

When Did Agriculture Begin?

Stephen W. Carmichael¹

Mayo Clinic

carmichael.stephen@mayo.edu

It has generally been considered that cereals (such as wheat, rice, and maize) were the first crops to be cultivated by human beings. But a new study that included scanning electron microscopy, by Mordechai Kislev, Anat Hartmann, and Ofer Bar-Yosef (micrographs by Yakov Langsam) provides strong evidence that figs were the first agricultural crop in human history.²

Kislev *et al.* recovered nine fig fruits (plus many nutlets called drupelets) from the ruins of a burned building near Jericho. The fire had carbonized the fruit which helped preserve the morphology of the specimens. The site was radiocarbon dated to 11,400 to 11,200 years ago. Microscopic analysis demonstrated that these specimens were of an edible fig that produces drupelets without embryos; that is, these fruits are sterile. Wild fertile figs have a symbiotic relationship with a wasp that plays an essential role in pollinating the fruit, but this fruit is inedible. In this study, no evidence of wasps or where a wasp could exit the fruit were found and these are features found in wild fruit. In other words, wild figs that can be pollinated and reproduce without human intervention are inedible, but edible figs require human intervention. The specimens examined in this study were of the latter variety.

The human intervention that apparently was required was to be purposefully propagated by people planting and tending shoots for generations and generations of fig trees. It is now known that

the edible fig is a genetic mutant of the inedible wild fig. What appeared to have happened as long as 11,400 years ago is that “farmers” discovered this edible fruit would not propagate on its own and learned that it could only be raised if they took an active role. Other fruit trees, such as the grape, olive, and date, can be similarly propagated, but other studies have suggested that this occurred about 5 millennia after these fig specimens.

Co-incidentally, a “Perspectives” article in the same issue of *Science* described how ancient farmers turned weeds into cereal crops.³ John Doebley pointed out that a central feature for domestication of cereals is that the grains must remain on the plant for harvesting by humans, rather than falling (in this context, referred to as “shattering”) from the plant, as required for a wild species to propagate. Quantitative locus mapping has convincingly shown that the loss of shattering arose through a relatively small number of genetic changes, allowing weeds to change to domesticated cereals. Careful selection of these harvestable mutants was probably the earliest stage of farming cereals. Although the studies supporting this did not use microscopy, Doebley pointed out that these genetic changes occurred about 10,000 years ago. If this is true, then agriculture probably began when humans first stuck fig branches in the ground about 11,400 years ago! ■

References

- 1 The author gratefully acknowledges Drs. Mordechai Kislev and John Doebley for reviewing this article.
- 2 Kislev, M.E., A. Hartmann, and O. Bar-Yosef, Early domesticated fig in the Jordan Valley, *Science* **312**:1372-1374, 2006.
- 3 Doebley, J., Unfallen grains: How ancient farmers turned weeds into crops, *Science* **312**:1318-1319, 2006.

INDEX OF ARTICLES

When Did Agriculture Begin?	3	Olympus E330 DSLR for Photomicrography with Older Design Microscopes	46
<i>Stephen W. Carmichael, Mayo Clinic</i>		<i>Theodore M. Clarke, Metallurgical Failure Analysis Consultant</i>	
Microscopy and Microanalysis of Nano-Scale Materials	6	Multi-Axial Stage for a Stereo Dissecting Microscope	48
<i>J. R. Michael, L. N. Brewer, D. C. Miller, K. R. Zavadil, S. V. Prasad and P. G. Kotula, Sandia National Lab., Albuquerque, NM</i>		<i>Zhaojie Zhang, University of Wyoming</i>	
Imaging Gas-Solid Interactions in an Atomic Resolution Environmental TEM	16	A Simplified Method for Formulation of Epoxy Resin Embedding Media	50
<i>Xiao Feng Zhang* and Takeo Kamino,** Hitachi High Technologies America, Pleasanton, CA, **Hitachi High Technologies Corp., Ibaraki, Japan</i>		<i>E. Ann Ellis, Texas A&M University, College Station, TX</i>	
Improved Sectioning of Polymers Using an Oscillating Diamond Knife for Transmission Electron Microscopy	20	A Simple Cleaning Method for Penning Gauges	52
<i>J.D. Harris* and J.S. Vastenhou,*** The Dow Chemical Company, Midland, MI, ** Dow Benelux B.V., Terneuzen, Netherlands</i>		<i>Valery Ray, PBS&T, MEO Engineering Co., Methuen, MA</i>	
Applications for Automated Particle Analysis	22	Negative Stains/Staining 2.5 mM Phosphotungstic Acid, 25µg/mL Bacitracin, pH 7.0	52
<i>Robert Anderhalt and Lara Swenson, EDAX Inc., Mahwah, NJ</i>		Agar Diffusion	
Electromagnetic Simulation Optimizes Design of a Sub-20 nm Resolution Optical Microscope	28	<i>Both by Paul R. Hazelton, University of Manitoba, Winnipeg, Canada</i>	
<i>Erik J. Sanchez, Portland State University, Portland, OR</i>		New and Interesting at M&M-2007	56
JECP—a Java Electron Crystallography Project	32	Industry News	58
<i>X.Z. Li, University of Nebraska, Lincoln, NE</i>		NetNotes	60
Preparation of the Yeast <i>Pichia pastoris</i> for Transmission Electron Microscopy	36	Index of Advertisers	70
<i>Benjamin A. Yount, Joan Lin-Cereghino, Geoff P. Lin-Cereghino, and Marcia M. Fox, U. of the Pacific, Stockton, CA</i>			
Fly Microdroplets Viewed Big: a Cryo-SEM Approach	38		
<i>Stanislav N. Gorb, Max Planck Institute for Metals Research, Stuttgart, Germany</i>			
Quantification of Virus Suspensions by Direct Particle Counting	40		
<i>Paul R. Hazelton, University of Manitoba, Winnipeg, Canada</i>			

ABOUT THE COVER

Electron backscatter diffraction map of a micro-wear scar in an electrodeposited Ni micro-electro-mechanical system (MEMS) device. The wear scar was produced by moving a Si₃N₄ ball, loaded with 100g, across the surface of the device 1000 times. The extent of the wear-induced sub-surface deformation and damage is easily visualized from this map. The image size is 8 µm x 10 µm. See the article by Michael, *et al.*, page 6.

COMING EVENTS

2006

- ✓ **The Fourth Int'l Congress on Electron Tomography, (4ICET)**
November 5-8, 2006, San Diego, CA
<http://www.4icet.org>
- ✓ **GATAN GIF & the FELMI EELS and EFTEM School - Europe**
November 8-10, 2006, Graz, Austria
www.gatan.com/training/index.html
- ✓ **Society for Neuroscience**
November 21-25, 2006, New Orleans, LA
info@sfn.org
- ✓ **American Society for Cell Biology**
December 9-13, 2006, San Diego, CA
www.ascb.org

2007

- ✓ **SPIE Photonics West, Multiphoton Microscopy/Applications**
January 20-27, 2007, San Jose, CA
spie.org/conferences/calls/07/pw/bios/
- ✓ **Microscopy 2007**
February 5-9, 2007, Auckland, NZ
enquiries@microscopy2007.org.nz
- ✓ **PITTCON 2007**
March 11-16, 2007, New Orleans, LA
www.pittcon.org
- ✓ **The American Chemical Society**
March 25-29, 2007, Chicago, IL
natlmtg@acs.org
- ✓ **American Soc. for Biochemistry and Molecular Engineering**
April 2007, Washington, DC
www.asbmb.org
- ✓ **Microscopy of Semiconducting Materials' Conf. MSM XV**
April 2-5, 2007, Churchill College, Cambridge
conferences.iop.org/msmxv
- ✓ **8th Multinational Congress on Microscopy**
June 17-21, 2007, Prague, Czech Republic
8mcm@biomed.cas.cz
- ✓ **34th Annual Mtg. of the Microscopical Society of Canada**
June 18-20, 2007, Alberta, Canada
www.phys.ualberta.ca/MS-2007/
- ✓ **Microscopy and Microanalysis 2007**
August 5-9, 2007, Fort Lauderdale, FL
mm2007.microscopy.org
- ✓ **The American Society for Cell Biology**
December 1-5, 2007, Washington, DC
www.ascb.org

2008

- ✓ **Microscopy and Microanalysis 2008**
August 3-7, 2008, Albuquerque, NM
www.msa.microscopy.com

2009

- ✓ **Microscopy and Microanalysis 2009**
August 3-6, 2009, Baltimore, MD
www.msa.microscopy.com

2010

- ✓ **Microscopy and Microanalysis 2010**
Portland, OR

Please check the "Calendar of Meetings and Courses" in the MSA journal "Microscopy and Microanalysis" for more details and a much larger listing of meetings and courses.

MICROSCOPY TODAY

The objective of this publication is to provide material of interest and value to working microscopists!

The publication is owned by the Microscopy Society of America (MSA) and is produced six times each year in odd months, alternating with MSA's peer-reviewed, scientific journal *Microscopy and Microanalysis*. We greatly appreciate article and material contributions from our readers—"users" as well as manufacturers/suppliers. The only criterion is that the subject matter be of interest to a reasonable number of working microscopists. *Microscopy Today* has authors from many disparate fields in both biological and materials sciences, each field with its own standards. Therefore *MT* does not have a rigid set of style instructions and encourages authors to use their own style, asking only that the writing be clear, informative, and accurate. Length: typical article length is 1,500 to 2,000 words plus images, longer articles will be considered. Short notes are encouraged for our Microscopy 101 section. See our "Instructions to Authors" document on our website.

MICROSCOPY TODAY

ISSN 1551-9295

Ron Anderson, Editor

randerson20@tampabay.rr.com

Phil Oshel, Technical Editor

oshel1pe@cmich.edu

Thomas E. Phillips, Contributing Editor

PhillipsT@missouri.edu

Dale Anderson, Art Director

microscopytoday@tampabay.rr.com

Renée Stratmoen, Advertising Director

oshel1pe@cmich.edu

Regular Mail to:

Microscopy Today, P.O. Box 247, Largo, FL 33779

Courier Mail to:

1001 Starkey Road, Lot #374, Largo, FL 33771

Telephones:

1-(727)507-7101 • Fax: (727)507-7102 • Cell: (727) 631-1022

e-Mail:

microscopytoday@tampabay.rr.com

www Page:

<http://www.microscopy-today.com>

Colophon: Microscopy Today is created using components of Adobe Creative Suite CS2

Total Circulation: 14,483

Disclaimer: By submitting a manuscript to *Microscopy Today*, the author warrants that the article is original (or that the author has the right to use any material copyrighted by others). The use of trade names, trademarks, etc., does not imply that these names lack protection by relevant laws and regulations. *Microscopy Today*, the Microscopy Society of America, and any other societies stated, cannot be held responsible for opinions, errors, or for any consequences arising from the use of information contained in *Microscopy Today*. The appearance of advertising in *Microscopy Today* does not constitute an endorsement or approval by the Microscopy Society of America of the quality or value of the products advertised or any of the claims, data, conclusions, recommendations, procedures, results or any information found in the advertisements. While the contents of this magazine are believed to be accurate at press time, neither the Microscopy Society of America, the editors, nor the authors can accept legal responsibility for errors or omissions.

© Copyright, 2006, The Microscopy Society of America. All rights reserved.

11 MEGAPIXELS

High Definition Digital TEM Cameras
AMT's HOT NEW LINE

**TEM
INTEGRATION**

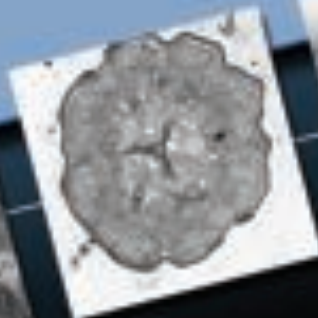
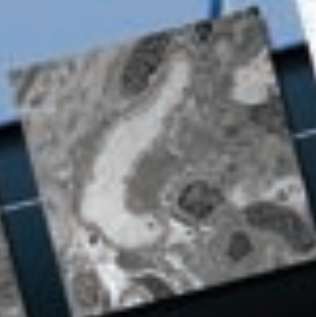
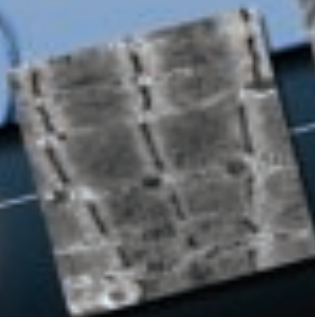
**FASTEST
DISPLAY**

**LARGEST FIELD
OF VIEW**

**BUILT-IN
RELIABILITY**

**PROVEN
SUPPORT**

**SIDE MOUNT
& BOTTOM MOUNT**



Advanced Microscopy Techniques Corporation
3 Electronics Avenue • Danvers, MA 01923
978-774-5550 • www.amt Imaging.com