



***Archimedes***  
***Palimpsest***

# *A Brief History of the Palimpsest*

Tracing the manuscript from its  
creation until its reappearance

# *Foundations...The Life of Archimedes*



Birth: About 287 BC in Syracuse, Sicily (At the time it was still an Independent Greek city-state)

Death: 212 or 211 BC in Syracuse. His age is estimated to be between 75-76 at the time of death.

Cause: Archimedes may have been killed by a Roman soldier who was unaware of who Archimedes was. This theory however, has no proof. However, the dates coincide with the time Syracuse was sacked by the Roman army.

# The Works of Archimedes

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## Archimedes' Writings:

- *Balancing Planes*
- *Quadrature of the Parabola*
- *Sphere and Cylinder*
- *Spiral Lines*
- *Conoids and Spheroids*
- *On Floating Bodies*
- *Measurement of a Circle*
- *The Sandreckoner*
- *The Method of Mechanical Problems*
- *The Stomachion*

# The ABCs of Archimedes' work

Archimedes' work is separated into three Codeces:

## **Codex A:**

- *Balancing Planes*
- *Quadrature of the Parabola*
- *Sphere and Cylinder*
- *Spiral Lines*
- *Conoids and Spheroids*
- *Measurement of a Circle*
- *The Sand-reckoner*

## **Codex B:**

- *Balancing Planes*
- *Quadrature of the Parabola*
- *On Floating Bodies*

## **Codex C:**

- *The Method of Mechanical Problems*
- *Spiral Lines*
- *The Stomachion*
- *On Floating Bodies*
- *Measurement of a Circle*
- *Balancing Planes*
- *Sphere and Cylinder*

# The Reappearance of the Palimpsest

Date: On Thursday, October 29, 1998

Location: Christie's Auction House, NY

Selling price: \$2.2 Million

Research on Palimpsest was done by Walters Art Museum in Baltimore, MD

The Main Researchers Include:

William Noel

Mike Toth

Reviel Netz

Keith Knox

Uwe Bergmann

# Codex A, B no more



Codex A and B no longer exist.

However, there are still copies and translations of both. Codex C is the only survivor, but just barely.

The surviving Codex has undergone many physical reconstructions through time, and has lost the vast majority of its visible appeal.

- William Noel, the Project Director for the analysis of the Palimpsest said:

"It was ugly. It was small-about the size of a standard bag of Domino sugar...the pages were mottled brown in color. Matching tide lines caused by water faded each other across page openings...Right on their edges the pages were black, as if they had been in a fire"

# *The Palimpsest*

Cover: Codex C, the Palimpsest, was written on animal skin (With treatment, the skin contains the same properties that make it an excellent, durable writing surface)

This treatment involves the use of collagen, which is crucial for the making of parchment; it makes it rough and writable

Ink: Composed of Gallic acid, made up of Carbon, Hydrogen, and Oxygen. When combined with collagen, this combination etches the ink in place.

The Gallic acid is then mixed with Ferrous Sulphate (A compound of iron and sulphuric acid, commonly found with pyrite as well). This compound supplies the color to the ink

# How did it manage to survive?



The Codex was passed from scribe to scribe, country to country for centuries.

In 998, Constantinople:

The manuscript's scroll form was made into a Codex, a more modern style, 3 dimensional book.

13th Century, Palestine:

The true value of the Codex was mantled. It was no longer a precious vestige of ancient learning, but an obscure text that could be put to better use as a prayer book

# How Will You Make a Prayer Book Out of a Mathematician's Bible? Seriously?

A not-so-smart scribe in 13th Century Palestine didn't bother to check what he was writing over!

- The taking apart of the Codex
  - He began the process by unbinding the pages
  - He washed the pages with citrus juice or milk and sanded them with a pumice stone; they were scrubbed with natural acids (apparently orange juice made the letters come out perfectly)
  - He cut the sheets in half, turned them 90 degrees and stitched the new book down the middle

# The Prayer Book is made...

- The first piece of parchment in the new codex was *On Floating Bodies*.
  - The scribe covered it with a blessing for loaves at Easter, then with a prayer for repentance
- He then wrote over *The Method*
  - *The Method* became a prayer of marriage
  - A different part of *The Method* was written over by a prayer recited at the foundation of a church
- Archimedes' prized Proposition 14 was equally destroyed
  - Ironically, this critical piece of mathematics was covered by a prayer for the dead

With the harsh treatment this Palestinian Scribe did to the Palimpsest, it is a wonder we can even read anything at all!!!

# After That Scribe, it's a Wonder We Can Even Recognize the Book Today!

July 16, 1907

- *New York Times* publishes an article on Professor Johan Ludwig Heiberg of Copenhagen's discovery of the Palimpsest
  - Heiberg recognized the erased text as the work of Archimedes
- Heiberg traveled to Constantinople to study the Palimpsest, which was not allowed to go to Denmark
  - Between 1910 and 1915, Heiberg completely re-edited the published works of Archimedes to incorporate his findings from the Palimpsest
  - However, his entire work is based on what he could view with only the naked eye, and maybe a magnifying lens

# *From Constantinople to Paris*

## **After Heinberg's analysis...**

Anne Guersan had owned the manuscript before its sale in NY. Anne's father, Marie Louis Sirieix, had come to own the Palimpsest in the 1920s.

Sirieix's travels:

- Sirieix served in Greece in WWI
- He traveled around in Greece and Turkey in the 1920s
- He came in contact with the Palimpsest in Turkey, most likely
- He left the Palimpsest in the care of his daughter after his death in 1956

# *From Paris to New York*



Anne Guersan, in the 1960's:

- She took the book for examination to two different Professors, none which could help her
- Anne also left a few detached pages of the Palimpsest with Father Paramelle at the National Center for Scientific Research of Historic Texts in Paris

1971:

- Anne took the book for cleaning, as in, remove some of the mold and fungus in order to preserve its already deteriorating present condition
- She tried selling it, but no one would buy it, until she came in contact with Christie's Auction House in New York City

# The Scientific Method and Investigation



# Multi-Spectral Imaging

- Successfully recovered text from prayer book text
- Ultraviolet rays (iron)
- Blurriness with lens and blow-ups
- Noise

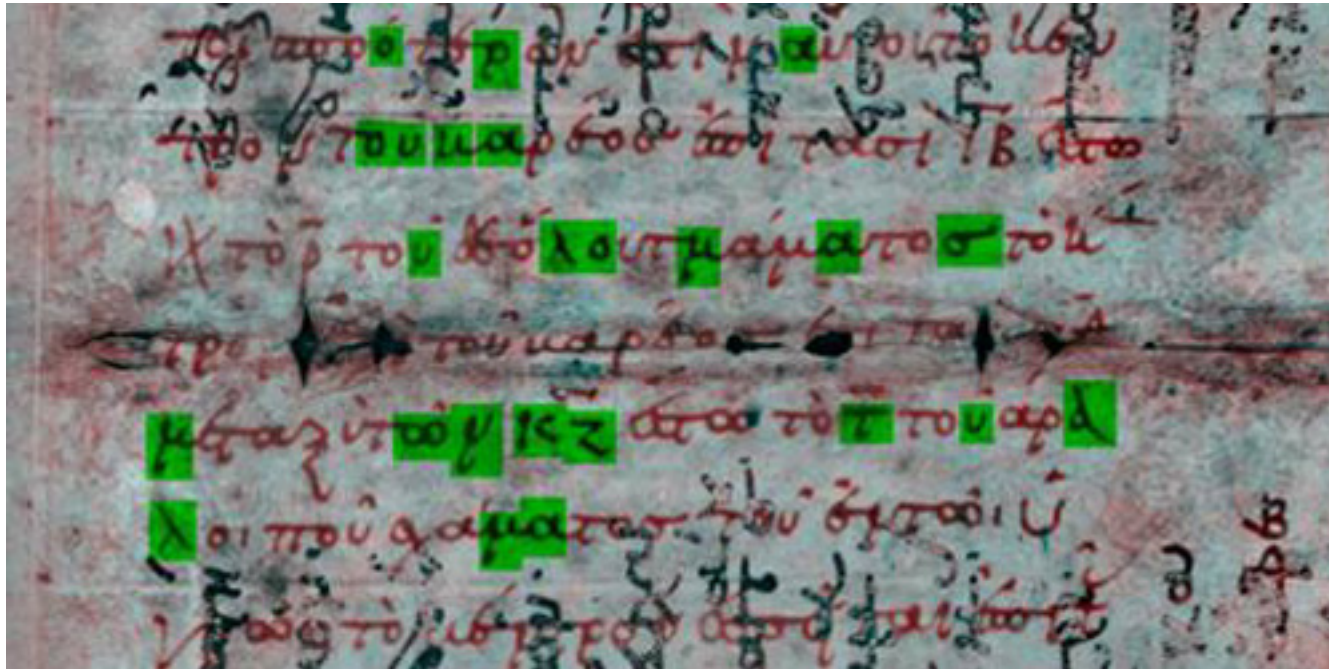


# X-Ray Fluorescent Imaging



- Element maps
- Iron and Potassium
- Stripping prayer book?

# Optical Character Recognition



- Digital reconstruction
- Narrowing possibilities

Character Recognition GUI v.1.0

File MSFs Composite Filters Other Archimedes About

**Load Filter Data File**

Browse

**Load Training Data File**

Browse |archie\_default\_training.dat

**Training Image Library**

1 Select Character Class Number

loaded:

Browse Reset Class Reset All

**Output Data File Storage**

Filter Data File(s) (.txt)  Output Data File (.txt)

Training Data File (.txt)  All Correlation Plane Image(s) (.ps)

Directory

Name Files

**Correlation Filter Performance Measure(s)**

PSR  SNR  PCE  FAHM

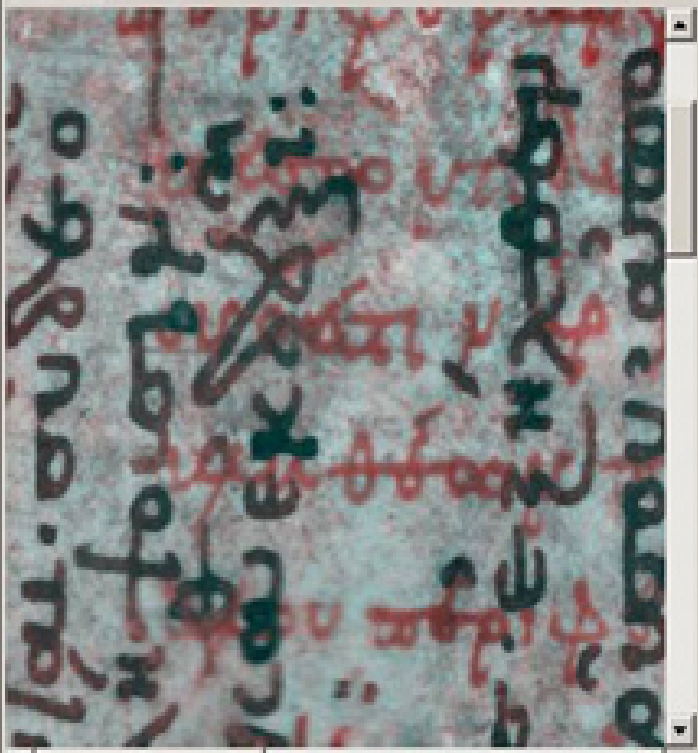
**Lock & Load**

Run System Reset Settings

Classification...

**Input Image**

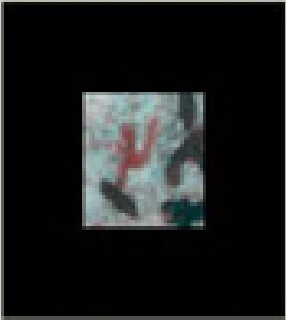
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**Output Data File**

Not Available

**Region of Interest - CONFIRMED**



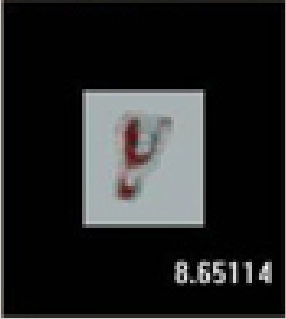
Select ROI Reset ROI

**Data Reduction & Classification**

Principal Components Analysis

Minimum Distance Classification

**Processing - Output**



8.65114

Current Image Library

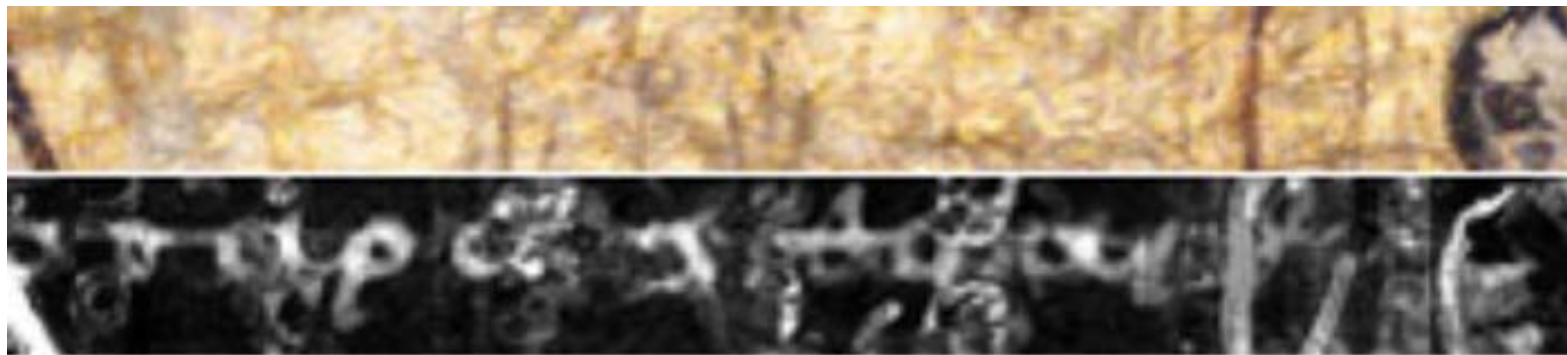
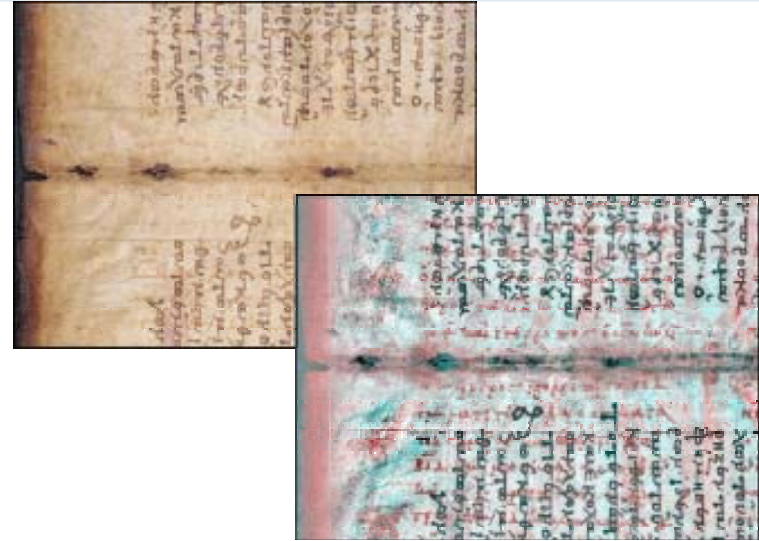
CHARACTER RECOGNITION INTERFACE  
for understanding the  
ARCHIMEDES PALIMPSEST

# RESULTS OF STUDY



# Able to recover most of the text!

- Multi-Spectral Imaging
- X-Ray Fluorescence



# Recovered the entire works of Archimedes!

Newly discovered works:

- Only known Greek copy of *On Floating Bodies*
- *The Method of Mechanical Theorems*
- *The Stomachion*



# *The Method of Mechanical Theorems*

- Volume of a cylindrical wedge
- Center of gravity of a solid hemisphere
- Proof of double contradiction method
  - Used to show equalities of two areas or volumes by saying there's a contradiction if it is said one is bigger or smaller than the other.
  - Used in other works, but never proven.
- Greek's knowledge of infinity.
  - Archimedes worked with infinitely large sets in a proof.

# *The Stomachion*

- Puzzle which asks, “how many ways can these shapes be arranged to form a square?”
- Archimedes tried to answer this question.
- These shapes can be seen in the margins of other works, unknown what it was until this discovery.



# Other works in the Palimpsest

- Speeches by Hypereides
- Critique of Aristotle by Alexander of Aphrodisias
  - Specifically critiques Aristotle's Categories
    - Groundwork of Western logic
- Author of prayerbook: Johannes Myronas

