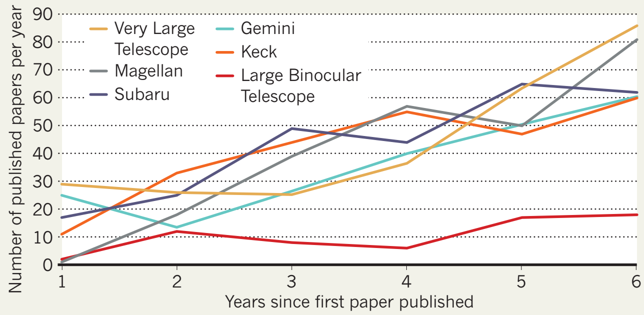
▶ Graham was chosen as the telescope's future home. Clashes with environmentalists, notably over the conservation of a red-squirrel subspecies that lives on the mountain, delayed construction until 1997.

Similarly complicated is the international corporation that funds and manages the LBT. Collaborations based in Arizona, Italy and Germany each have an equal share in three-quarters of the telescope. One-eighth belongs to Ohio State University in Columbus, and the other one-eighth is shared among Ohio State and three other US universities. "I often refer to the LBT as a confederation of interested parties rather than a partnership," says Woodward.

DOUBLE TROUBLE

The Large Binocular Telescope has lagged behind its peers in terms of scientific productivity.



Number of peer-reviewed published papers is normalized on a per-mirror basis for multi-mirror observatories; observatories published their first papers in different years.

SOURCE: DENNIS CRABTREE, NATURAL RESOURCES CANADA

By 2002, the LBT was built. Then came the challenge of getting it to work. Its sheer size is one problem: the presence of two 16-tonne mirrors on one mount causes the structure to flex. Another issue is getting both mirrors to point in precisely the same direction.

However, most of the time since construction has been spent getting the first three pairs of instruments up and running. Of the six instruments expected, only four have made it to the telescope so far: two Italian-built cameras, plus one German spectrograph and one US spectrograph. "There has been a huge learning curve for the facility instruments," says Richard Pogge, an astronomer at Ohio State University and principal investigator for the US spectrograph. "We all have our scars from this."

Yet astronomers persevere because of the science promised by the LBT. Its two mirrors can be combined to gather as much light as a single telescope mirror 11.8 metres across, which would make the LBT the largest telescope in the world.

Another asset is image sharpness, thanks to the LBT's adaptive optics system, which uses deformable secondary mirrors to correct for distortions in Earth's atmosphere. It is one of these mirrors, on the LBT's right side, that failed after the cooling accident this spring. When it works, the adaptive optics system "is a world-beater", says astronomer Richard Green of the University of Arizona, who stepped down as LBT director in February in part because he wanted to keep the focus on the instruments before pushing for more science. The LBT's sharp eyes allow it to spot celestial objects that are close to other ones, such as planets around stars or objects near black holes.

The LBT's resolving power is boosted even further when it is operated as a giant set of binoculars. This mode, which requires a light-combining interferometer, yields a resolution that is equivalent to that of a telescope 22.8 metres wide.

This spring, the LBT interferometer had started an infrared survey that hunts for giant exoplanets as well as the 'exozodiacal' dust left in planet-forming disks around other stars. NASA is also planning to use the LBT's binocular mode to conduct a similar survey that would detect places where planets may be born and would help astronomers to subtract the signal from the exozodiacal dust that may obscure any planetary signatures.

But those efforts are on hold for now. The LBT shut down on 8 July for three months, as it does every summer, for Arizona's monsoon season. While technicians fix the adaptive secondary mirror, crucial tests on the interferometer will have to wait. "In some ways that's a bummer," says Veillet. "But in two to three years, nobody will remember that it was late." ■

PUBLISHING

Deal boosts blind's access to texts

Global copyright agreement will increase availability of scientific texts in accessible formats.

BY DECLAN BUTLER

An international treaty approved on 27 June is a major victory for people with visual impairments. The 186 member states of the World Intellectual Property Organization came to a historic agreement to remove copyright obstacles that have hampered the global availability of textbooks and other published works in accessible formats such as braille, large print and audio.

The agreement, which has been a decade in the making, was reached in Marrakesh, Morocco, after more than a week of intense negotiations. All ratifying states must now introduce national copyright exemptions that will allow government agencies and non-profit bodies to convert published works to accessible versions and distribute them globally to visually impaired people.

The agreement also means that organizations for the blind will be able to freely share their collections of accessibly formatted works across borders, in particular with developing nations. Only around one-third of the world's countries, mostly the richest, have such copyright exceptions in place. Yet 90% of the world's 285 million visually impaired people live in developing countries, according to the World Health Organization. The treaty will help visually impaired individuals worldwide to have "access to and full participation in science education and research", says Richard Weibl, director of the Project on Science, Technology, and Disability at the American Association for the Advancement of Science in Washington DC.

But organizations for blind people have the resources to convert only a fraction of the books and other materials published each year. So they are also pushing for publishers to format their mainstream products to be fully accessible to the blind from the outset and for suppliers of devices such as e-readers, tablets and smartphones to ensure that such content is usable.

"We have not yet seen the adoption of accessible formats and standards on the scale that we would like to see, particularly in the area of scientific and mathematical texts," says Chris Danielsen, a spokesman for the US National Federation of the Blind in Baltimore, Maryland.

A big step towards that goal came in March, when the International Publishers Association endorsed EPUB 3 — sweeping international standards for publishing multimedia-rich, interactive digital content on all devices.

➲ NATURE.COM
For more on the future of scientific publishing, see go.nature.com/gdtvaw

EPUB 3 incorporates the Digital Accessible Information System (DAISY) Consortium standards that many organizations for blind people use to convert books and other published content to accessible formats. The DAISY standards are a set of specifications for formatting digital documents that allow for unrivalled speech-based access to texts. They permit blind people to easily navigate chunky textbooks, for example, to add audio notes, and to create and find bookmarks. The DAISY standards also make figures, graphics and equations machine-readable and thus accessible to the blind through a range of software and devices, including refreshable braille, embossing printers and tactile tablets.

"I'm very excited about EPUB 3," says Mark Doyle, director of journal information systems at the American Physical Society (APS) in New York. The APS is one of the few publishers to have experimented with using DAISY standards so far. Adding DAISY functionality to the society's papers would have been too cumbersome and costly, he says. But in the coming years it will be much easier to include it now that the APS is shifting its publishing workflow towards using EPUB 3 across the board.

However, whether publishers will take full advantage of the opportunities offered by EPUB 3 to make graphics and equations accessible remains a concern, says John Gardner, a solid-state physicist and founder of ViewPlus Technologies in Corvallis, Oregon. Gardner lost his sight at the age of 48 and has since dedicated his talents to developing assistive software and devices to make scientific content more accessible to the blind.

Even if publishers do widely embrace EPUB 3's accessibility features, another big unknown is whether e-readers and other devices will support them. Amazon's Kindle reader, for example, provides access to a vast library, including classics such as *Molecular Biology of the Cell* (5th edn, Garland Science, 2012), but is "still not fully accessible", says Danielsen.

Broader access came in May, when Amazon released an application that allows many Kindle e-books to be read on Apple devices using Apple's VoiceOver — a screen reader designed for the blind. Organizations for the blind give Apple products top marks for their attention to accessibility. Larry Hjelmeland, a blind researcher at the University of California, Davis, who studies the biology of eye ageing, says that Apple's latest operating system has made it much easier for him to read everything from e-mails to scientific papers.

Gardner hopes that the treaty and advances in technology will also help to address the under-representation of the visually impaired in science. "These people tend to have restricted opportunities for social interaction and entertainment," he says. "So they often are much more productive than people without disabilities." ■

PHYSICS

Imaging hits noise barrier

Physical limits mean that electron microscopy may be nearing highest possible resolution.

BY EUGENIE SAMUEL REICH

Plans for the next generation of electron microscopes have been dealt a blow by the discovery of an unexpected source of noise that could frustrate efforts to improve resolution to well below the size of an atom.

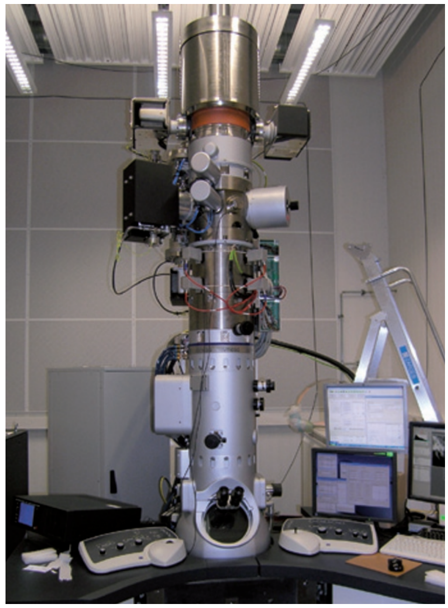
Researchers working for a leading manufacturer of advanced optics describe the noise source in a paper[1] now in press. They think that they can find a way to mitigate it, but electron microscopists admit that the finding is the latest sign that their costly quest to capture ever more detailed images is coming up against physical limits. Some say their efforts might be better spent on making instruments cheaper and more widely available.

"Is it better to have ten machines working at 1-ångström resolution solving hundreds of materials-science problems, or one expensive instrument that may not work — but will push the boundaries?" asks David Muller, a physicist at Cornell University in Ithaca, New York.

Electron microscopes, first developed in the early twentieth century, fire electrons through a material and use the way they scatter to produce images thousands of times finer than can be captured with a light microscope. In 1959, US physicist Richard Feynman set a daunting challenge: to reach a resolution of 0.1 Å, smaller than the radius of an atom. Nearly 60 years later, in 2008, the US$27-million Transmission Electron Aberration-Corrected Microscope (TEAM) project, at Lawrence Berkeley National Laboratory in Berkeley, California, unveiled a microscope with a resolution of 0.5 Å — twice the sensitivity a microscope had achieved four years before, and the size of the smallest chemical bonds in nature. Since then, manufacturers have been pushing to make that technology more affordable, microscopists in Japan and Germany have planned their own sub-ångström instruments and the Berkeley researchers have sought even finer resolution for TEAM.

However, TEAM did not quite fulfil their hopes, despite reaching its intended resolution. The project's first instrument performed as expected, but a second failed to improve on its forebear, despite being more advanced.

The second microscope includes a chromatic-aberration corrector, a complex assembly of magnetic and electric lenses intended to remove blurriness caused by variations in electron energy. Researchers hoped that would help them to achieve a resolution of 0.33 Å, but the instrument turned out to have worse resolution than the first microscope. In 2010, engineers at Corrected Electron Optical Systems (CEOS) in Heidelberg, Germany, the company that built the roughly €1.2-million (US$1.6-million) corrector, began to investigate why.



UTE KAISER/SALVE/CEOS

The German SALVE 2 electron microscope is being redesigned to limit noise.

The answer was slow to come, says Stephan Uhlemann, a CEOS engineer. Eventually, in experiments this year, he found that he could replicate the blurring without the corrector, if he replaced it with empty tubes of materials used in its construction, such as a nickel–iron alloy, copper and stainless steel. This suggested that the noise arises from a physical phenomenon in the materials, rather than from problems with the lenses. The effect is worse at higher temperatures, so Uhlemann realized that it must be caused by thermal vibrations jiggling electrons in the materials and producing magnetic fields that jostle electrons in the microscope's beam[1].

Such noise is thought to be present in all electron microscopes, but the scale of the CEOS ▶