CARDIO-ACTIVE explores the relationship between the human heart and the foxglove, through images, words and objects. It is a collaborative project researched and developed by visual artist Pauline Aitken and writer Judith Palmer, in association with the Department of Physiology, Development and Neuroscience, University of Cambridge.
Corollular Valve

Digital mixed media montage (ink-jet print on paper, 600 x 920 mm).

The montage comprises a macro image of a single foxglove flower. Placed in the throat of the tubular form of the flower and integrating with the petals is a watercolour painting and pencil crayon drawing of the mitral valve of the heart. Over areas of the resulting image were laid scanning electron micrographs of petal and stamen tissue of the flower.

Digital scanning electron microscope recorded tissue from the flower varying from 1.4 millimetres to 800 micrometres across the surface.

Foxglove flower photographed on 35 mm transparency film.
The project has explored the form and structure of the human heart and also the changes that occur, particularly at the cellular level, when normal function ceases. Structures and forms were simultaneously explored within the foxglove plant, *Digitalis purpurea*. Digitalis is the source of a family of vital cardio-active drugs that have been used for the last 250 years in the treatment of certain heart conditions. Micrographic and macrographic images of plant and human tissue have then been hybridised, to reveal the interconnectivity.

Another area of the work explored the depiction of the form of the heart in historical, anatomical atlases, the techniques used for this and for conveying the textural qualities of the heart and its surrounding organs, in these illustrations (in particular woodcuts by Vesalius in *De Humani Corporis Fabrica* of 1543).

In a hugely informative and profoundly interesting start to the project, I examined in detail the structure of the heart and made observational and analytical, as well as expressive drawings and watercolours, which described both the healthy and diseased heart.

The tissue of *Digitalis purpurea* was investigated using the scanning electron microscope where I discovered areas of tissue, both beautiful and strange in form, and fascinating in structure. Sometimes there are surprises, like suddenly finding a perfect heart symbol in the form of a cell in a vascular bundle, whilst scanning a transverse section of a petiole!

The flower and its component parts, plus stem and leaves, were recorded through photomicrography and photomacrography, providing stunning imagery, important source material and excellent colour reference. The apparent fragility and delicate nature of the plant tissue is revealed as robust, substantial and often fleshy when scanned. A selection of these images has been assembled into a portfolio of works exploring external surface textural qualities and both external and internal structure that is an intimate portrait of this beautiful plant.

Initial work involved a search for analogous forms and corresponding structures in the integration of plant with heart and arterial tissue. These structures and forms were juxtaposed and/or overlaid in an inter-play of plant and heart tissue to create hybrid forms, which retain the identity of their component parts. This has involved the exploration of both the ‘macro’ and ‘micro’ form and structure of the heart with its associated blood vessels and the foxglove then a visual comparison made of the two.

These corresponding forms of heart and plant tissue have been integrated through digital techniques, including montage. Some montages include the

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**Digitalis vesaluis**

*Digitalis phlomontage (Lightjet Lambda print, 920 x 1120 mm).*

The inspiration for this image is one of a set of elegant illustrations of the heart in *De Humani corporis Fabrica*, Andreas Vesalius, printed in 1543 (held at Cambridge University Library). The chosen woodcut depicts the heart, credited within the leaf-like form of the lungs. It has the appearance of a fragile flower bud, revealed, as the sepals and leaves that enfold and protect it are unfurled.

Having made a comprehensive record of the form and structure of the plant, Digitalis purpurea, together with details of texture and colour, a selection was made of leaf and petal tissue which could be used to clothe the areas of the heart (the left atrium and ventricle, in an anterior view) together with the lobes of the lungs and the diaphragm, in the illustration.

These images of sections of macro and micro plant tissue were interwoven and integrated as a whole, areas being placed together, then adjusted and aligned within the boundary dictated by the woodcut. This involved re-orientating, inverting and rotating the re-piecing sections. Altogether 20 scanning electron micrographs and 11 macro images of the plant were integrated within the montage and the resulting digital photomontage comprises 36 layers.

The black and white scanning electron micrographs were then coloured in order to achieve a cohesive whole. Finally, a scan of the original woodcut, with a half tone filter was floated across the forms, to overlay them and to reassert the linear qualities of the composition.

Micrographs produced using a Phillips XL30 Digital scanning electron microscope.

Leaf tissue specimens varied from 25 micrometres to 300 micrometres across and those of the petal 800 micrometres to 1,400 micrometres.

Macro images photographed on an 35 mm transparency film using a Leitz Aristophot macro unit.

A study of pathology slides revealed the complexity and remarkable nature of the heart in detail and also the destruction of tissue during the process of atherogenisis. A selection of slides was studied and thoroughly recorded; shapes were isolated and combined with texture and form achieved through printmaking techniques.

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addition of objective and expressive drawings and paintings of the heart, combined with various autographic printmaking techniques. The colour used is saturated and sensuous.

The search for ways to integrate form and convey meaning was both fascinating and absorbing with exciting and unexpected relationships emerging. Sometimes there was an almost effortless marrying of forms that speak, instantly, with eloquence. Other images required weeks of work in the pursuance and development of an idea, demanding the slow and painstaking work of selecting images followed by their integration and composition on the computer. This entailed adjustments and re-alignments together with the compatible layering or juxtaposition of hues, to create a satisfactory and harmonious interweaving of shape and form.

The collaborative work of artist and writer includes digital outcomes that are created for specific gallery and other spaces. Here the aims are to generate sequential large-scale 2D images and projections with layers of inquiring text (some integrated with the images, some for concurrent display), which provide striking facts, observations and cultural associations thrown up by the images. Working on projections and installations would instigate an enquiry into the changes in the rhythm of the heart associated with coronary malfunction. One of the aims would be the creation of rhythms of the beating heart, without the use of sound, by using highly saturated sensuous colour and sequences of images, which provide a rhythmic ‘silent music’, experienced internally. In a recently completed piece of work, changes in the rhythm of the heart are explored in an animation with sound, of pulsing petal tissue.

Exhibitions of the Cardio-Active project are taking place May to October 2009 at BioCity, Nottingham, and February to June 2009 at Papworth Hospital in Cambridge.
Heart Stopping

Digital mixed media montage (Ink-jet print on paper, 840 x 1060 mm).

The image is a montage of a 35mm transparency of tobacco smoke with ink and coloured pencil drawings of part of the interior of the left ventricle of the heart.

The transparency was reversed in colour and tone, which produced a hue reminiscent of both tar and dried blood.

Lonely Heart

Colour enhanced scanning electron micrograph (Ink-jet print, 180 x 230 mm).

This was an intriguing, curious and serendipitous discovery made whilst scanning the surface of a cross-section of a foxglove petiole! Width of cell - 12 micrometres.

Leaf Terrain

Scanning electron micrograph, coloured (Ink-jet print, 600 x 750 mm).

The dynamic rhythms of the undulating epidermis of the underside of a section of diseased foxglove leaf with its covering of epidermal hairs (non-secretory trichomes).

Image recorded on a Philips XL 30 digital scanning electron microscope. Coloured by using layers of watercolour painting. Specimen approximately 1 millimetre across surface.

Digitalis: Changing the Rhythm

Digital Photomontage (Light-jet/Lambda print, 900 x 1200 mm).

Macro photograph of a longitudinal section of a foxglove flower with tone and colour reversal.

Transverse sections of arterial tissue (pulmonary artery) were inserted into the dappled/spotted area of the petal. Work in progress.
**Entrapped**

Colour enhanced scanning electron micrograph (ink-jet print, 600 x 750 mm).

The curiously convoluted epidermis of the underside of a section of a diseased leaf, is patterned with stomata and covered with epidermal hairs (non-secretory trichomes) two of which appear to grasp an alien form. This image provides a correspondence with that of fibrin threads formed in the blood as it clots, which with the same tentacle-like extended fingers, entrap blood platelets.

The raised ridges also correspond to the endothelium lining of the blood vessel enlarging as an atheroma develops in the intima (inner coat of the artery).


Specimen approximately 1 millimetre across surface.

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**Pauline Aitken**

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Pauline Aitken is a visual artist specialising in mixed media and printmaking using both traditional and digital techniques. She studied at the Slade School of Fine Art, University College London, where she also completed her postgraduate studies. In 2002-3 she undertook a research residency at the School of Biological Sciences, University of Cambridge, which was funded by an Awards for Artists (Arts Council East) and a Six of the Best Award (Arts Council East and Anglia Television) and during this time began developing work using microscopy and digital imaging. This culminated in an exhibition, Bringing into Focus, comprising large-scale digital prints, light-box works and installations at the Cambridge University Botanic Garden.

Since then she has had her digital work, developed from research through microscopy, selected for Visions of Science, Novartis/The Daily Telegraph, Photographic Awards and also for their exhibitions at The Royal Society, The Science Museum, London and a UK travelling exhibition.

The work has been developed under the guidance of Dr. Jeremy Skepper, Technical Director, Multi-Imaging Centre, Department of Physiology, Development and Neuroscience, University of Cambridge, Scientist Adviser to the project and Jahn Bridger, Departmental Demonstrator in Human Anatomy within the department. The pathologist Dr. Laszlo Hegyi, Honorary Clinical Lecturer, Division of Investigative Science, School of Medicine, Imperial College, London provided additional advice.

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