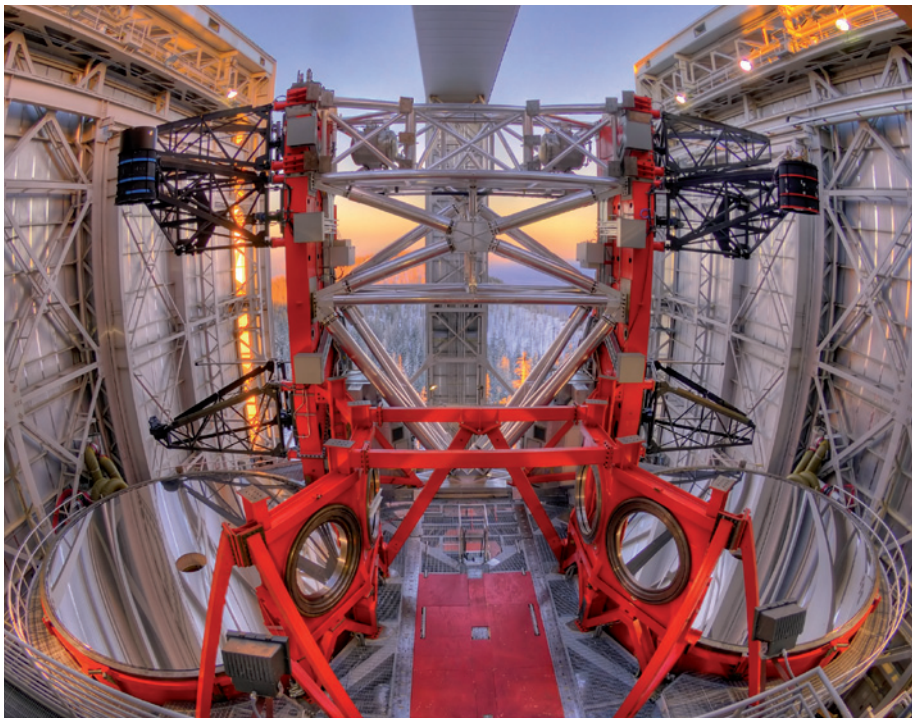
NEWS IN FOCUS

PUBLISHING A boost in access to science texts for the visually impaired **p.134**

MICROSCOPY Imaging the truly tiny may face physical limits **p.135**

FUNDING New rules mean companies must commercialize **p.137**

CLIMATE MODELS Unsettled outlook for near-term forecasting **p.139**



MARC-ANDRE BESEL/WIPHU RUJOPAKARN/LARGE BINOCULAR TELESCOPE CORP.

Operated as if it had a single mirror, the Large Binocular Telescope is the biggest telescope in the world.

ASTRONOMY

Teething troubles at huge telescope

The Large Binocular Telescope gets off to a sluggish start.

BY ALEXANDRA WITZE

In April, something went awry at the astronomical observatory atop Mount Graham, a 3,200-metre peak in Arizona. A valve got stuck open on a line that feeds coolant to a secondary mirror at the Large Binocular Telescope (LBT), a double-barrelled behemoth with two 8.4-metre-wide main mirrors. By the time anyone noticed, one of the telescope's smaller, secondary mirrors was coated in frost. When the ice melted, it ruined this thin mirror, which brings the LBT's double vision into exquisite focus.

By itself, the incident was a minor glitch. Technicians are already installing replacement parts, and expect to have the mirror working again in a few months.

But the US$200-million telescope is facing much bigger problems. Although it saw 'first light' through its left mirror in 2005 and opened its second 'eye' in 2008, the LBT lags behind other, comparably sized telescopes in terms of scientific output. Eight years on, only 60% of the telescope's observing time is given to astronomers, with the rest devoted to getting its instruments to work. Large telescopes often take several years to ramp up their scientific production, but the number of peer-reviewed publications coming from the LBT has barely risen (see 'Double trouble').

NATURE.COM
For more on giant telescopes, see:
go.nature.com/iizkao

Hoping to boost the science output, in February the board that oversees the LBT — an amalgamation of US, Italian and German research interests — brought in Christian Veillet as director. His job is mainly to boost the rate of science discoveries, as he did in his previous position as director of the 3.6-metre Canada–France–Hawaii Telescope on Mauna Kea in Hawaii. And to do it fast.

"You can only wait for Godot for so long," says Charles Woodward, an astrophysicist at the University of Minnesota in Minneapolis and vice-chairman of the LBT board.

In one respect, the LBT's troubles are not unlike those facing any massive, multinational research machine. Construction takes longer than planned, instruments arrive late, accidents happen. But the LBT is the world's only telescope with two giant mirrors separated on a single mount, which complicates everything from design and construction to observations.

"We always talk about whether we can manage it better or whether it can be better funded," says Xiaohui Fan, an astronomer at the University of Arizona in Tucson, who chairs the LBT's scientific and technical committee. "But the bottom line is, with a system as complex as this, it's just difficult."

Getting the LBT right is crucial because it is seen as a technological stepping-stone to the next generation of large telescopes, which will use multiple mirrors working in concert. Planned 30-metre-scale telescopes in Hawaii and Chile will rely on technical systems being tested at the LBT. "I don't refer to the LBT as the last 8-metre telescope, but as an intermediate to the 30-metre ones," says Adriano Fontana of the INAF Astronomical Observatory of Rome, and head of the Italian LBT collaboration.

Supporters of the LBT say that the bugs are being worked out, and that the telescope will soon increase its science. "You're going to see the whole thing really take off," says the University of Arizona's Peter Strittmatter, a leader in the LBT project since its inception.

There were many times when Strittmatter thought that the LBT wouldn't make it. The idea, born in the 1980s as the Italian–US Columbus Project, hit a major snag when Mount ▶

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.

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.

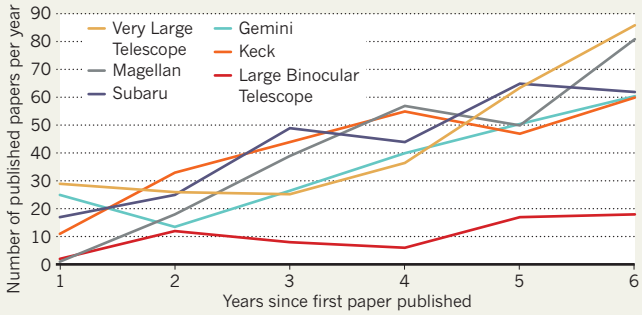
The LBT's resolving power is boosted even further when it is operated as a giant set of binoculars. This mode, which requires a light-combining interferometer, yields a resolution that is equivalent to that of a telescope 22.8 metres wide.

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." ■

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, NATIONAL RESEARCH COUNCIL CANADA

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.

EPUB 3 incorporates the Digital Accessible Information System (DAISY) Consortium

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