GRAMPIAN HOSPITALS ART TRUST

FROM WHERE DO WE SEE?

Craft skills and aesthetics in MRI

Curated by Dr Silvia Casini

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Exhibition information

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Craft skills and aesthetics in MRI

An invention never happens in the way in which it is later publicised. The story of the invention of Magnetic Resonance Imaging (MRI), a scanning technique carried out on many millions of patients every year all over the world, is a myth. MRI was not the result of a singular event or discovery, but the result of entangled activities of laboratory teams across the world that extended over decades. In this exhibition we particularly celebrate the importance of craftsmanship and aesthetic judgments that always accompany scientific discovery, but rarely become part of the official history of an invention.

The development of MRI was carried out at The University of Aberdeen in two periods. The first occurred between the late 1960s and the early 1980s thanks to the work of a visionary team of medical physicists. The research group, comprising physicists James Hutchison (named Jim), John Mallard and William A. Edelstein (named Bill), constructed Mark-I, the world's first whole-body MRI clinical scanner, and invented the spin-warp method which became the global standard for data–image conversion. The second Aberdonian period is the ongoing development of an advanced biomedical imaging technology known as Fast Field-Cycling MRI (FFC-MRI) thanks to the IDentIFY project, led by the University of Aberdeen in collaboration with EU research partners. Attention to the patient and the close connection between the research laboratory and the clinic have always been the driver of biomedical imaging research at The University of Aberdeen.

This exhibition bridges the two moments in the history of MRI innovation trajectory at Aberdeen University to investigate how craft skills, aesthetics and theories from the arts and humanities, usually considered peripheral to science, feed into past and present MRI innovation networks.

The selection of original and previously unknown archival material on display, contributes to re-frame the history of MRI development as a collective endeavour comprising expertise in physics, engineering, biology, design and photography. Laboratory notes, old photographs, diagrammatic drawings, design sketches that might at first seem marginal, turn out on closer examination to be some of the driving forces behind the development of MRI.

The aim of this exhibition is twofold. First, to unveil the role played by craftsmanship, creativity and imagination in science. Art and science are both skilled practices. Visitors are encouraged to visit the solo-exhibition of the artist Beverly Hood in The Suttie Arts Space and to explore relationships between aesthetic forms, functions and past and present times. Second, this exhibition is one among several ongoing and future initiatives aimed at showcasing to the research community and the wider public a range of the rich archival material that will be acquired and catalogued by The University of Aberdeen Special Collections.

MOUSE MAP PRINTOUTS

These are reproductions of the original copies of the seminal hand-coloured mouse map printouts from the mid-1970s, accompanied by handwritten notes.

The final colourful, pop-art-like, hand-painted map of the mouse was produced in late March 1974 and presented at a conference in Nottingham. The diagrammatic map is pictorial yet based on data measurements. It displays relaxation time information (T1) – the time it takes the tissue to return to a state of equilibrium after magnetization. The long T1 values around the neck fracture are visualised as the black area. This was the world's first MR image to show a sort of pathology and, therefore, to be clinically useful.

The handwritten notes explain the experiment. There is a reference to zeugmatography, the name first used in the early 1970s by the chemistry professor Paul Lauterbur to describe the technique known today as MRI.

At a time when computers were not yet that powerful, the manual labour put into the creation and display of the mouse image series was part of its visual performance. The gradation and colour code have a degree of arbitrariness, yet colour enables information to flow more easily. Colour changes were obvious to the human eye at a time in which MR image production, display and interpretation were difficult.

Thanks to this manually painted map, it was quickly believed that MRI would soon be in wide commercial clinical use. For the first time ever, scaling up from the mouse to a full human body seemed possible.

LABORATORY NOTEBOOKS How do scientists come to know what they know?

Scientists' laboratory notebook entries and diagrammatic sketches offer an insight into the scientific method and creative process: the passage from intuitive, at times imaginative, understanding to rigorous formal proof and experimentation. Hand-made drawings accompanying calculations can be tools for testing out hypotheses under ideal conditions before or together with experimental work at the laboratory bench.

8th November 1974: Jim Hutchison's laboratory notebook sketches, measurements and observations demonstrate the leap in imagination and scale that would lead him and the team to build a full-body MRI scanner, Mark-I, scaling up the imaging process from small tissues to a whole human.

The laboratory entries from one of the researchers involved in the IDentIFY project contain 2D simulations of image-data problems and their possible causes. The hand-drawn sketches on pages 110–111 are ways in which physicists train their eyes to see and read image artefacts before automated algorithms become available. The images on pages 182–185 present data recorded from the scanner. Each line of the image corresponds to one recording. In ideal conditions, each recording should be identical, but this is not the case due to the magnetic field being unstable.

The last entry shows a sketch for a modular scanner bed that was built in the 1990s. The bed is crucial for patients' wellbeing inside an MRI scanner. Patients' needs are often imagined and addressed even before clinical trials are conducted.

DRAWINGS MARK-I, II AND FFC-MRI

How does a complicated structure with many components and materials, and involving several different professionals, first come together?

The series of drawings illustrate components of the Mark-I and Mark-IMark-II scanners. In the second half of the 1970s and early 1980s, Britain was at the centre of MRI research and drew industry involvement, such as that from the British EMI. A detail from the drawings demonstrates how the Aberdeen team, through funding from the Japanese company Asahi, invested in the industrial development of MRI.

The Mark-I and II drawings are showcased along with the computer-aided design (CAD) drawings for the current Fast Field-Cycling MRI scanner. These CAD drawings represent dimensions faithfully. Measurements were taken manually from the existing FFC-MRI scanner and then used to construct a smaller 3D model for demonstrative purposes.

The drawings show how when anything is built, it is dreamed, drawn and planned.

The physicist Jim Hutchison is photographed while working hands-on on Mark-I, which was developed through the 1970s by his team of medical physicists assisted by specialised technicians. With its six feet firmly on the ground of the Suttie Arts Space, Mark-I is now living its second life connecting different communities (researchers, clinicians and gallery visitors) and different times (past and present).

3-D PLOT DRAWINGS OF GRADIENTS WINDINGS

These 3D plot drawings of gradient windings are part of the modelling of the FFC-MRI scanner prototype. They illustrate what the gradient windings look like without having to cut open the scanner. Gradients are made up of a loop of conducting material, such as copper, on a cylindrical shell lying inside the MRI scanner tube. When current is passed through these coils, a secondary magnetic field is created. The x-, y-, and z-gradients are the three sets of gradient coils used in nearly all MRI systems.

Each colour designates a different segment of copper track, illustrating which role each gradient winding performs. The dots represent the end of the copper track.

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All photos courtesy of University of Aberdeen

Curator Biography

Dr Silvia Casini is a lecturer in Film and Visual Culture at the University of Aberdeen. Her work is situated at the crossroad of visual culture and science and technology studies. She is the author of several articles on the aesthetic, epistemological and societal implications of scientific visualisation. She has been recently awarded a Leverhulme Research Fellowship to complete her second book project "Bodies of Data. Image-makers, Data and Reinvention in Magnetic Resonance Technology", which is under contract with MIT Press Leonardo book series.

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