Revealing the Inscriptions on an Egyptian Obelisk

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- House and 8,500-acre estate in Dorset
- Seat of the Bankes Family since 1636
- Rebuilt and remodelled in 18th century
- Given to the National Trust in 1981
“Of all the parts of the world which I have visited ... Egypt and Nubia are those which interested me, beyond all comparison, the most, and have made the deepest impression upon my mind.”

- William John Bankes
The obelisk

- Claimed by Bankes for Britain
- Broken in a fall during loading
- Arrived by boat in England in 1821, 6 years after leaving Philae
- Transported from London to Dorset in a gun carriage lent by Duke of Wellington
- Raised at Kingston Lacy by 19 horses
- Repaired with granite from Libya, a gift from King George IV
The inscriptions

- Egyptian hieroglyphs on the main shaft
- Greek inscriptions on the plinth
- When obelisk discovered, hieroglyphs had not yet been deciphered.
- Bankes hoped the Greek would provide a ‘crib’ for the hieroglyphs.

*Lithograph by George Scharf (1821)*
The inscriptions

• Bankes commissioned a lithograph of obelisk and its inscriptions while it was being unloaded at Deptford in 1821.

• He began to distribute copies of the print, believing that the two texts were the same.

• He tried to identify hieroglyphic parallels of the proper names which appeared in the Greek.
The decipherment of hieroglyphs

Champollion’s phonetic reading of ‘Ptolemy’ and ‘Cleopatra’ cartouches
The Philae comet lander

On 12 November 2014, the landing module Philae, from the European Space Agency’s robotic spacecraft Rosetta, successfully touched down on the comet 67P/Churyumov-Gerasimenko.
The Philae project 2014–15

- National Trust is keen to promote Bankes collection at KL to coincide with Philae lander.

- Scaffold tower built to enable close-up photography and 3D scanning on all four faces of obelisk.
Photography with multi-angle illumination

Canon camera clamped to scaffold pole.

Procedure for directional photography

Issues of working outdoors on scaffolding: weather, daylight, vibration, power, temperature, safety...
**H-RTI technique**

- Flash light moved freely at constant distance from surface
- Highlight on billiard balls determines illumination vector
- Images combined by software to show reflected intensity as a function of the angle of incident light.
RTI interactive visualisation

Obelisk’s cartouche of ‘Cleopatra’ on image set EB4
3D scanning of obelisk

- Scanner designed for industrial metrology, with projector and two 5 Mpixel cameras
- Scanning volume: cube dimension 500 mm

GOM ATOS
Compact Scan 5M
Processing 3D point clouds

• Markers placed on object to aid alignment.

• Whole obelisk required >400 scans, each producing a point cloud of 5 million points.

• Merged into single point cloud with GOM Inspect software.

Rendering of the Cleopatra hieroglyph from the 3D point cloud.
Imaging workflow

After photography and 3D scanning we have:

1) a merged point cloud for the complete structure, with 4.8 million points – geometry

2) 48 sets of images and RTI files (12 for each of four faces) – surface texture

Objective is to ‘stitch together’ separate RTI files into a single RTI file to form a long vertical swathe for each face over the full height of inscriptions on shaft of obelisk.

The 3D point cloud provides a geometric framework to register each image set, before merging.
Point cloud processing

- Alignment by PCA and rotation
- Delaunay triangulation
- Height map on grid of 5 points/mm
- Calculate surface gradients

**Triangulation of cropped section of point cloud, showing cartouche of Cleopatra on the east face.**

**Gradient map computed from point cloud, visualised with X gradients in red, and Y gradients in green.**
Photometric normals from image sets

• Normal vectors are perpendicular to the tangent plane at each point on surface.

• Calculated from set of 50 images by ‘bounded regression’ technique.

• Corrected for geometry of projection through perspective centre of lens.

*Normal vectors from photographic image set, In false colour (Nx in R, Ny in G, Nz in B).*
Correcting lens distortion

- Canon 50mm macro lens

- Photogrammetric analysis of test object with retroreflective targets

Image distortion map for Canon 50mm lens. Vectors are shown as 20x true length.

Distortion (pixels) vs radius from image centre.
Registration of images with point cloud

Detail of registered sets of normals, with scanner normals in red and photometric normals in cyan.

False-colour map of correlation between normals image and a block feature to detect position of vertical channels.

Horizontal section of surface of east face of obelisk, showing two channels and incisions.
Conclusions

• The Philae project has created a permanent image set and accurate dimensional surface record of the obelisk.

• Image processing techniques successfully used to stitch together all RTI files for overlapping individual sections into a single vertical swathe.

• These will be utilised in making new readings of Greek and hieroglyphic inscriptions, even those now so worn that they are invisible to the naked eye.

• This is a truly celestial project...