materials at high pressure is challenging, because intrinsic magnetism of the high-pressure cell must not interfere with the measurement (S. Tozer, Natl High Mag. Field Facility, Florida). But using a new technique for measuring magnetic susceptibility that involves immersing the high-pressure cell with its loaded sample in an external magnetic field (V. Struzhkin, Carnegie Inst., Washington), elemental sulphur has been shown³ to become superconducting at high pressure, and to reach T_c values of 17 K at 160 GPa — the highest recorded superconducting transition temperature for an elemental material.

Another new tool is being brought to bear on high-pressure materials — intense beams of X-rays from new-generation synchrotrons (G. Shen, Y. Wang, GSECARS, Univ. Chicago). Beryllium gaskets can be used to permit the X-ray beam to enter a diamond anvil cell from the side⁴ (H.-K. Mao, Geophysical Laboratory, Washington). This means that X-ray absorption experiments on light elements — down to chlorine, sulphur, and perhaps even silicon — can be carried out *in situ*, and also allows a full determination of elastic properties of materials at high pressure.

In the field of optoelectronics, one of the most exciting recent developments is the use of GaN to make blue LEDs and lasers. Growth of large, single GaN crystals (as substrates for homoepitaxy of unstrained nitride films) is experimentally challenging, because the material decomposes far below its melting point at ambient pressure — but high pressure stabilizes GaN enough for large, single crystals of up to 1 cm² surface area to be obtained, with fine control over

impurity content and structural defects (S. Porowski, Warsaw).

Materials science is a field in constant flux, in the search for new technological materials and processes, and ways to probe material properties and structure. The high-pressure route offers another window through which to view materials science, with a largely unexplored landscape waiting beyond. □

Telemicroscopy

Net progress

Kevin Burton and Daniel L. Farkas

The microscope is a staple of the sciences, but for many years only a single observer could effectively use the instrument. Increasing the number of eyepieces and, much more recently, adding cameras and monitors for local or remote viewing, were big advances. But there has remained the need to enable groups physically separated from the microscope to control it interactively, and view the images together.

On page 613 of this issue¹, Wolf *et al.* describe a telemicroscopy system that allows Web-browser software to connect multiple 'clients' through the Internet to a 'server' computer that controls an automated light microscope. Such Internet-based remote control is not new²⁻⁴. But Wolf *et al.* have made telemicroscopy more accessible by employing commonly used Web browsers as remote viewers (see also ref. 3), while taking the approach a step further by incorporating Java technology to make the interface more interactive and dynamic.

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Several developments lie behind this and other advances in telemicroscopy. Video microscopy and digital imaging allowed acquisition of images for display to large groups on video monitors, as well as electronic transmission to many different sites⁵. Automation of microscopes allowed digital (including remote) control of motorized moving parts, electro-optics and other components, and, along with software control, facilitated more rapid, reproducible and complicated operations⁶.

The final step in freeing the operator from the instrument has been to control the microscope remotely by sending instructions and the resulting images over the Internet. Although remote control of telescopes began some years ago⁷, connection of microscopes to the Internet came later, with the word 'telemicroscopy' first being applied to electron microscopes⁸. Given the cost of electron microscopes, control from remote sites is extremely valuable for both research and education⁹.

As Wolf *et al.* show, there are equal and broader benefits to be had with light microscopy linked to the Internet. They have connected a PC running under Windows to an automated microscope equipped with a colour CCD camera and frame-grabber. The PC acts as a Web server, accepting commands from clients using common Web-browser software and passing the instructions to the microscope and camera through commercial software drivers (Fig. 1). The client can control automated features of an upright bright-field microscope, including stage position, focus, lamp intensity and magnification (by rotating a motorized objective turret). Proper illumination is maintained when changing objectives by automatically adjusting lamp intensity, condenser lens, and field and aperture diaphragms. The software offers some features for image handling that are useful even with microscopes under manual control — for example, detection of changes in the digitized images resulting from local operations, such as adjusting focus or stage position, and then automatic updating for clients.

Like all other systems that use the Internet, this one slows down when transferring

Exhibition

Natural attraction

Later this month, the Natural History Museum, London, presents a little-known aspect of its collections to the public — a selection of 70 works of natural-history art from its massive collection of some half a million. The exhibition is called 'Images from Nature', and birds, bugs and botanical specimens are all predictably well represented. Yet there are also less obvious subjects, such as 'pebbles found on British beaches' and copper ores, as well as a couple of vivid lichens executed in watercolour and pencil.

Shown here is Bryan Kneale's depiction in chalk of a giant tortoise (1990), one of the 'bone drawings' he produced while associated with the museum. Other exhibits come from the great days of exploration and the hands of such illustrators as Ferdinand Bauer and Sydney Parkinson, who sailed with Cook on the *Endeavour* (and died on the return leg of

the journey). The organizers have also failed to resist the temptation to include examples of the design work of the Natural History Museum's architect, Alfred Waterhouse — justifiably so, for his chunky drawings are a refreshing contrast to the delicacy of some of the other pictures.

The exhibition is at Christie's, King Street, London SW1 (not the museum itself), and runs from 9 to 20 February. Tim Lincoln

Figure 1
Microscopic connections — an Internet-based system of remote viewing and control as implemented by Wolf *et al.*¹.

large images. Delays result from both the Internet transfer itself, and the process of image compression that precedes transmission^{1,2}. Wolf *et al.* speed things up by providing options for reduced-size images, autofocus to eliminate the transfer of multiple images otherwise required during manual focusing^{2,3,8}, and generally reducing Internet traffic between client and server using Java applets running on the client machine.

Another advantage of Internet-based systems is that many clients can simultaneously view, and confer over, a single specimen^{2-4,8}; the use of common Web-browser software increases this potential enormously^{1,3}. To aid communication between clients, Wolf *et al.* provide a neat Java-based interactive pointer overlaying the image; movements of the pointer by any one client can be seen by all. Further developments would be a facility to annotate images with text or drawings, and provision of video/audio conferencing^{3,4}.

One of the disadvantages of not being at the microscope can be difficulty in getting, and staying, orientated — that is, keeping track of where the current image lies within the entire specimen. Solutions include acquiring a reference image at low magnification, graphically indicating which portion of the specimen is currently being viewed, or building up a montage of contiguous high-magnification images^{3,4,8}.

The uses of telemicroscopy span research, education, medicine and manufacturing^{1-4,8,9}. For centralized research facilities, distant collaborations will benefit by allowing collaborators to stay put yet look in on their specimens during an experiment⁸. Likewise, travelling professors could check in on experiments being carried out at their home laboratory.

Telepathology is a further application^{1,3,4}, consultation around case specimens being aided by moving around the specimen, changing magnification and otherwise examining it for diagnostic features (although image resolution and time response are limitations). In education, large numbers of students or colleagues, on-site or farther afield, could view precious specimens without having to crowd around microscopes or video

monitors. The separation between server and client can also take the form of a protective barrier, for example when high-power lasers are used for illumination, or clean-rooms are required for manufacturing processes or for the examination of infectious specimens². Many servers could also be accessed by a single client, allowing modifications in server software or hardware to be tested from a single site. Finally, other types of instrument are being connected to the Internet, atomic force microscopes being a recent example¹⁰.

Assembling a telemicroscopy system, however, is not yet as easy as downloading the latest Web browser. One consideration is the expense of automated hardware. Another is the compatibility of Java applets with the Web-browser/operating system/computer-platform of the client. Also, more and more systems incorporate some level of tele-microscopy^{1-4,8,9}, but each has distinct features and accessibility that are often affected by regulatory and intellectual property issues. So anyone considering setting up a server has to weigh the various options. Nonetheless, these are still early days. Given the ubiquitous use of microscopes, it seems inevitable that many will become linked into an interactive network of researchers, educators, clinicians and companies through the World Wide Web. □

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Daedalus

The seeing ear

Sunlight makes us cheerful. The pineal gland in the brain is responsible; in bright light it releases hormones such as melatonin more strongly. Melatonin is a mood enhancer and sexual stimulant. One consequence is seasonal affective disorder, or SAD, whose sufferers are peculiarly depressed and unsexy during the winter. The short, dull days fail to stimulate their pineal glands. Brief daily exposure to intense light reduces the SADness.

In this connection, Daedalus recalls the theory that the pineal gland is the relic of a third eye possessed by our distant reptilian ancestors. Presumably it still retains a vestigial sensitivity to light. Indeed, it must be amazingly light-sensitive. It is stuck almost in the middle of the brain — how can light reach it? Through the ears, says Daedalus. The pineal gland is almost exactly on the right level, and the ear hole is an excellent entry point for light. It is formed of soft, translucent tissue, and is close to the carotid canal and several nerve pathways into the brain. Light could diffuse along these paths quite well, without being blocked by opaque bone.

This notion has many implications. It explains the sexual allure of the world's tropics and sunlit regions, despite the dark glasses which are *de rigueur* for their devotees. It explains the ear-concealing headgear of monks and subservient groups in some traditional societies: the garb must serve to damp dangerous feelings, and encourage a grave and humble mien. It also suggests a simple method of countering SAD and depression. Daedalus's 'Earlight' is a headband carrying two well-focused lamps to beam light into the wearer's ears. Human tissue is most translucent to red light, so small red lasers or LEDs are the lamps of choice. Accurately aimed, they will illuminate the pineal gland far more effectively than the fiercest daylight. The Earlight should bring cheer and erotic interest to the saddest of SAD sufferers.

More cunning still, the Earlight could illuminate one ear more than the other, thus biasing pineal output into the more illuminated hemisphere. Left-brain-dominated rationalists could boost their emotional awareness, and right-brained dreamers could get a grip on reality. And combined with a personal stereo system, the Earlight could cure the glum truculence of so many teenagers, whose melatonin level is clearly lowered by their permanent wearing of ear-blocking audio equipment.

David Jones