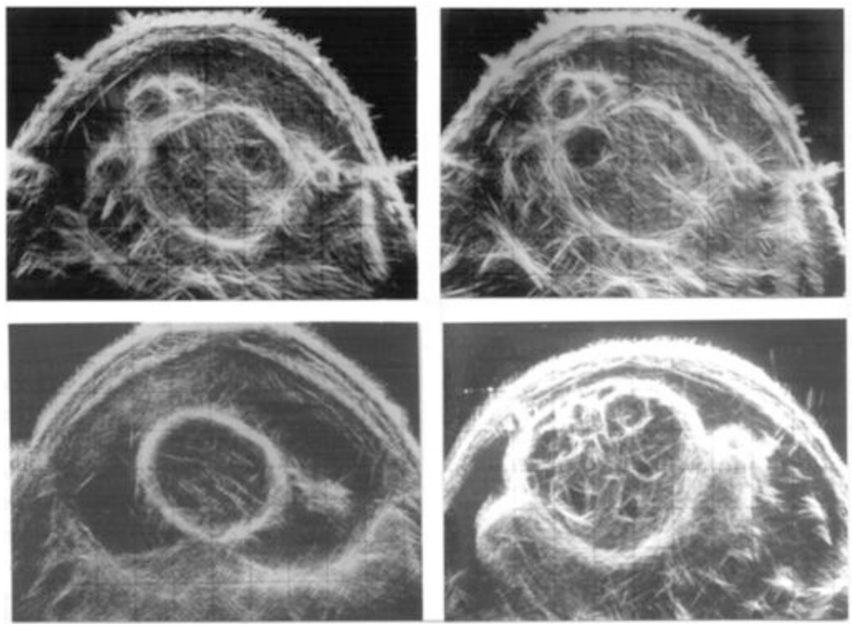
Annular array transducers were later installed on a UI Octoson.



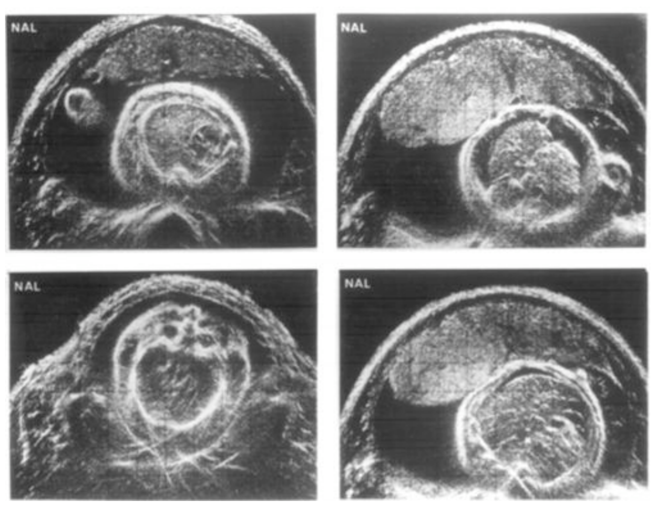




20dB
Beamwidth
in mm.
Ball
Target.
Annular
array
Medium
focusing.
0·5v
1v
2v
3v
Working
Depth.
20cm
24cm
28cm
32cm
36cm
40cm
Distance from Transducer



PRE ANNULAR ARRAY



ANNULAR ARRAY

EARLY ECHOSCOPES

This machine was designed and built by George Kossoff (right) and Dave Robinson (left), and installed at the Royal Hospital for Women, Paddington, Sydney. The clinician in the project was Bill Garrett. The machine consisted of a trolley running on a circular track, and performed compound scan motions, arc sector in the horizontal plane and linear sector in the vertical plane. The transducer was a 2 MHz, 25 mm weakly focused disc. The original electronics were built entirely of vacuum tubes, and used a Hughes Tonotron storage tube for image display. The patient stood on an angled stretcher and her abdomen was brought into contact with the flexible window on the wall of the coupling tank.

MK I ABDOMINAL ECHOSCOPE - 1961

MK 1B ABDOMINAL ECHOSCOPE - 1964

This upgrade of the original scanner incorporated a number of improvements. Provision for adjustment was made to ensure that the circular track was level, so that the transducer described an accurate circular arc. The success of this was due to the efforts of Ian Shepherd. The main problem in building this scanner was that the scanner itself was the most accurate piece of test equipment available. The electronics rack was modified to take advantage of the newly developed transistor technology. George Radovanovich played a major part in its development.

Many papers on ultrasonic imaging from our group were based on experience gained using this echoscope. A selection is listed below.

1962 Design of narrow-beamwidth transducers; Kossoff. JASA, 35.

1964 Design criteria for ultrasonic visualisation systems; Kossoff, Robinson, Liu and Garrett. Ultrasonics, 2.

1965 Ultrasonic two dimensional visualisation techniques; Kossoff, Robinson and Garrett. IEEE 8U-12.

1966 The effects of backing and matching on the performance of piezoelectric ceramic transducers; Kossoff. IEEE 8U-13.

1966 Artifacts in ultrasonic echoscope examination; Robinson, Kossoff and Garrett. Ultrasonics, 4.

1968 Ultrasonic two-dimensional visualisation for medical diagnosis; Kossoff, Robinson and Garrett. JASA, 44.

The above photo shows the echoscope operated by George Radovanovich and Patricia Duff.

MK II ABDOMINAL ECHOSCOPE - 1967

To overcome the problems of mechanical accuracy encountered with the circular track approach in the MK1 echoscope, this machine had a system of trolleys running on two sets of parallel rails at right angles. The transducer was accurately controlled to remain in a single horizontal plane and its position was derived by a radial drive arm, giving an accurate circular motion in the horizontal plane.

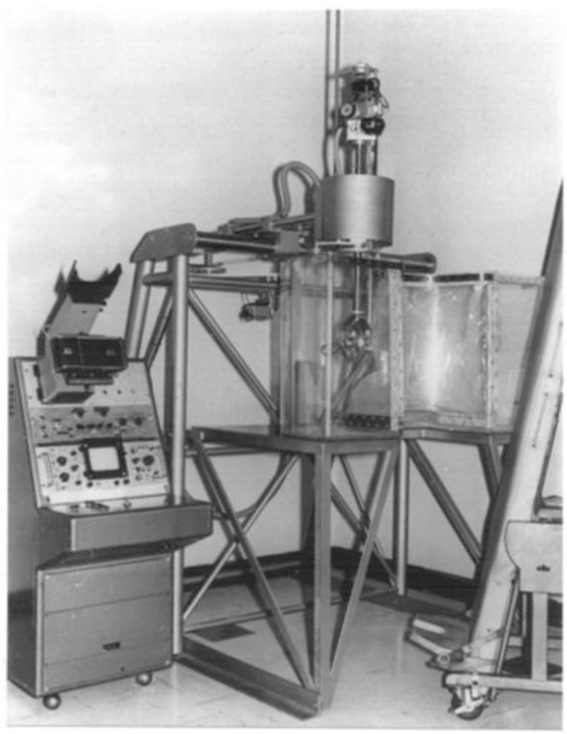
The machine was capable of compound scans in both the horizontal and vertical planes as in the earlier echoscope.

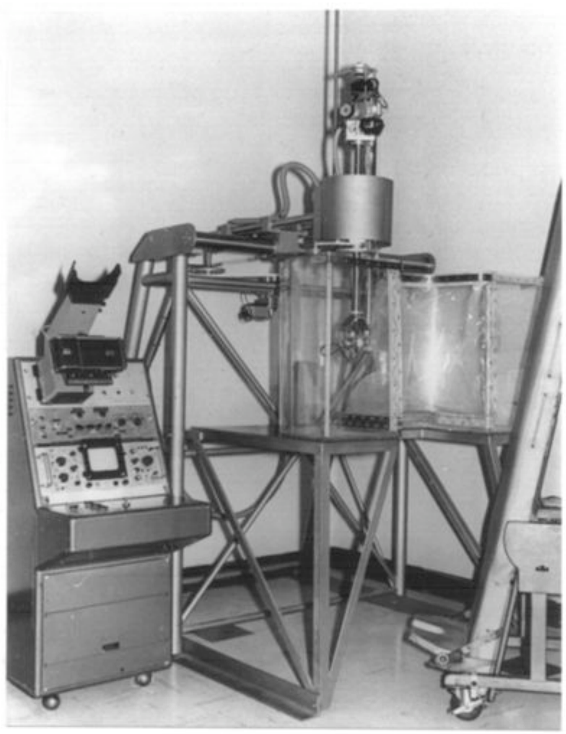
This echo scope formed the basis for a large part of the development of clinical ultrasound in obstetrics by the Sydney group. Development of clinical applications of the grey scale technique display for signal processing was incorporated into this scanner in 1970.

A large aperture dynamically focused annular array transducer was incorporated in 1973. This is displayed in the central showcase.

Experience gained with this echoscope formed the basis for the design and development of the U1 Octoson in 1974.

Pulsed Doppler capability was added in 1977, when the first volumetric flow measurements were made in the fetal umbilical vein.





OBSTETRICS 1962-1969

The obstetrics work was carried out at the Royal Hospital for Women with William Garrett as the principal clinical investigator. Our first obstetric echograms were obtained and published in 1962. There was no literature to help us identify the structures seen. Each improvement in echoscope performance, sensitivity or resolution revealed additional detail which had to be interpreted. With the bi-stable display and little grey scale, the incident angle of the beam was of prime importance in obtaining detail, and careful positioning, extensive compound scanning and good fortune were needed to obtain attractive images. Nevertheless, considerable progress was made in identifying anatomical structures and by 1967 sufficient information had been gathered to prepare a book.

1970 Ultrasound in clinical obstetrics; Garrett and Robinson. Charles C. Thomas, Ill.

Recognition of the anatomy opened the door for taking measurements of the fetus, and its organs to assess fetal well-being, as well as an ability to diagnose fetal pathology.

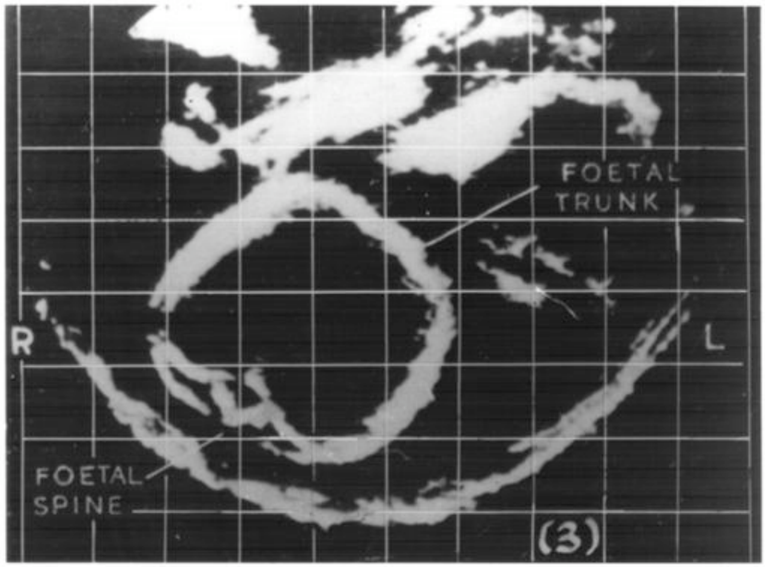
1966 Ultrasonic echoscope examination in late pregnancy; Garrett, Robinson and Kossoff. Obstet Gynecol, 28.

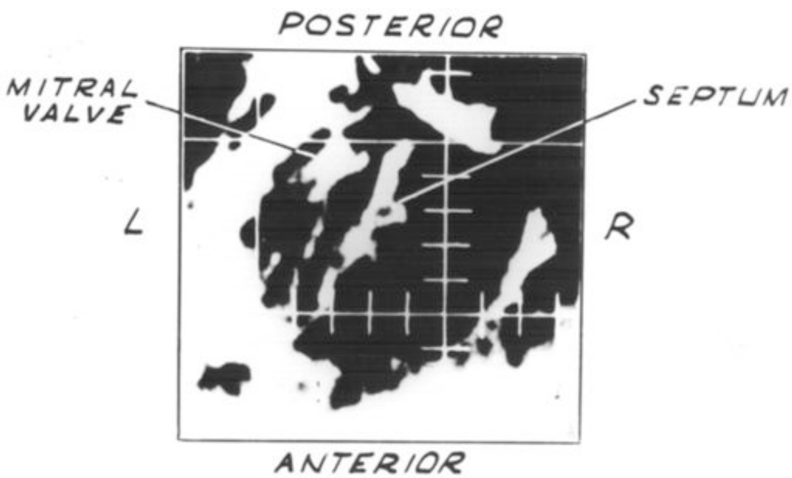
1968 Fetal anatomy displayed by ultrasound; Robinson, Garrett and Kossoff. Investigat Radiol, 6.

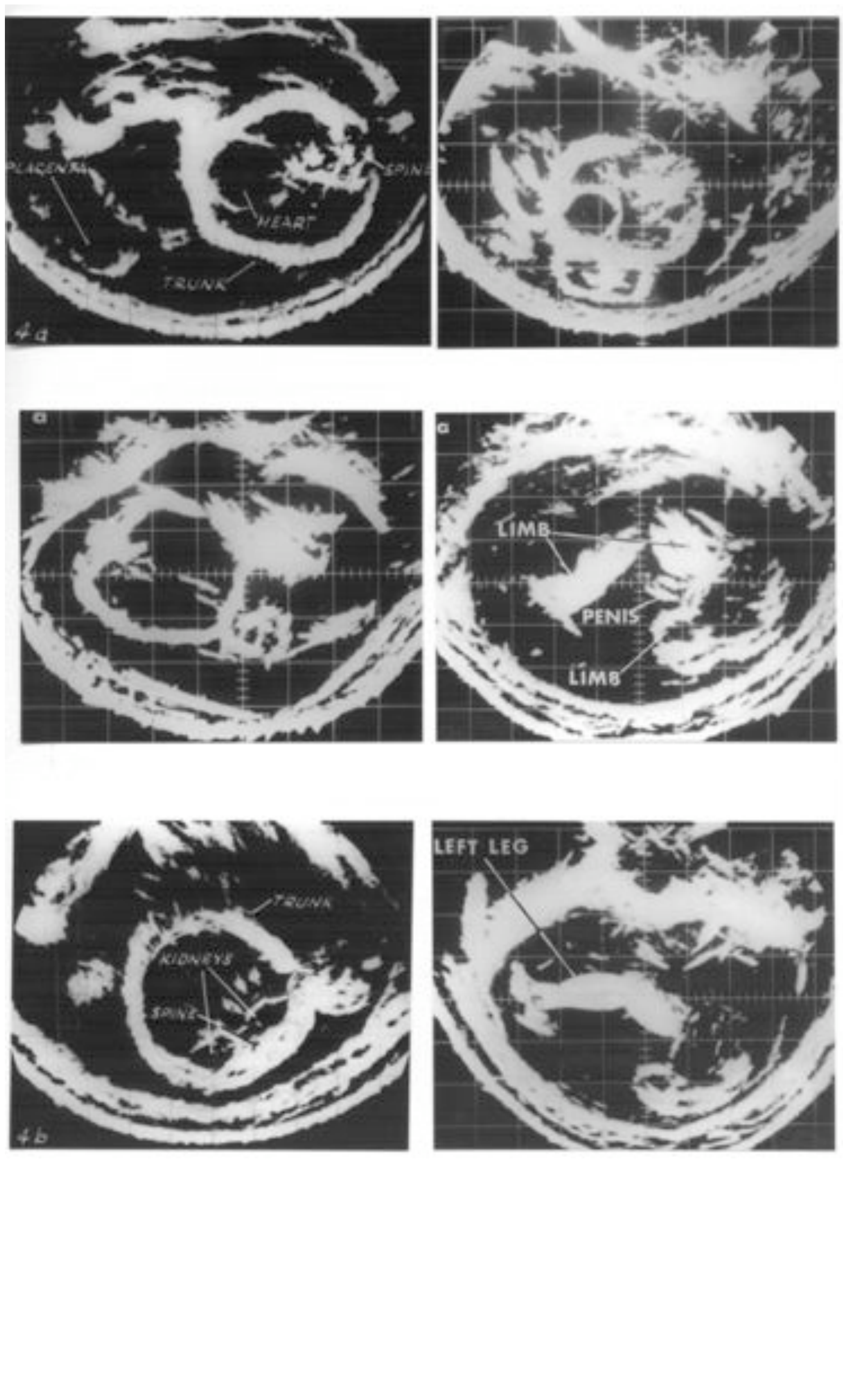
1970 Prenatal diagnosis of fetal polycystic kidney; Garrett, Grunwald and Robinson. Aust NZ Obstet Gynecol, 10.

1970 Fetal heart size measured in vivo by ultrasound; Garrett and Robinson. Pediatrics, 46.

1971 Assessment of fetal size and fetal growth rate by ultrasonic echoscopy; Garrett and Robinson. Obstet Gynecol, 38.


FOETAL
TRUNK
R
L
FOETAL
SPINE
(3)


POSTERIOR
MITRAL
VALVE
SEPTUM
L
R
ANTERIOR



PLACENTA
SPINE
HEART
TRUNK
4a
a
a
LIMB
PENIS
LIMB
TRUNK
KIDNEYS
SPINE
4b
LEFT LEG

GREY SCALE 1969

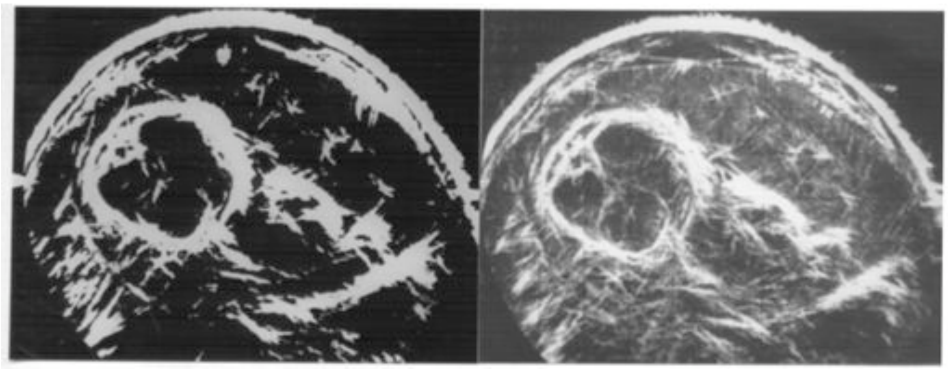
Grey scale display was introduced to the abdominal, eye and breast echoscopes in 1970 following development of new concepts in signal processing, image recording and transducer resolution. Initially the display was obtained by a time exposed film, the so called "open shutter" technique. This system was suitable for mechanically driven scanners with even and repeatable scan patterns.

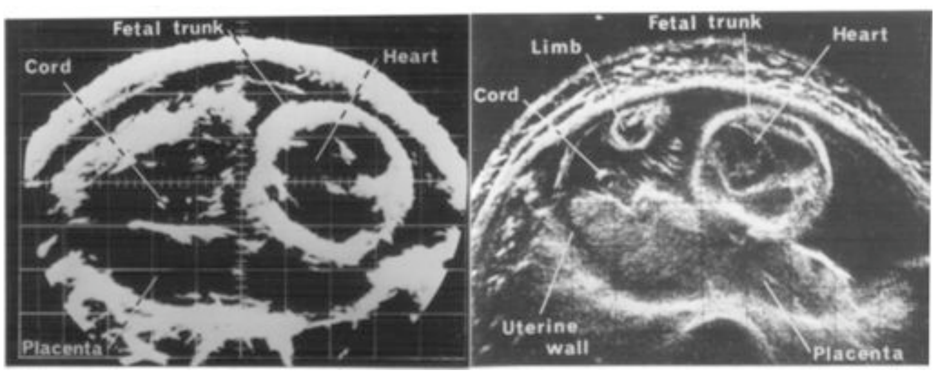
Later technological developments such as the analogue and digital scan converter made the technique suitable for manually driven contact scanners which became commercially available by 1974.

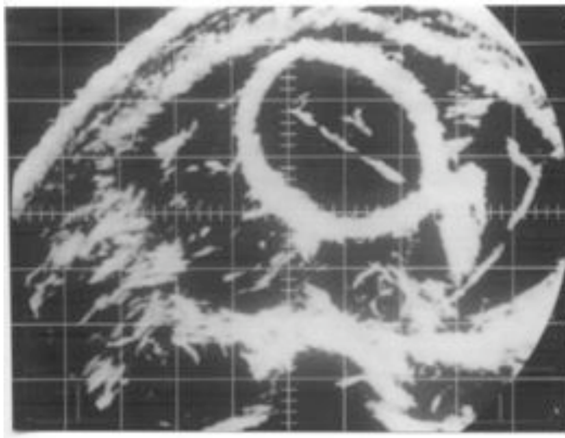
The principle of the grey scale technique is to compress the larger outline echoes into the small part at the top of the dynamic brightness" range, and emphasize. the range of smaller echoes scattered from tissue micro-structure. In this way different tissues such as liver, kidney, spleen, muscle, fat and cystic spaces can be easily differentiated, providing a new dimension in imaging detail and ultrasonic diagnosis.

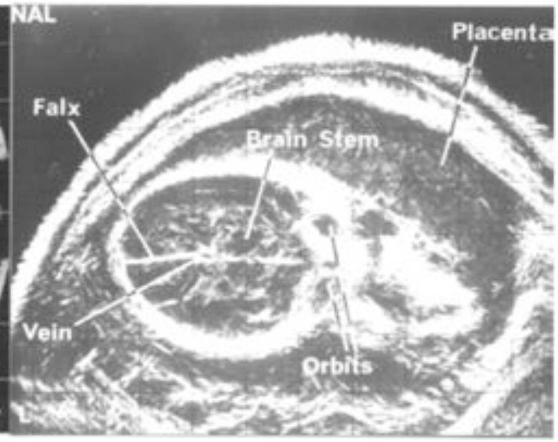
1972 Improved techniques in ultrasonic cross-sectional echography; Kossoff. Ultrasonics, 10.

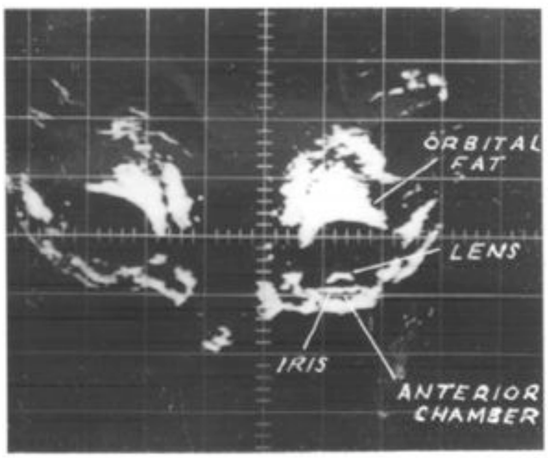
1976 principles and classification of soft tissue by grey scale echography; Kossoff, Garrett, Carpenter, Jellins and Dadd. UMB, 2.

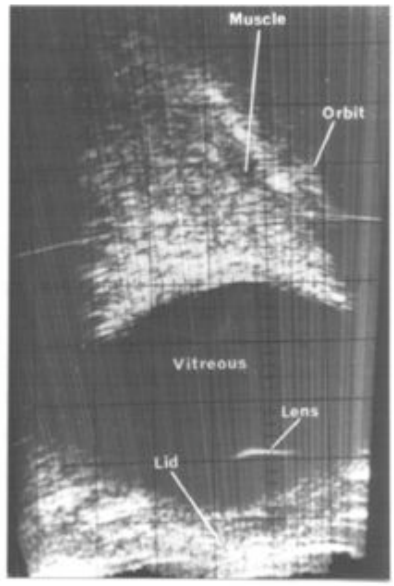


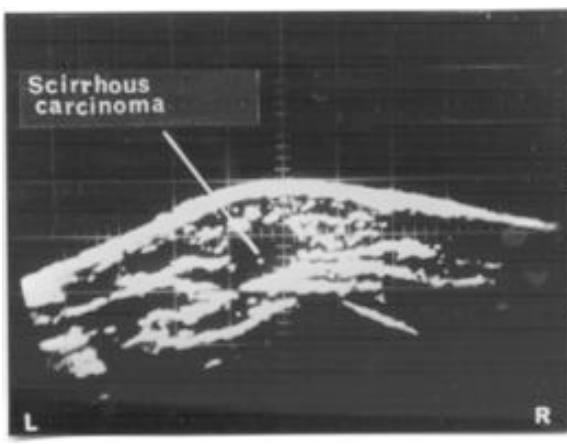

Fetal trunk
Cord
Heart
Placenta
Limb
Fetal trunk
Heart
Cord
Uterine wall
Placenta

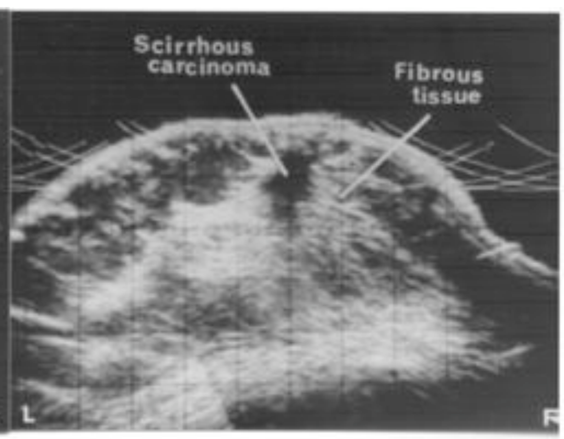



Placenta
Falx
Brain Stem
Vein
Orbits


ORBITAL FAT
LENS
IRIS
ANTERIOR CHAMBER


Muscle
Orbit
Vitreous
Lens
Lid


Scirrhous carcinoma
L
R


Scirrhous carcinoma
Fibrous tissue
L

EYE 1964

In 1964 the first ophthalmic echo scope was installed at Royal Prince Alfred Hospital by C.N. Liu and later M.J. Dadd with H.L. Hughes as clinical collaborator. It used a weakly focused 8 MHz transducer with a 20 dB beamwidth of approx. 2.5 mm. Both eyes were examined in one pass using compound scanning. The first logarithmic amplifier was introduced into the signal processing in 1967. Clinical emphasis was on examination of the retrobulbar space.

The first grey scale signal processing was introduced into this echoscope in 1969 and the technology first described in 1971.

In 1972 a high resolution, precision grey scale echo scope using an 8 MHz 36 mm diameter highly focused transducer with a 20dB beamwidth of 1mm was introduced. The scanner was fully motor driven and capable of both simple and compound scanning. Each eye was examined separately with the focal region (indicated by the focus marker) placed in the area of interest and the results recorded automatically on 35 mm film. Publication of results of the first 5 years experience in grey scale ophthalmology occurred in 1974.

Landmark Publications

1965 The CAL ultrasonic Echoscope for ophthalmological Investigations; Kossoff & Robinson, J. coll. Radiol. Aust.

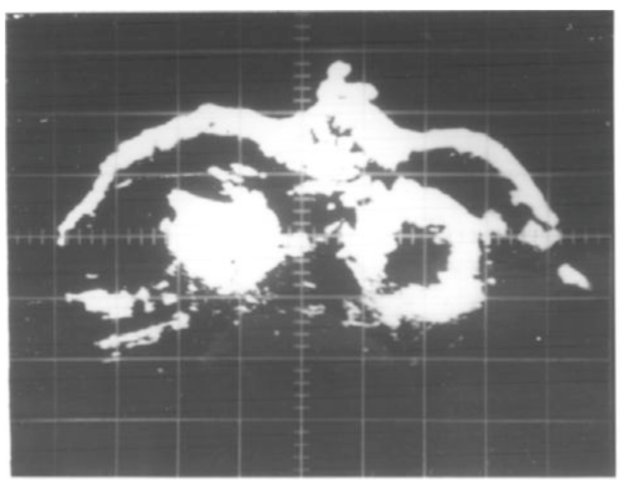
1969 The Application of Ultrasonography to the Examination of the Eye; Hughes & Dadd, Med. J. Aust.

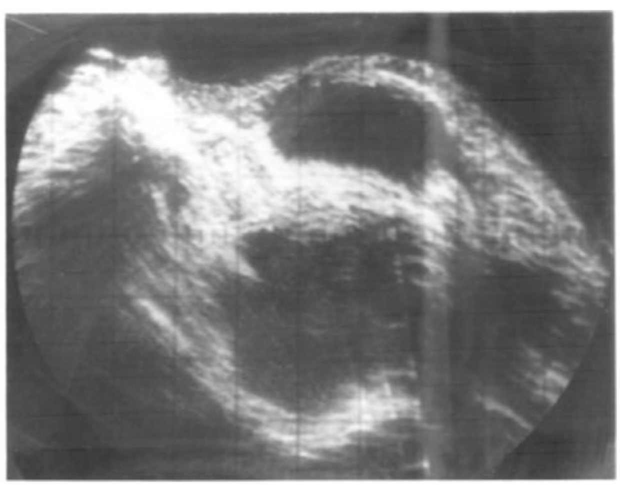
1971 Grey Scale Requirements for ophthalmological Echograms; Dadd & Kossoff, 9th Int. Conf. on Med. & Biol. Eng.

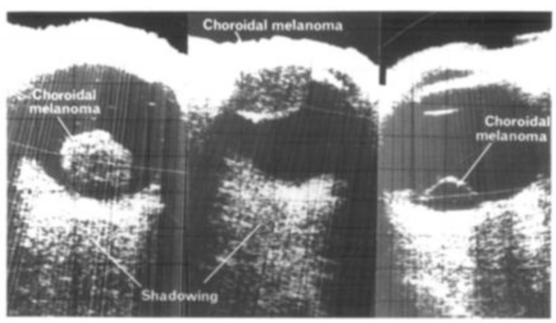
1974 Ultrasonic Display of the Orbital Contents; Dadd, Kossoff & Hughes, Med. J. Aust.

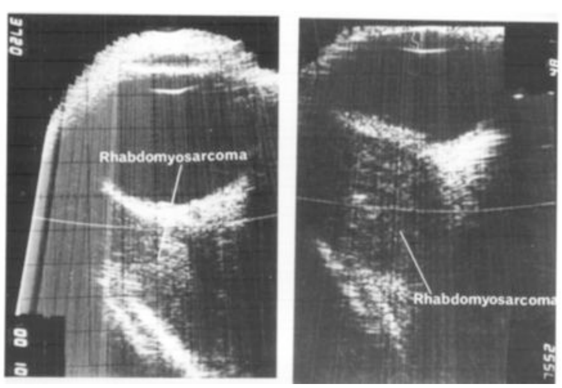
Project Assistance from

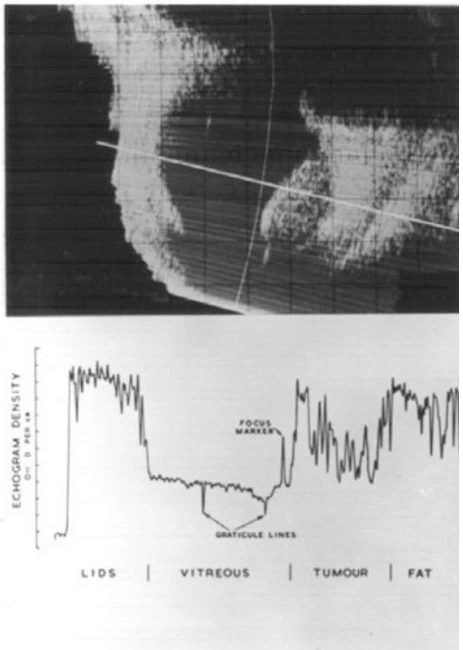
Technical: D. Chipling, P. Isaacs, I. Shepherd, G. Radovanovich
Clinical: M. Tabrett, S. Simpson, S. Barnstable, A. Lambrechtsen

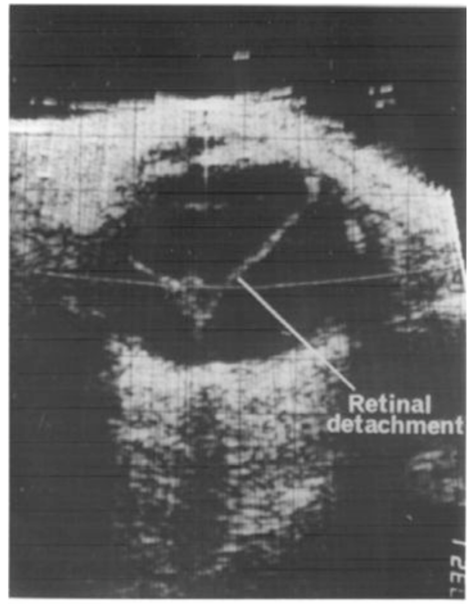


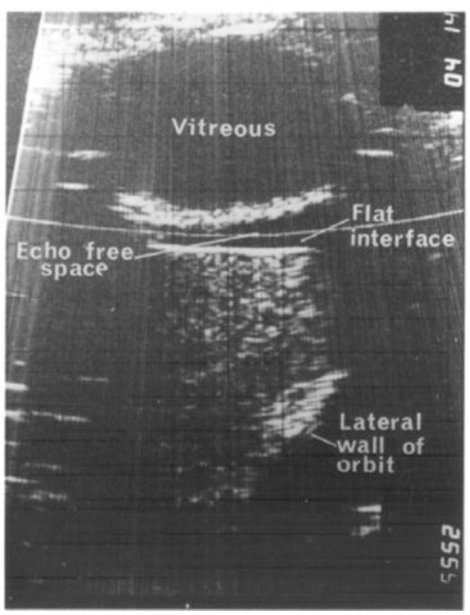


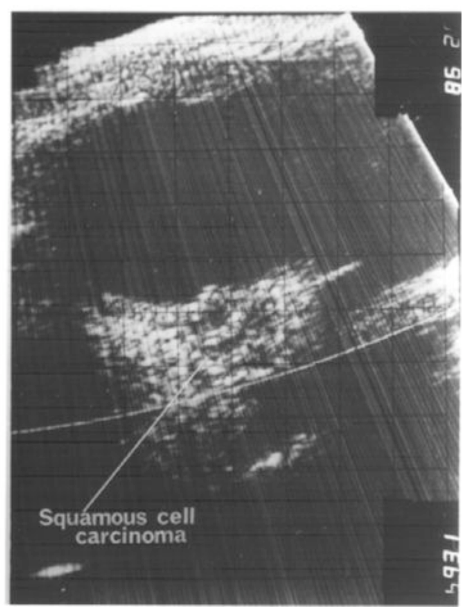

Choroidal melanoma
Choroidal melanoma
Choroidal melanoma
Shadowing


Rhabdomyosarcoma
Rhabdomyosarcoma


ECHOGRAM DENSITY
FOCUS MARKER
GRATICULE LINES
LIDS
VITREOUS
TUMOUR
FAT


Retinal detachment


Vitreous
Flat interface
Echo free space
Lateral wall of orbit


Squamous cell carcinoma

BREAST 1966

The first breast echoscope (top) was installed at the Royal North Shore Hospital in 1966 under the technical and clinical direction of Jack Jellins and Tom Reeve respectively. The bistable machine was capable of imaging in linear sector and compound modes.

The breast presents coupling problems which were tackled in different ways in successive machines. Initially the patient lay supine with the transducer in a large water bag lowered onto her Chest, but the weight of water caused tissue distortion and patient discomfort.

In the next system (left) the patient remained supine. Holes were cut in adhesive drape, which was attached to the patient's chest, allowing the breasts to float freely in the water tank. Difficulty of implementation and poor patient toleration remained problems.

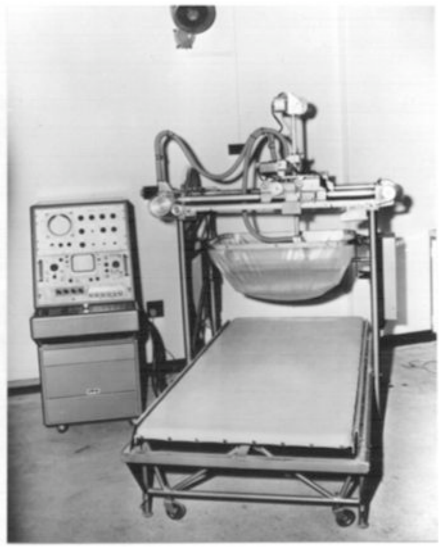
This machine obtained high quality images using a medium focussed 4 MHz Transducer with 2 mm lateral resolution, and introduced grey scale to breast imaging in 1969.

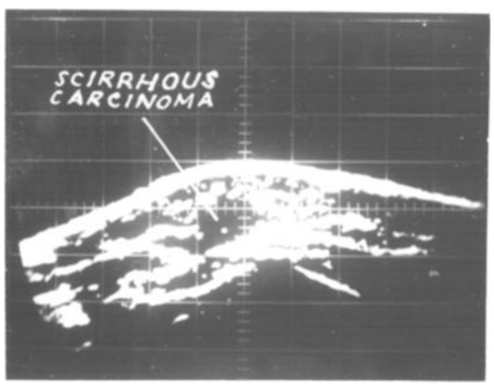
In a later development (seen below operated by Brian Hill) the patient lay prone with her breasts dependent in a coupling tank, with the transducer scanning from below. This system was technically satisfactory and well accepted by the patient.

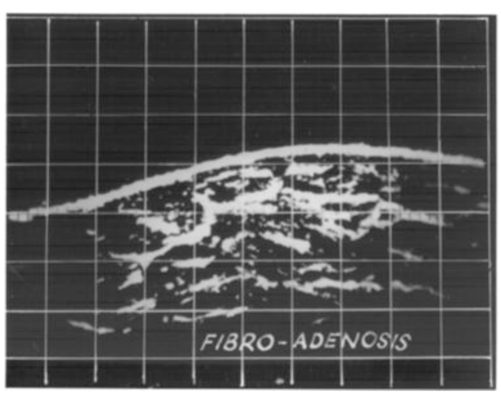
One of the first grey scale findings was the low internal echo content of cancers, contrary to previous findings in which the high level echoes from surrounding reactive tissues had actually been seen. A comprehensive range of diagnostic criteria followed, including disruption of architecture, internal echo content, boundary detail, central shadowing, refractive edge shadowing and shape. Later, distortion of skin outline, skin involvement, thickened cooper's ligaments and attachments to surrounding tissue were added. Significant contributions to this work were made by Kaye Griffiths and Margaret Tabrett.

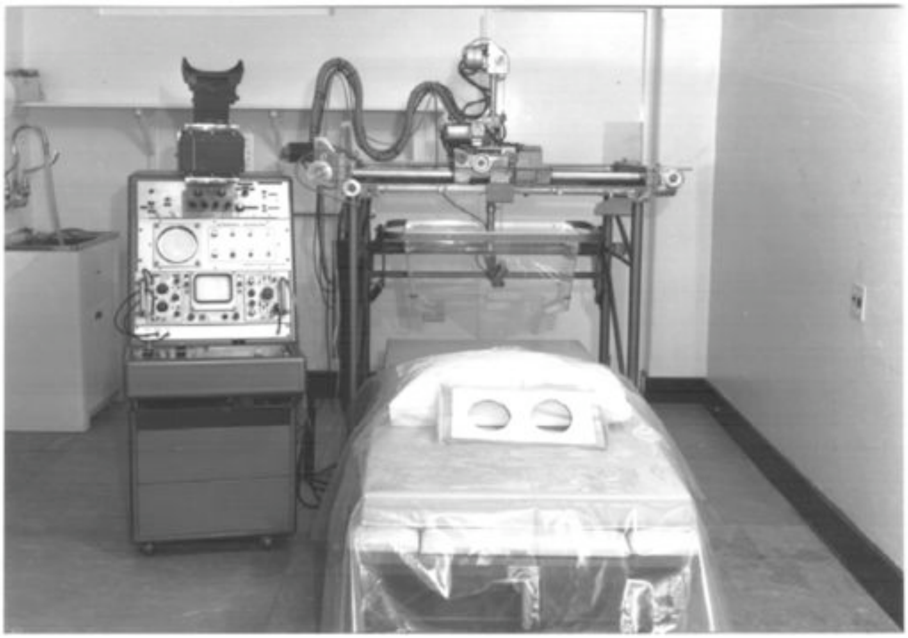
1971 Ultrasonic visualisation of the breast; Jellins, Kossoff, Buddee and Reeve. Med. J. Aust., 1.

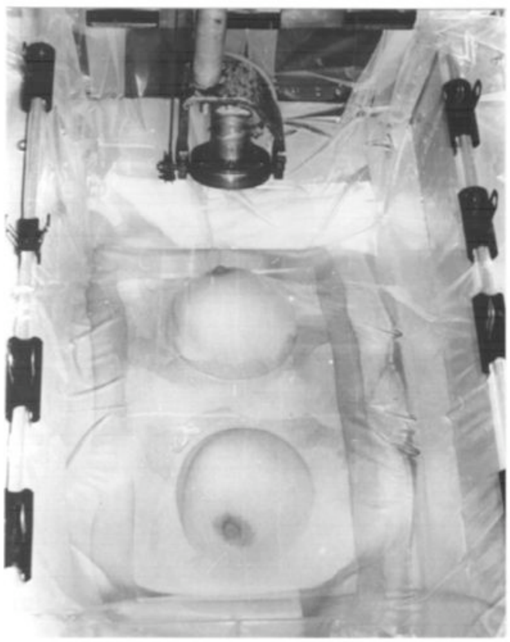
1975 Ultrasonic grey scale visualistion of breast disease; Jellins, Kossoff, Reeve and Barraclough. UMB, 1.

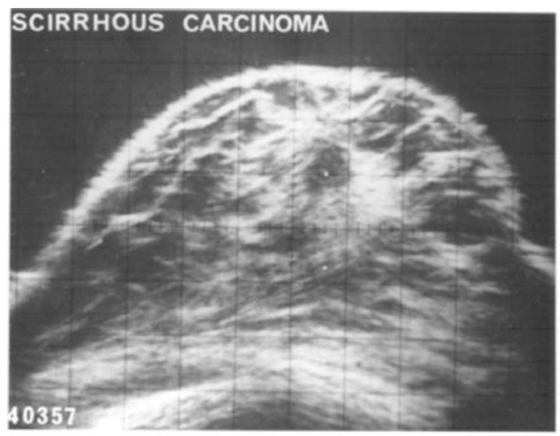


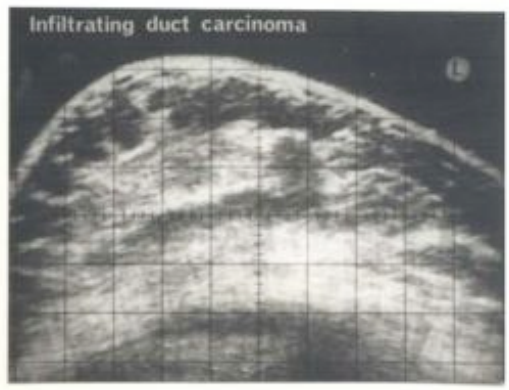

SCIRRHOUS
CARCINOMA


FIBRO-ADENOSIS






SCIRRHOUS CARCINOMA
40357

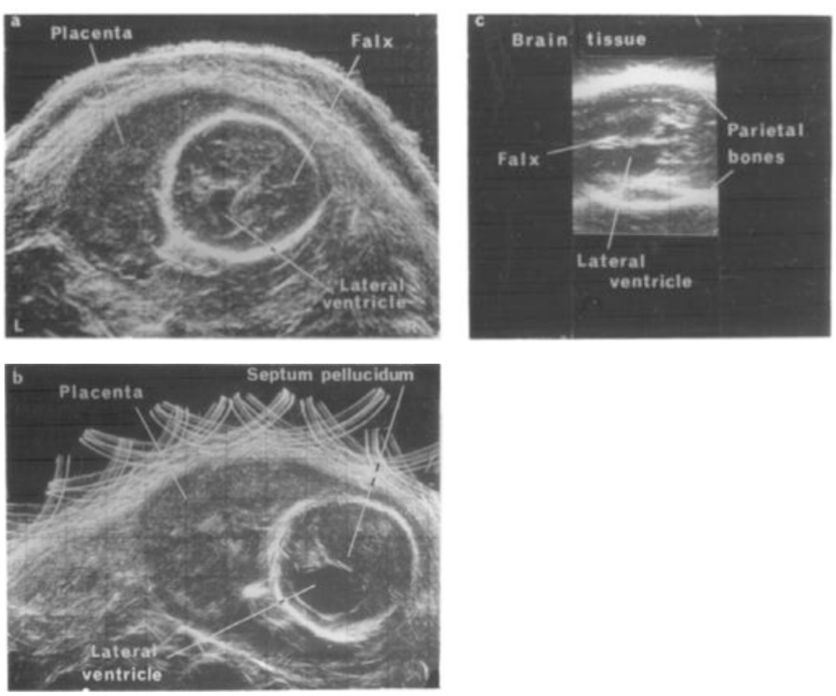

Infiltrating duct carcinoma

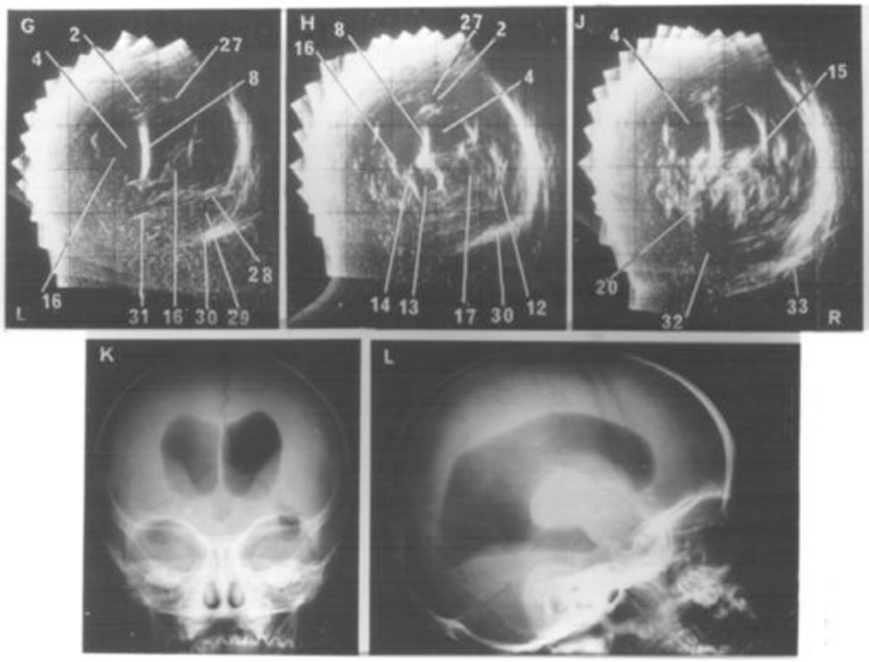
BRAIN 1972

Following the recognition that intracranial structures were clearly visible in the fetus, attempts were made to study intracranial structures in the new-born and older children at the Royal Hospital for Women. A manually operated contact scanner, originally built to investigate the differences between water delay and contact imaging, was used. The success of this procedure was critically dependent on the technique of the ultrasonographers. The grey scale images were formed on a time-exposed film, and perfectly even scans were required. The later development of the analog scan converter allowed this requirement to be relaxed. An atlas of brain structures visible by ultrasound was derived, and the series displayed were published in the references listed below. Development of this technique lead to the cessation of pneumoencephalography in Sydney in 1974.

1974 Ultrasonic atlas of normal brain of infant; Kossoff, Garrett and Radovanovich. UMB, 1.

1975 Ultrasonic cross-sectional visualisation of hydrocephalus in infants; Garrett, Kossoff and Jones. Neuroradiology, 8.


a
Placenta
Falx
Lateral ventricle
c
Brain tissue
Parietal bones
Falx
Lateral ventricle
b
Placenta
Septum pellucidum
Lateral ventricle


G
2
4
27
8
16
31
16
30
29
28
L
H
16
8
27
2
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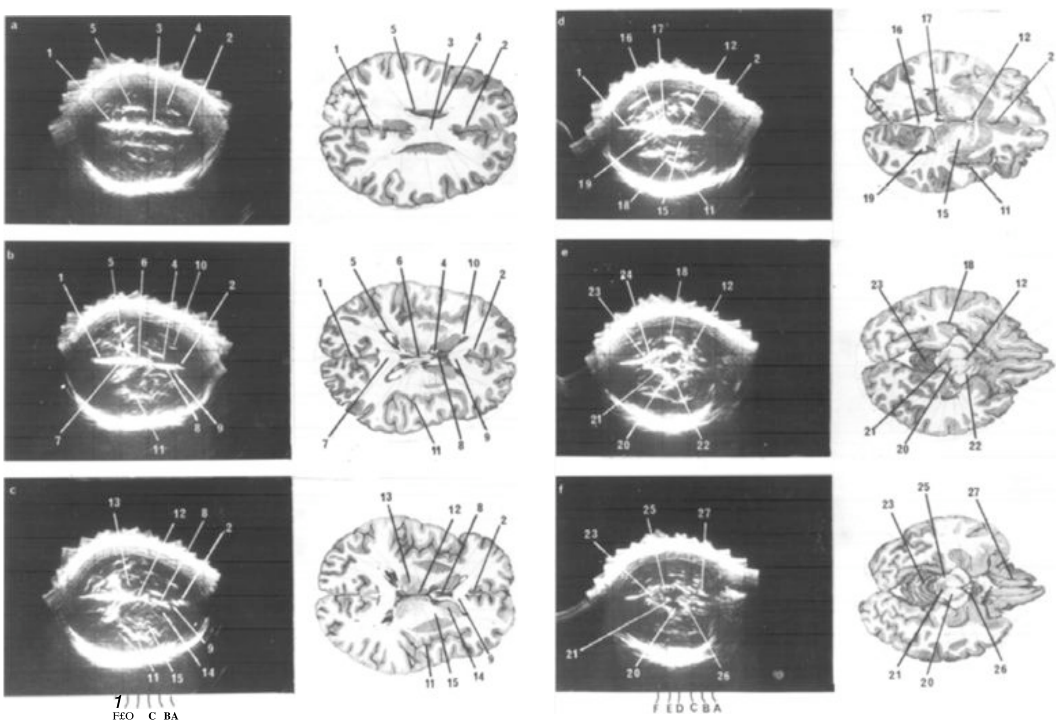
14
13
17
30
12
J
4
15
20
32
33
R
K
L


a
b
c
d
e
f
F E D C B A

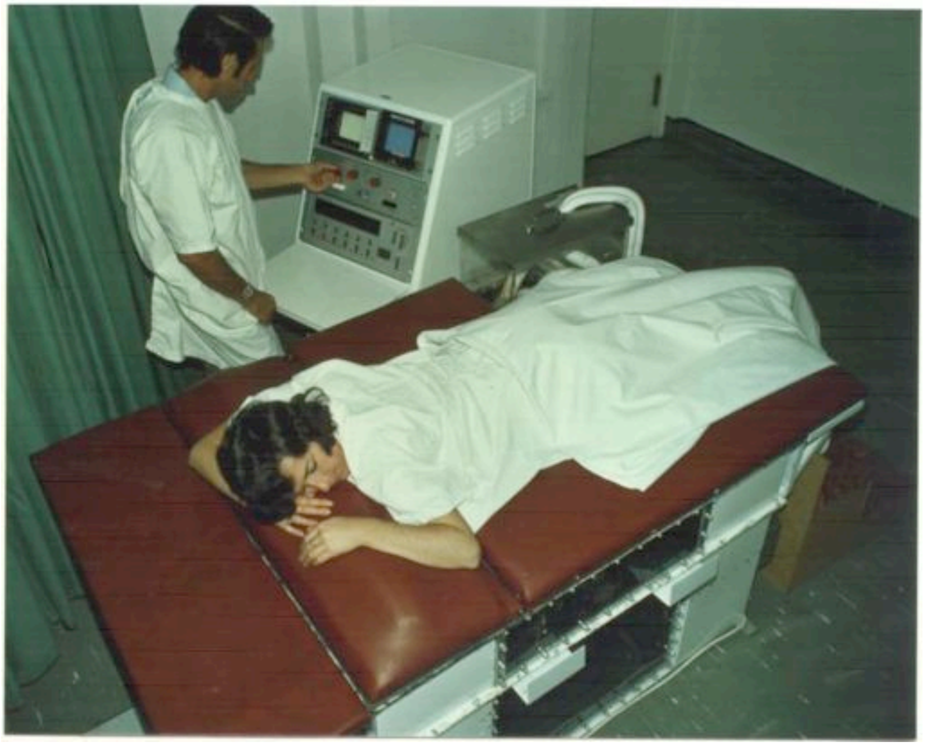
OCTOSON 1974

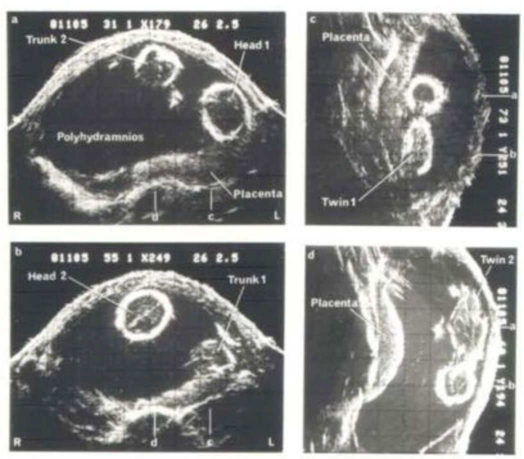
The Octoson prototype scanner was devised to overcome the problems of scanning a transducer over a long mechanical path. It was developed at the Ultrasonics Institute with Dave Carpenter as project leader in 1973 and installed at the Royal Hospital for Women for clinical trials in 1974.

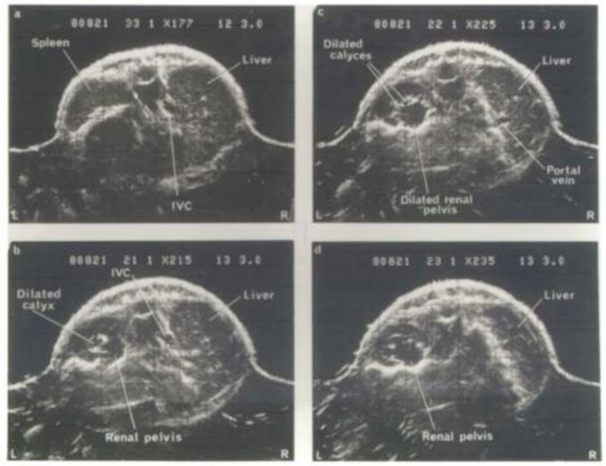
It used 8 transducers on a circular arm operating inside a water tank. The arm was supported on a gantry to allow transverse, longitudinal and oblique scan planes, with automatic position incrementing. The eight transducers were mechanically linked and scanned simultaneously, but operated as independent ultrasonic transmitters and receivers. A full scan took about 4 seconds, and during this time about 500 ultrasonic lines were obtained from each transducer. Because of the even scan pattern, broad window and compound scanning, excellent images of the entire cross-sectional anatomy were obtained.

The machine was set up similar to a water bed with the patient lying prone. Coupling was achieved via a polythene membrane. It was excellent for its primary purpose, the pregnant uterus. It was also excellent for neonates, who required no sedation other than feeding, and for examination of the breast. It also had applications for abdominal examinations.

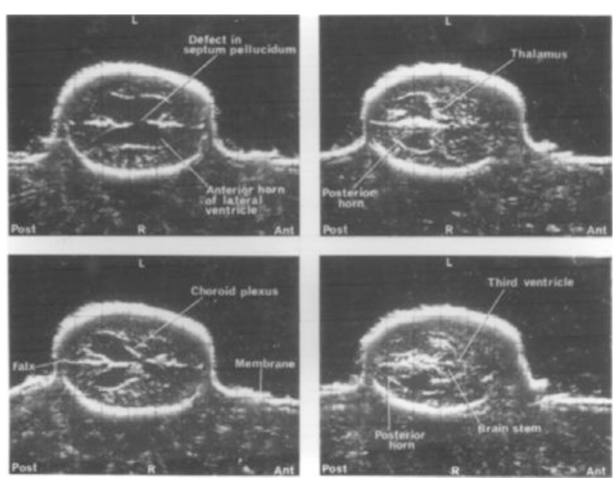
The UI Octoson was manufactured by Ausonics Pty. Ltd. in Australia, and over 200 were sold world-wide between 1976 and 1985.




a
01105 31 1 X179 26 2.5
Trunk 2
Head 1
Polyhydramnios
Placenta
R
L
d
c
c
Placenta
Twin 1
b
01105 55 1 X249 26 2.5
Head 2
Trunk 1
d
Twin 2
Placenta


a
00821 33 1 X177 12 3.0
Spleen
Liver
IVC
L
R
c
00821 22 1 X225 13 3.0
Dilated calyces
Liver
Portal vein
Dilated renal pelvis
b
00821 21 1 X215 13 3.0
IVC
Dilated calyx
Liver
Renal pelvis
d
00821 23 1 X235 13 3.0
Liver
Renal pelvis


0714 20.12.78.


L
Defect in septum pellucidum
Anterior horn of lateral ventricle
Post
R
Ant
L
Thalamus
Posterior horn
Post
R
Ant
L
Choroid plexus
Falx
Membrane
Post
R
Ant
L
Third ventricle
Posterior horn
Brain stem
Post
R
Ant

Normal Breast
Age 20 Para 0