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A Trend Towards Computer Aided Microscopy

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As the dawn of the next millennium approaches, the light microscope enters its fifth century of use, while the personal computer barely enters its third decade.

When Antony van Leeuwenhoek peered through his self made hand crafted microscope and documented the first observations of bacteria and cells, much of microbiology and cell biology was born. When the personal computer became a tool in modern science, molecular cell biologists were well into the age of human genetic engineering.

While the rise and acceptance into scientific importance of the microscope and the personal computer represent vastly different periods of sophistication in modem science, the combination of these two important scientific tools for computer aided microscopy (CAM) clearly provides bold uncharted potentials and opportunities for medicine, biomedical research, and industry in the future century to come.

Researchers need more information from microscopes than provided with simple microscope imaging. These new needs often require the motorization and the automation of one or more of the many basic controls on a microscope. One of the first controls on the microscope automated years ago was a motorized stage for scanning areas of a specimen in the x and y axis, to accurately locate and relocate specific areas on a microscope slide or sample. Another control motorized years ago was the z-axis control for image focusing.

Newer developments on motorizing and/or automating research microscopes over the years involve the development of hardware and sofiware based application program interfaces to perform specialized tasks. These include microscope spectrophotometer systems that can measure light reflectance, transmittance absorbance, and spectral characteristics from specific samples. Coal petrography, oil and coal exploration, and forensic science, currently utflize the personal computer for microscope control, data collection, evaluation, and display for application specific sample analysis.

Microscope users in medicine, biomedical research and industry now demand more than simple imaging from microscopes. They require not only more motorized but additional automated options on microscopes. These demands include a motorized nosepiece in order to rapidly change objectives. This offers the ability to survey and/or inspect a greater magnification range of specific details from a speciman or sample. The need for complete motorization automated illumination control for transmitted and epi-illumination sources including illumination selection and shuttering, and the selection of epi-fluorescence filter cubes for multiple wave length excitation of the sample is rapidly becoming commonplace. Additionally, requirements to maintain the microscope's optimal performance parameters in transmitted light are now achieved with optional motorized field and aperture diaphragms for transmitted light for automated Koehler illumination. Microscope motorization and automation also offers numerous user ergonomic benefits.

In the field of semiconductor equipment manufacturing, all wafer fabrication facilities (wafer "fabs") utilize computer aided microscopy (CAM) for control and automation with application software for wafer handling, staging, focus, objective changing, imaging documentation, and quality assurance and quality control record keeping. This is an important trend in the semiconductor wafer fabrication arena and is due primarily to the need to minimize operator errors and wafer damage during wafer handling, minimize overall process contamination, increase production yields, and operator ergonomy.

The simple motorizing or automating of key microscope controls represents in itself no major significant advancement for CAM. The key is in integrating a microscope design and concept that allows for simple and easy computer interface of these motorized functions. The initial design parameters of the LEICA DM R research microscopes were among the first systems to include an RS 232 C computer interface for CAM with upright compound microscope (1992) and inverted microscope (1994) imaging systems. Today, the latest LEICA DM RXA extends the CAM design concept to include many additional automated functions

on the microscope along with the latest in software protocol interfaces using Microsoft Windows® 95 and WindowsNT™ operating systems. With the networking advantages of the Microsoft WindowsNTTM operating system, the LEICA DM RXA microscope can now become integrated into a computer local area network.

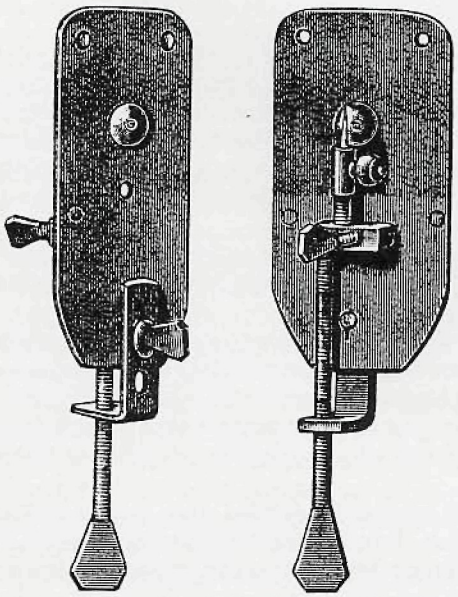
Currently, the development of confocal microscopy represents yet another sophisticated level of computer aided microscopy. Applications in telepathology, remote control microscopy, and microscope image and quantitative analysis work stations represent yet another field for computer interface possibilities. The highly divergent fields of applications in medicine, biomedical research, and industry can now utilize the many possibilities of CAM with automated and or remote controlled microscopy. For industry, these include remote controlled microscopes for contamination or clean rooms. Telepathology in medicine is currently gaining acceptance in many parts of the world, where centrally located pathologists can lower medical costs by remotely controlling an automated microscope such as the LEICA DM RXA microscope and "view" patient slides at off site facilities virtually anywhere on the globe. Even cyberspace is not without a microscope, where anyone with Internet access can today control a LEICA DM RXA microscope located at one of the Leica research facilities in Cambridge, England, via the Internet *(www. leica. com)*.

Any microscope design incorporating numerous remote controlled or automated microscope functions must address long term reliability and ease of use. For nearly a year in the exhibit, "METEORITES!", in the Grande Galerie de l'Evolution at the Museum National D'Histoire Naturalle in Paris, France, a LEICA DM RXA operates flawlessly six days a week in the hands of the visiting public. The museum exhibit leads the human eye through a colorful journey thorough the stars and meteors of outer space, and with the use of the LEICA DM RXA microscope, the public gazes into the dazzling colors revealed in the innermost world of meteorites *(www.leica.com/e/about/news/events/meteor.htm)*.

In the nearly *500* years after Leeuwenhoek, there have been very few tools that have consistently provided significant contributions to the advancement of modern science. And now, late in the 20th century automated research microscopes for computer aided microscopy are available. The need to gather more information from the microscope and the trends toward more and more computer interfacing and analysis in microscopy with new software guarantees the light microscope as an important tool for science well into the first part of the 21st century. Automated microscopy represents an example of innovative solutions to the new challenges of computer aided microscopy (CAM) to explore new worlds within. ■

Reference: Schade, Karl-Heinz; *Light Microscopy-Technology and Applications*, verlag moderne industrie AG, 1993

See *www.leica.com/lmg/e/prod/dmrxa.htm* for additional information regarding the LEICA DM RXA microscope. See *www.com* for other Leica product and company information.



Front and backside of a microscope by Leeuwenhoek - circa 1670's