
About the Cover

Slicing the Antikythera Mechanism

This month's cover was suggested by the review in this issue of the book by Jo Marchant about the Antikythera Mechanism. The images there are a selection from a sequence made by extremely sophisticated technology that in effect depicted slices of the Mechanism without actually taking it apart. They are taken from an original collection of over 2,500. On the Web page

<http://www.antikythera-mechanism.gr/data/ct>

you can see more of the images from this collection, making up a remarkable animation. The images were provided to us by Tony Freeth, one of the group involved in the Antikythera project, who commented to us:

“The new studies of the Antikythera Mechanism were carried out by an Anglo-Greek research team in cooperation with the National Archaeological Museum in Athens. In order to understand the structure of the Mechanism, we wanted high-resolution 3D X-rays. In 2005 we finally managed to get all the permissions necessary to undertake a new X-ray study and this was carried out by X-Tek Systems, now part of Nikon Metrology. To make 3D X-rays, it is necessary to penetrate the sample at all angles in a 360° rotation. Luckily, Roger Hadland, the proprietor of X-Tek Systems, developed a deep interest in the Mechanism and this resulted in his company building a special prototype machine with sufficient power for the undertaking.

“The X-ray technique was Microfocus X-ray Computed Tomography (X-ray CT). This consists of rotating the sample on a turntable, while its X-ray image is projected onto a 2D detector. In our study, around 3,000 X-ray projections were gathered covering a complete rotation of the sample. A mathematical technique called filtered back-projection was then used to create a 3D X-ray image of the sample. The 3D image can then be viewed using specialist imaging software—VGSStudio Max by Volume Graphics. We carried out this technique on all 82 surviving fragments of the Antikythera Mechanism.

“The great power of X-ray CT is that a single slice through the sample can be isolated and viewed. This was our primary analysis tool. We expected that the 3D X-rays would reveal the problematic structure of the gearing of the Mechanism. Eventually, this turned out to be true but not in the way that we expected. The first insight came from analysis of Fragment F. X-ray slices through this fragment showed that it contained part of the four-turn spiral dial on the lower back face of the Mechanism. Analysis of the scale divisions and text on this dial showed that it was an eclipse prediction calculator, based on the Saros cycle of 223 lunar months. This discovery forced a complete reassessment of the gearing of the Mechanism and eventually (after a huge struggle) an understanding of the epicyclic system that calculates the Moon's variable motion—an extraordinary insight that revealed the genius of the designer.

“Another surprising revelation was the presence of thousands of new text characters that were hidden inside the fragments. Invisible to conventional X-rays and unread for more than two thousand years, they could be seen in slices through our new 3D X-ray data. A direct result of this was the deciphering of the month names of the 19-year lunar calendar on the upper back face, which turned out to be Corinthian in origin; an understanding of the star calendar at the front of the Mechanism; and the identification of a dial that followed the panhellenic games in Greece—including the Olympic Games. The new X-ray data was at the heart of all our discoveries.”

An enormous amount of information about the Mechanism can be found at the home page of the Project:

<http://www.antikythera-mechanism.gr/>

The review of Marchant's book mentions that it is involved in some controversies. Some discussion of this matter can be found at the two sites:

<http://www.connectives.com/decoding-the-heavens-bromley-comments.html>

<http://www.decodingtheheavens.com/blog/post/2009/08/01/Response-to-criticisms-of-Decoding-the-Heavens.aspx>

Freeth tells us that there are also a number of errors in the book, and that corrections can be found at

<http://www.antikythera-mechanism.gr/system/files/Decoding-the-heavens-notes-and-comments.pdf>

As mentioned above, the data making up the images is from X-Tek Systems, now owned by Nikon Metrology. The copyright (dating from 2005) is held by the Antikythera Mechanism Research Project. We thank Tony Freeth for his invaluable help.

—Bill Casselman
Graphics Editor
(notices-covers@ams.org)