

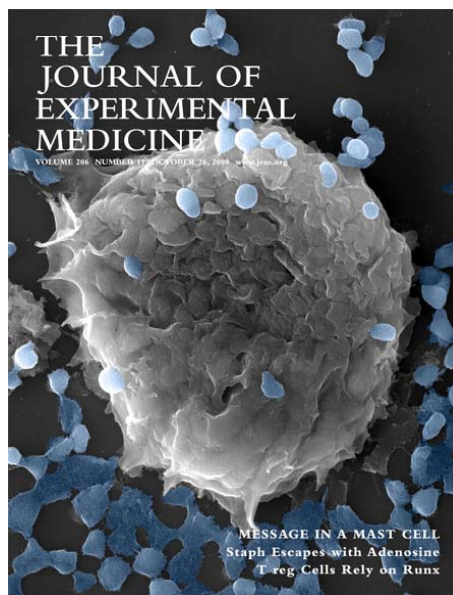
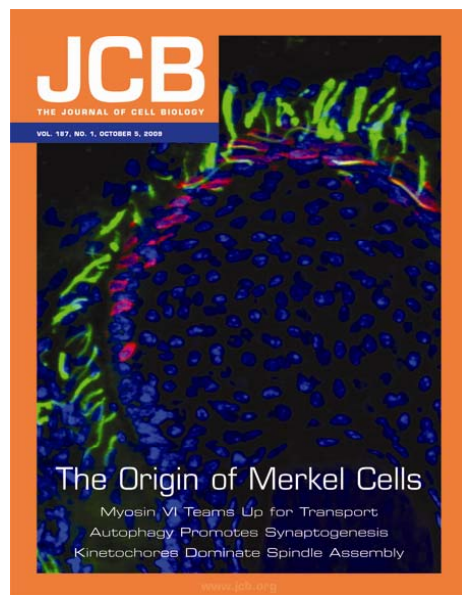
What's in a picture?

New tools to promote image integrity

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JCB

THE JOURNAL OF CELL BIOLOGY



THE ROCKEFELLER
UNIVERSITY

PRESS

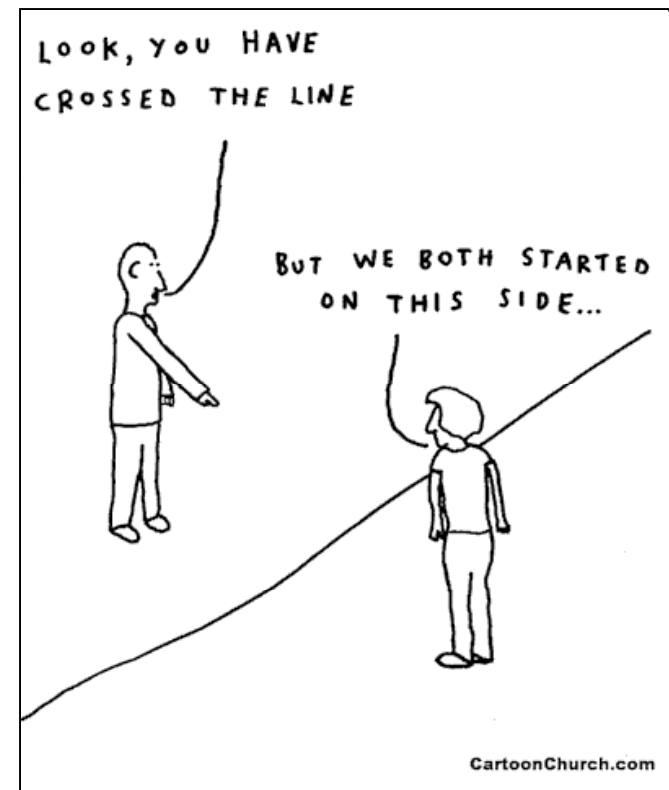
QUALITY AND INTEGRITY

Why would a publisher care about image integrity?

- To ensure, to the best of our ability, that what our readers see is what the authors saw.
- To maintain the reputation of the journal.
- To maintain the integrity of the scientific record.

Why do scientists manipulate images?

- A culture of image manipulation: perceived acceptability?
- The ease of image manipulation with today's sophisticated software
- Naïveté/ignorance/incompetence of the line between acceptable and unacceptable manipulation
- Professional pressure to succeed
- A deliberate intent to deceive



The ease of image manipulation in the Digital Age

- Nearly everyone is a Photoshop expert.
- Image acquisition platforms contain many complex image processing tools.
- Every new technology means a new way to alter results.



*Seeing no longer
means believing.*

Detecting image manipulation before publication

Who should do it?

- Principal Investigators - *the proactive approach*
- Journal Editors - *the reactive approach*

Detecting image manipulation

How Big is the Problem?

Of all editorially accepted papers:

- ~50% must remake at least one figure.
- >10% must provide the original data for further assessment.
- ~1% have acceptance revoked or are withdrawn.

	# of papers since 2002
Total screened	3081
Original data obtained	430
Acceptance Revoked / Withdrawn	32

Investigating image manipulation

If we suspect our guidelines have been violated...

Step 1: We request the original data (unmodified microscopy files, films, etc).

→ >10% of accepted manuscripts

Step 2: We analyze those data.

- *Do the original data match the prepared figure?*
- *Is the manipulation acceptable (and fixable), or does it constitute misconduct?*

Inappropriate Manipulation

Guideline #1: “No specific feature within an image may be **enhanced**, obscured, moved, removed, or introduced.”

- Adjustment of a specific feature: **altering intensity**

Submitted
Figure

Confidential

Original
Data

Confidential

Inappropriate Manipulation

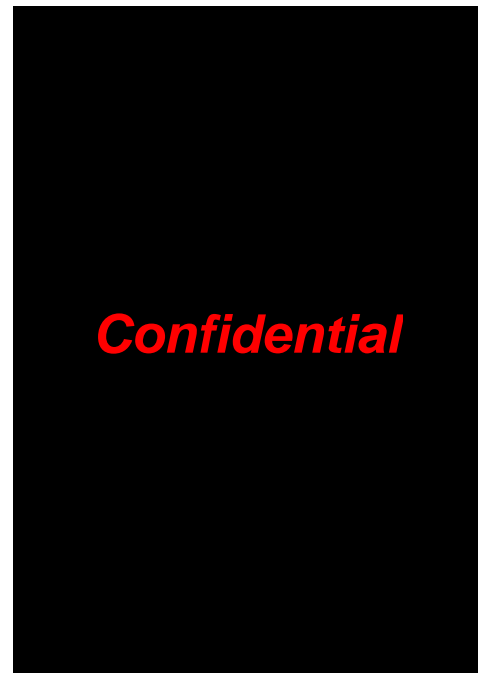
Guideline #1: “No specific feature within an image may be enhanced, **obscured**, moved, removed, or introduced.”

- Adjustment of a specific feature: **cleaning up background**

Submitted Figure



Adjusted Contrast



Inappropriate Manipulation

Guideline #1: “No specific feature within an image may be enhanced, **obscured**, moved, removed, or introduced.”

- Adjustment of a specific feature: **cleaning up background**

Submitted
Figure



Adjusted
Contrast



Original
Data



Inappropriate Manipulation

Guideline #3: “The grouping of images from different parts of the same gel, or from different gels, fields, or exposures must be made explicit by the arrangement of the figure.”

- splicing

Submitted
Figure

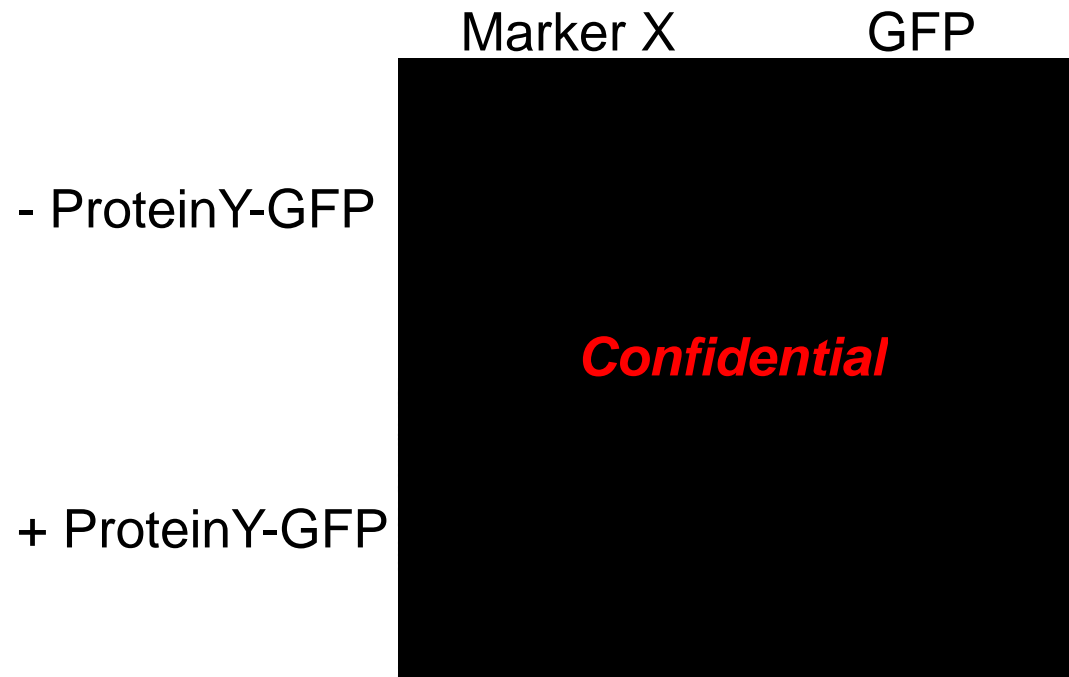
Manipulation
revealed by
contrast
adjustment

Confidential

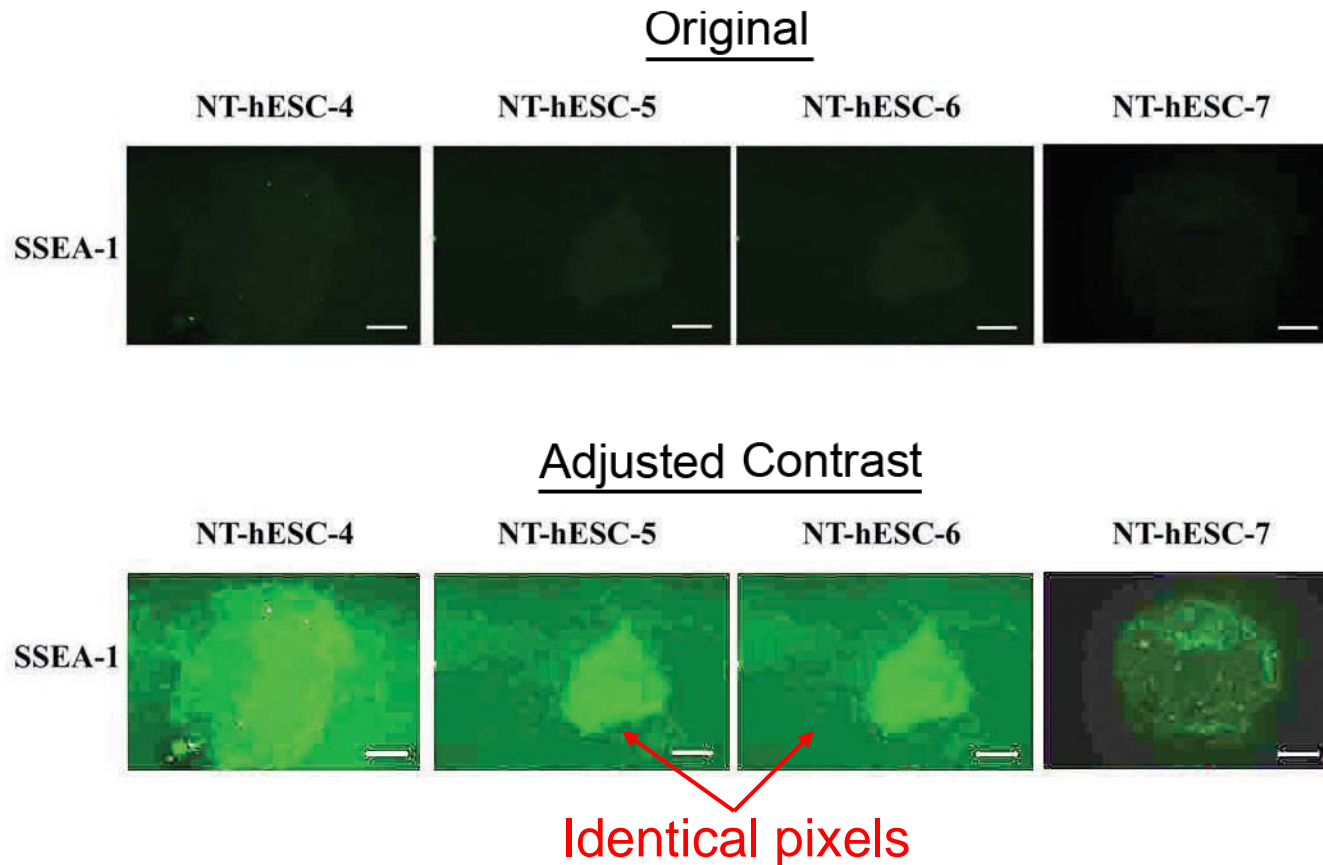
Fraudulent Manipulation

Guideline #1: “No specific feature within an image may be enhanced, obscured, moved, removed, or **introduced**.”

- Adjustment of a specific feature: **fabricating data**



Fraudulent manipulation: The Case of Woo-Suk Hwang



from Hwang, W.S., *et al.* (2005) Patient-Specific Embryonic Stem Cells Derived from Human SCNT Blastocysts. *Science* 308:1777-1783.

How do OME/OMERO fit into this?

The JCB DataViewer

- A browser-based application for archiving, viewing, and sharing original, raw files associated with JCB articles, including multidimensional image files.
- Allows presentation and archiving of the original data as acquired by the user, pre-manipulation.
- Allows us to host files from various types of light microscope and gel-documentation systems.
- Allows users (editors, reviewers, readers) to perform simple analyses of the data within the application and download the data in the open OME-TIFF format for more detailed analysis with their software of choice.

The JCB DataViewer

- Tool for authors
 - data archiving pre- and post-publication
 - data sharing post-publication
- Tool for editors and reviewers

Are the authors showing us what they actually saw?

- data validation pre-publication ***without having access to proprietary image acquisition and processing platforms***

The JCB DataViewer

Voluntary participation rate (as of May, 2011):

524 GB of images total (published and unpublished)

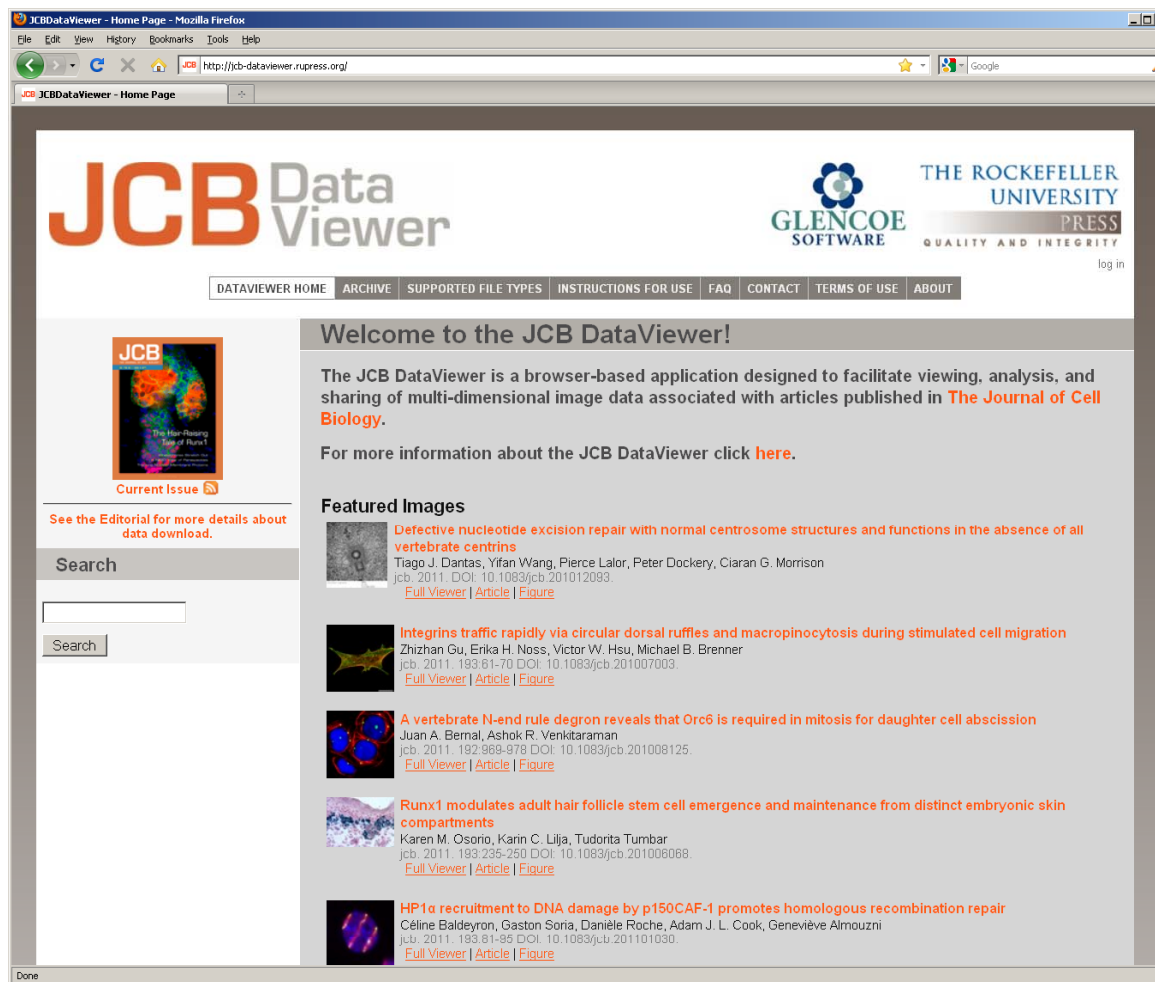
→ 178 published manuscripts

→ 624 published figures

→ 7236 published images

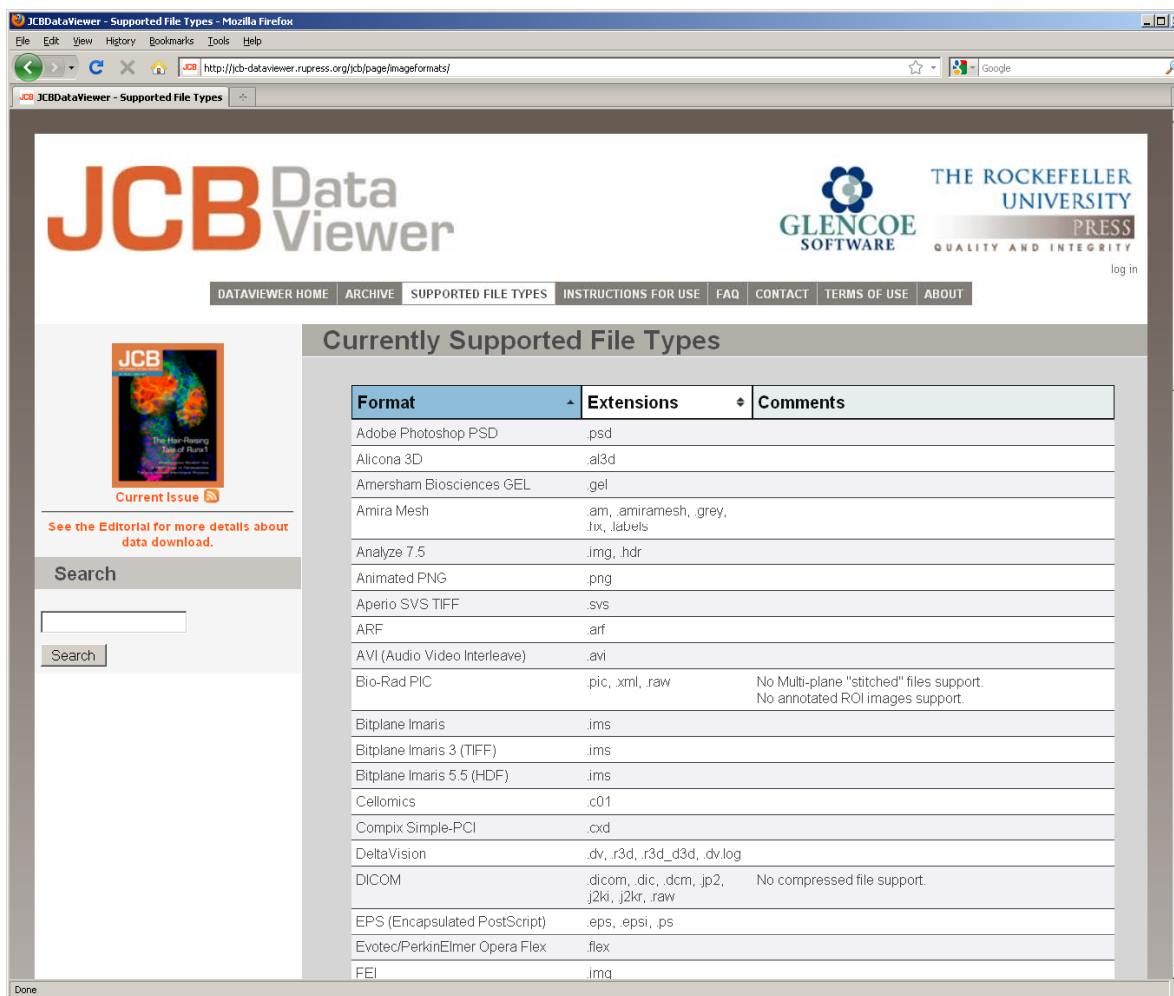
→ 1007666 frames

The JCB DataViewer



<http://jcb-dataviewer.rupress.org>

The JCB DataViewer: File Types Supported



The screenshot shows the JCB DataViewer website in a Mozilla Firefox browser window. The page title is "JCBDataViewer - Supported File Types". The URL in the address bar is <http://jcb-dataviewer.rupress.org/jcb/page/imageformats/>. The website features the JCB logo, the Glencoe Software logo, and The Rockefeller University Press logo. A navigation bar includes links for DATAVIEWER HOME, ARCHIVE, SUPPORTED FILE TYPES, INSTRUCTIONS FOR USE, FAQ, CONTACT, TERMS OF USE, and ABOUT. A sidebar on the left contains a "Current Issue" section with a thumbnail of a brain scan and a "Search" box. The main content area is titled "Currently Supported File Types" and contains a table with three columns: Format, Extensions, and Comments.

Format	Extensions	Comments
Adobe Photoshop PSD	.psd	
Alicona 3D	.ai3d	
Amersham Biosciences GEL	.gel	
Amira Mesh	.am, .amiramesh, .grey, .tux, .labels	
Analyze 7.5	.img, .hdr	
Animated PNG	.png	
Aperio SVS TIFF	.svs	
ARF	.arf	
AVI (Audio Video Interleave)	.avi	
Bio-Rad PIC	.pic, .xml, .raw	No Multi-plane "stitched" files support. No annotated ROI images support.
Bitplane Imaris	.ims	
Bitplane Imaris 3 (TIFF)	.ims	
Bitplane Imaris 5.5 (HDF)	.ims	
Cellomics	.c01	
Compix Simple-PCI	.cxd	
DeltaVision	.dv, .r3d, .r3d_d3d, .dv.log	
DICOM	.dicom, .dic, .dcm, .jp2, .j2ki, .j2kr, .raw	No compressed file support.
EPS (Encapsulated PostScript)	.eps, .epsi, .ps	
Evotec/PerkinElmer Opera Flex	.flex	
FEI	.img	

<http://jcb-dataviewer.rupress.org>

The JCB DataViewer: The Mini Viewer

The screenshot displays the JCB DataViewer web interface within a Mozilla Firefox browser window. The address bar shows the URL <http://jcb-dataviewer.rupress.org/jcb/browse/202/227/>. The page header includes the JCB Data Viewer logo, Glencoe Software logo, and The Rockefeller University Press logo. A navigation bar contains links: DATAVIEWER HOME, ARCHIVE, SUPPORTED FILE TYPES, INSTRUCTIONS FOR USE, FAQ, CONTACT, TERMS OF USE, and ABOUT. A 'log in' link is also present.

The main content area is titled 'Original Data' and features a 'Download All Data as OME-TIFF' button (6 images). Below this, there are links for 'Figure 1 [4]' and 'Figure 2 [2]'. The 'Manuscript Links' section is also visible.

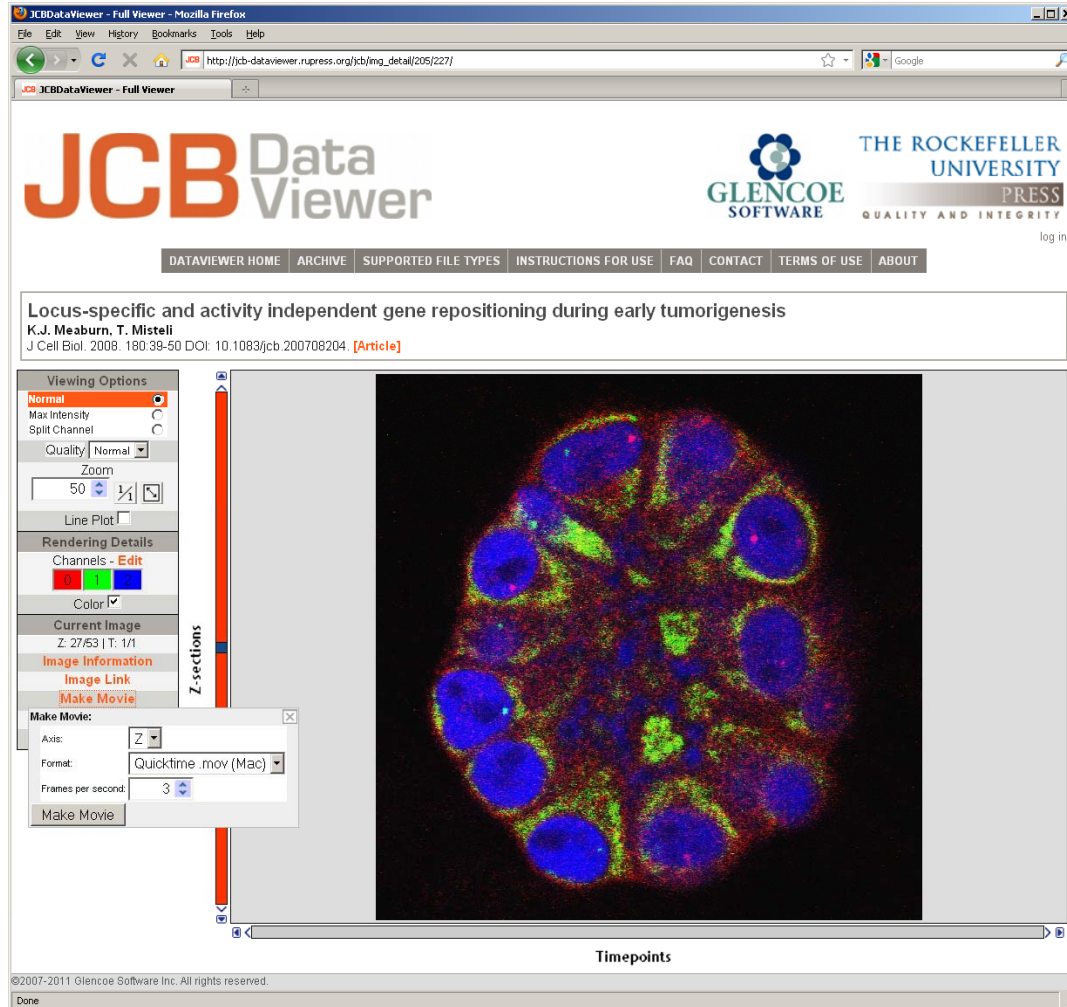
The 'Search' section includes a search input field and a 'Search' button. The 'Legend' section provides a detailed description of the image data: 'PTEN gene loci (red) and VEGF loci (green; the color of VEGF was changed to red in the main manuscript) were detected in paraformaldehyde fixed MCF10A B2 cells grown for 20 days under 3D growth conditions. A representative acinus structure is shown. Whole acini were not imaged to reduce bleaching and to increase the number of acini analyzed. Instead the optical sections imaged totaled approximately 15-20µm in thickness.'

The article title is 'Locus-specific and activity independent gene repositioning during early tumorigenesis' by K.J. Meaburn, T. Misteli, published in J Cell Biol. 2008, 180:39-50. The DOI is 10.1083/jcb.200708204. The article was published on Monday, 14 Jan 2008.

The 'Figure 2' section features a 'Select Images to Download' button. The main image is a fluorescence microscopy image of a cell cluster, showing PTEN gene loci (red) and VEGF loci (green). The image is displayed in a 'Mini Viewer' window with a 'Download Image as OME-TIFF' button and an 'Open Full Viewer' button. Below the main image, there are two smaller thumbnail images of the same cell cluster.

<http://jcb-dataviewer.rupress.org>

The JCB DataViewer: The Full Viewer



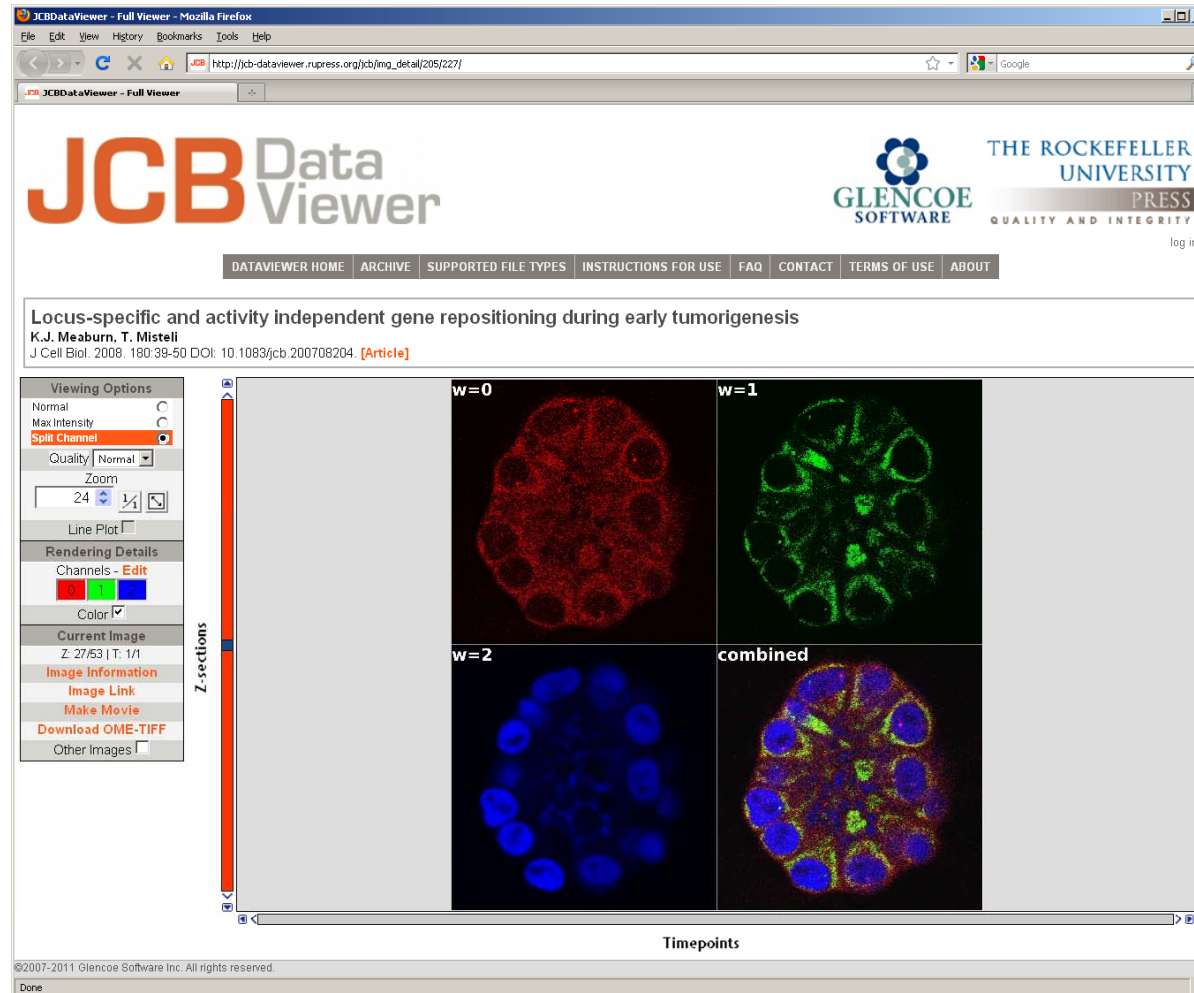
<http://jcb-dataviewer.rupress.org>

The JCB DataViewer: Single Channel Views



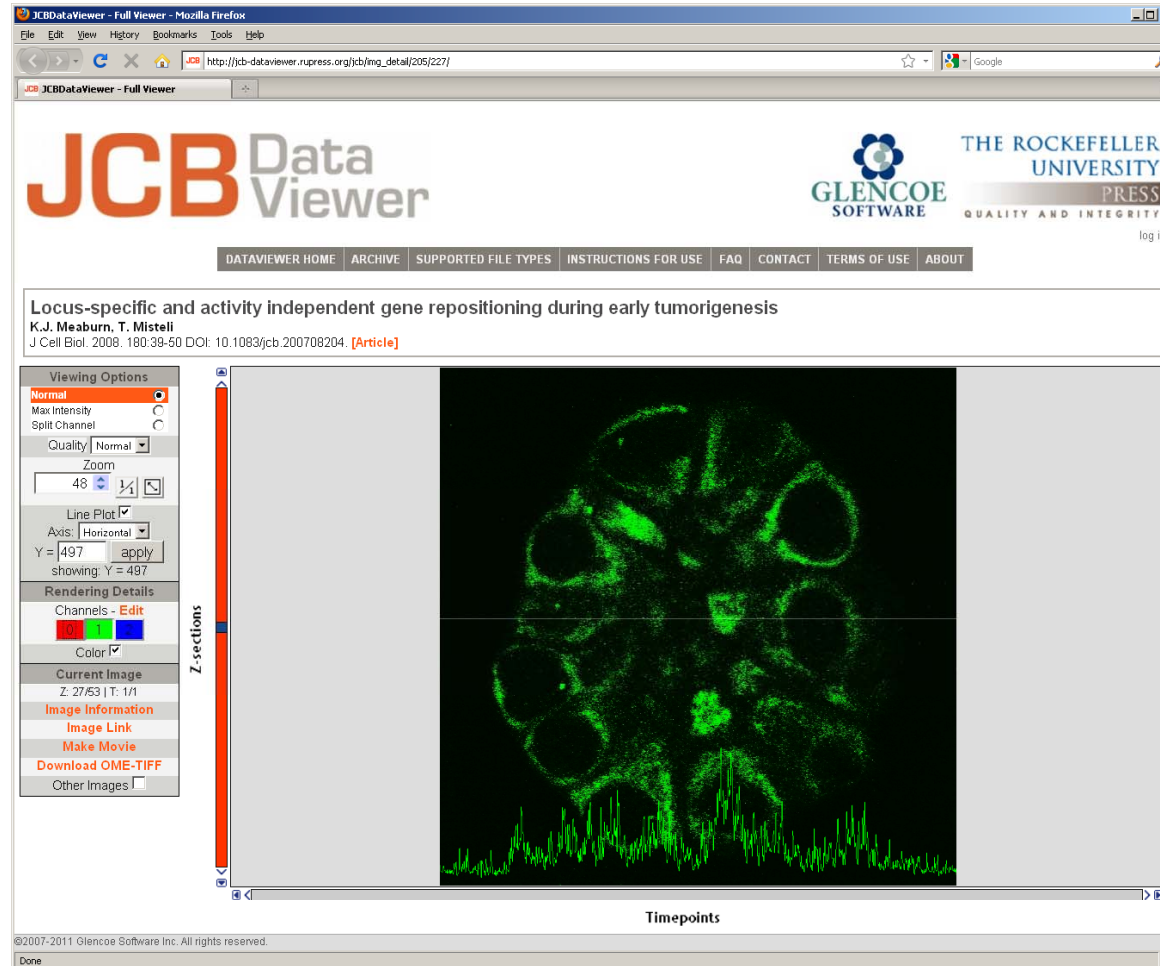
<http://jcb-dataviewer.rupress.org>

The JCB DataViewer: Split Channel View



<http://jcb-dataviewer.rupress.org>

The JCB DataViewer: Lineplots

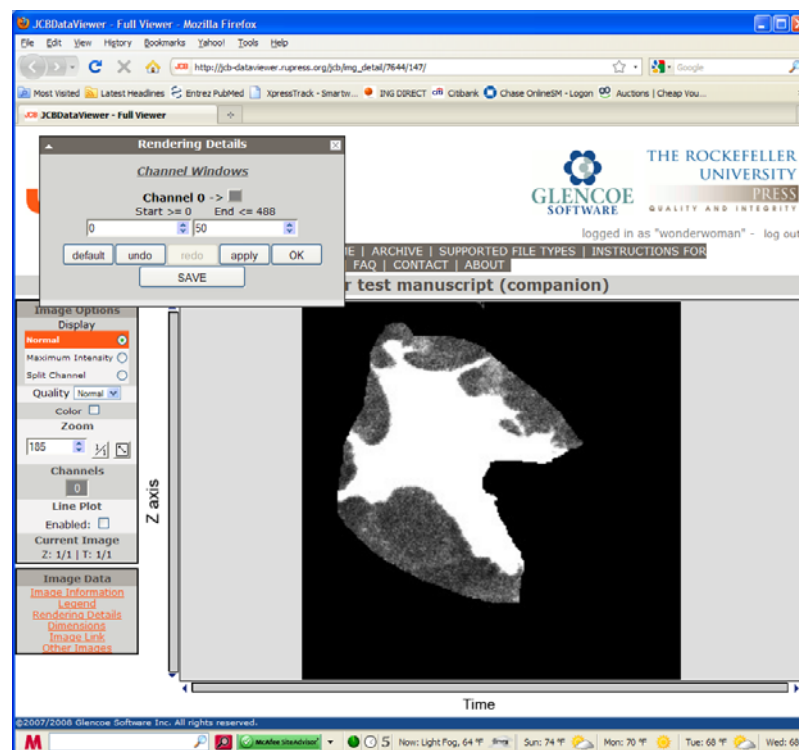
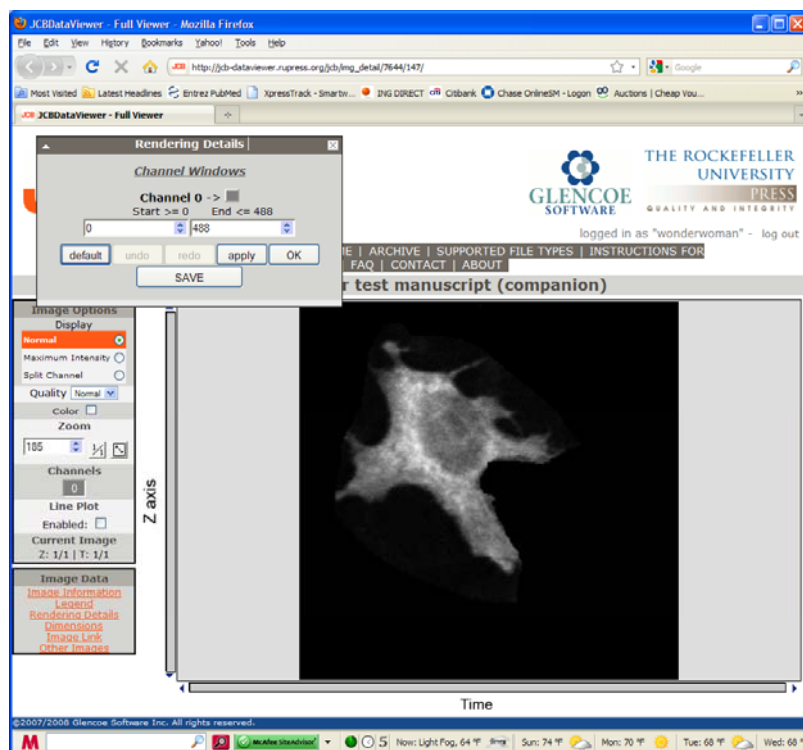


<http://jcb-dataviewer.rupress.org>

Where do we go from here?

- Promote a new standard for sharing and archiving of published image data.
 - Submission and publication of more than just 300 dpi, flat image data that editors, reviewers, and readers can only assume are fair representations of reality
 - Public data archiving
 - Greater openness in research
 - ...an international repository for all published image data?

A new era for image sharing = A new era for image manipulation?



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