NOT YOUR AVERAGE TECHNICIAN

Research relies on unsung heroes working behind the scenes — and some of them have rather unusual jobs.

The glass-blower in the bush

BY MICHAEL HOPKIN

The West Australian town of Jarrahdale (population 1,082) seems an unlikely place to go if you need to get your hands on some highly technical glassware in a hurry. Turn off the main street with its tavern, general store and logging museum, and the road quickly becomes dirt punctuated by sun-faded letter boxes, wonky fences and dusty driveways.

But it is down one of these driveways that you'll find Sarah Davis, who has been running a scientific glass-blowing business since 2010. Working from her garage, she provides local researchers — mostly university chemists in nearby Perth — with handmade flasks, tubes, condensers and bespoke items that don't even have a name.

"If they want a simple condenser, I can whip that up in half an hour," says Davis, referring to the glass tube used to cool hot vapours. "I get people ringing up saying, 'I've broken this,' and generally I get it out for them the next day." For scientists who live in one of the world's remotest cities, this makes Davis an extremely useful person to have around. The alternative is to wait at least six weeks for orders to be made and shipped from Sydney. "Sometimes she comes in after a couple of days and says, 'I've finished,' and I say, 'Already?'" says Grant Cope, who orders from Davis as part of his job as stores officer for the chemistry department at Curtin University in Perth.

Many big research institutions have their own scientific glass-blowers — and that is what Davis was doing until five years ago, working as the in-house glass-blower on the University of Western Australia (UWA) campus in Perth. But in 2010, when she was laid off in a round of university cutbacks, she decided to go it alone, putting her outbuildings into service as her workshops.

"What could be more Australian than working in your garage and seeing a kangaroo come hopping down the drive?" she says. This is, in fact, routine. She also shares the garage with two possums that like to take naps in the rafters when the temperature creeps past 40 °C, as it tends to do in summer. But in the worst of the weather, Davis is less likely to be toiling over hot glass: she is a volunteer firefighter and is regularly called up to deal with bush fires.

"If they want a simple condenser, I can whip that up in half an hour."

The rustic setting belies the fact that Davis's craft is a highly technical practice, bearing very little resemblance to traditional glass-blowing. For a start, there is not much blowing involved.

She works with borosilicate glass, which unlike standard glass, can withstand temperatures of 300 °C, as well as corrosive chemicals and high pressures. She heats and softens the glass over a gas flame, then uses a variety of tools to work it into shape. Perhaps most important is the glass-blowing lathe, with two spindles facing one another, both turning at precisely the same speed. On a day in December, with blowtorch in one hand and safety glasses firmly on (hot borosilicate glass gives off a dangerously intense orange glare, not to mention lots of ultraviolet radiation), she carefully attaches a section of glass to the end of a long tube mounted on the lathe, rounding it off to create a test tube the size of her arm. She uses a similar process to make her flasks and other more specialized glassware.

To finish off, Davis bakes her wares at 560 °C in an annealing oven, smoothing out stress points that could otherwise break the glass. With

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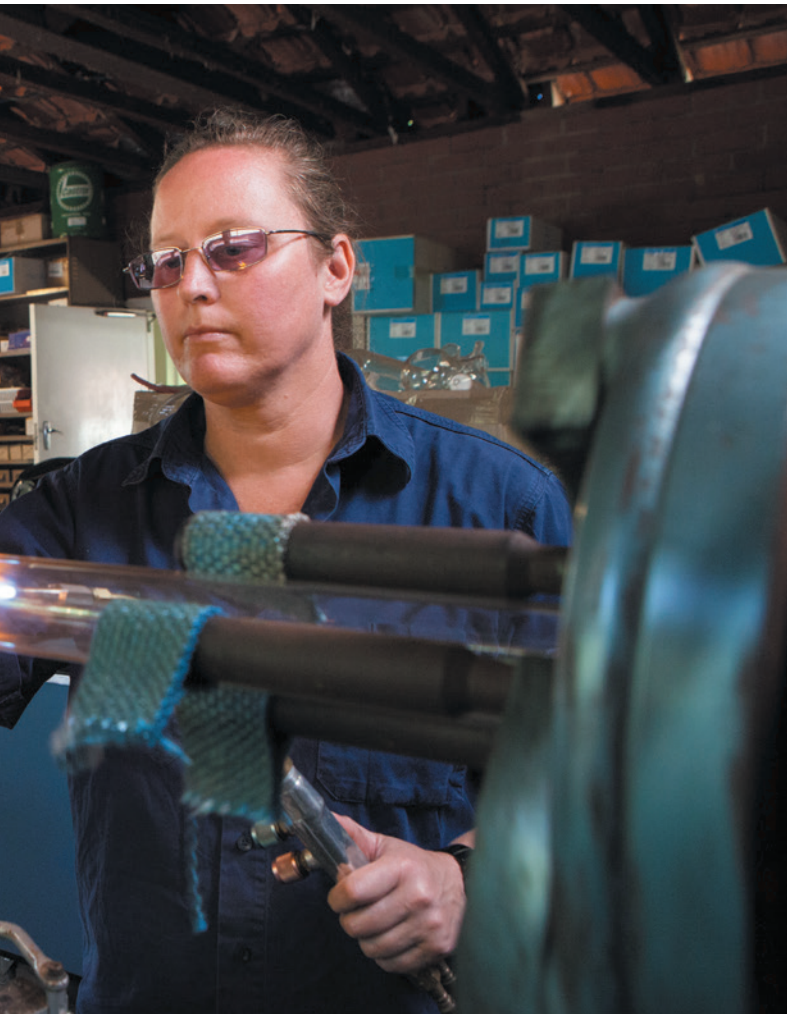

MATT DEVLIN

diamond saws, tube cutters, lathe and oven, Davis estimates that her set-up is probably worth around half a million Australian dollars (US$400,000), and as a result she prefers to keep a low profile — even in a quiet town. "I don't tend to have clients come and see me, I don't have a web page; it's all word of mouth and previous clients."

She has plenty of those, garnered over a 20-year career that started when, as a newly qualified lab technician in Perth, she landed a job that included a glass-blowing traineeship. Davis admits that she had never heard of scientific glass-blowing before that. George Koutsantonis, a chemist at the UWA, describes her components as "vital" for his research on pyrophoric chemicals, which ignite spontaneously if exposed to air. "It's not the sort of thing you can buy off the shelf," he says. Davis's strangest commission so far has been from some intrepid zoologists who asked her to make a glass funnel to hold over a dolphin's blowhole in the hope of catching a sample for analysis. "I never got to see it in action," she says.

These kinds of weird and wonderful commissions are a lot rarer now. Thanks to financial pressures, only a handful of Australian universities still have an on-campus glass-blower — researchers have to order off-the-shelf glassware, and are less likely to request customized parts if they have to pay freelance glass-blowers out of tight budgets.

Even counting those still plying their trade off-campus, there are only 25 scientific glass-blowers left in Australia and New Zealand, says Davis. "There are just two of us in Western Australia that do it — the other guy is getting to retirement age. Hopefully I've got another 25 years left in me, but the chance of training someone is probably not there. It's a dying art." ■

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For videos of the glass-blower and squid collector, see:
go.nature.com/k5oule

The snake milker

BY KELLY RAE CHI

In nearly four decades collecting deadly snake venom, Jim Harrison says, he has been bitten "only eight times". And although he remembers each one vividly, tallying them up on his fingers can be tricky. An Indian cobra (*Naja naja*) mangled his right little finger 12 years ago, leaving it curled and increasingly sore until he had surgery to repair it . A bite from a desert horned viper (*Cerastes cerastes*) dissolved part of the bone in his left middle finger. Two other fingers, although functional, bear the scars of his profession.

All this is par for the course when you nurture lethal snakes for science. Harrison and his wife, Kristen Wiley, run the Kentucky Reptile Zoo (KRZ) in Slade, which Harrison opened in 1990 as a research and education centre. It houses 1,600 snakes from more than 100 species, and it is one of just a handful of places around the world producing snake venom for biomedical research.

Snake venoms contain a complex cocktail of enzymes and other substances that help to immobilize or digest prey, and which are of great interest to scientists. Drugs used to treat hypertension have been modelled on substances in venom that drastically lower the blood pressure of prey, for example. Other proteins in ▶

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venom have been used to identify and study specific signalling molecules in the nervous system. And venoms are needed to develop antivenoms. The KRZ sells about 1,400 grams of venom per year.

Wiley and Harrison "provide a tremendous service, because most of us don't have time to be zookeepers", says Steven Aird at the Okinawa Institute of Science and Technology Graduate University in Japan, who has studied venom. "They really become not just suppliers, but almost collaborators in a sense."

Harrison's fascination with snakes and other reptiles took hold when he caught a garter snake at the age of six. Throughout childhood, he read voraciously on reptiles and amphibians; at 16, he worked on an alligator farm.

Harrison started keeping venomous snakes as a hobby. He learned about venoms and extraction from books, including those written by Sherman Minton, a prominent herpetologist in Indianapolis with whom Harrison eventually became friends. Minton connected Harrison with others interested in venoms, and soon Harrison began to milk king cobras (*Ophiophagus hannah*) for university researchers.

Harrison never believed that he could have a career involving snakes, so he became a police officer instead. But he continued extracting venom in a home laboratory equipped with a centrifuge to purify venom and a lyophilizer for freeze-drying it. At 26, after getting mown down by a stolen car while trying to make an arrest, Harrison's heart stopped. He decided that policing was too dangerous, so he retired early and dedicated his career to snakes. Since then, snake bites have stopped Harrison's heart three more times.

DEADLY DISPLAY

These days, Harrison and Wiley divide the work of running the reptile zoo. Wiley, who did an internship at the KRZ in 1998, manages the zoo's educational programmes, reads the scientific literature and attends conferences to stay current on venoms and work out whether to breed a particular species that year.

The actual milking falls to Harrison, who for liability reasons is the only staff member at the KRZ who does it. In front of a group of goggle-eyed schoolchildren, he demonstrates his technique on a monocled cobra (*Naja kaouthia*), a species that put him in hospital on life support after a bite in 2012. He pulls the 1.2-metre-long, dishwater-grey specimen onto a padded mat and pins its head down with the flat part of a long metal hook.

Harrison grabs the cobra behind its head. As it reveals its fangs — a natural response to threat — Harrison plants them through a sheet of plastic film stretched across a funnel. He uses his thumb and a partially missing forefinger to massage the muscle supporting its venom glands. He will do this on between 600 and 1,000 snakes per week. If everything goes as it should, he says, then milking snakes is methodical — "boring", even. In fact, according to data that a physician friend gathered on him, Harrison's heart beats faster when he is driving to the supermarket than when he is milking.

Stephen Mackessy at the University of Northern Colorado in Greeley says that the KRZ's reputation and knowledge of venoms sets it apart. Some companies provide repackaged venoms, but the provenance of these products, which can matter greatly in research, is uncertain at best, he says. Wiley says that much of this comes down to understanding the animals, which she and Harrison breed themselves, but also obtain from zoos and universities. "We attempt, as much as we can, to provide the locale and the origin information to the researcher," says Wiley.

Harrison says that the benefits for medical researchers — and for society — make him willing to take his daily calculated risks. "I don't plan on slowing down," he says. "I will keep extracting until I die." ■

The squid collector

BY ELIE DOLGIN

DANIEL COJANU PHOTOGRAPHY

On a blustery morning in late October, the wind is blowing up quite a swell — enough to make this reporter heave his breakfast into the briny deep — but Bill Klimm is unperturbed. The 78-year-old fisherman sits calmly in his captain's seat, arms folded, staring straight ahead at the choppy waters off the coast of Martha's Vineyard, Massachusetts, as his boat, the *Gemma*, travels southwest.

Klimm and his co-captain, Dan Sullivan, are heading to Menemsha Bight in search of longfin inshore squid (*Doryteuthis pealeii*). These squid are prized for their giant nerve fibres, which allow biologists to study neurotransmission in exquisite detail. For the past 18 years, Klimm has been collecting these and other saltwater specimens for scientists at the Marine Biological Laboratory (MBL) in Woods Hole, Massachusetts, and elsewhere around the world.

From invertebrates such as sponges, worms, sea stars, urchins and anemones to several fish species and some plants, the creatures have a wide range of habits and dwelling places, but Klimm knows where to find them. And if he does not, he has a network of local fishermen that he can tap for advice.

David Remsen, who manages the Marine Resources Department at the MBL, tells Klimm what to catch on the basis of the orders he receives from scientists. He says that a good specimen collector needs intuition for the local seas and the skills to maintain the boats that navigate them. Klimm has it all. "He knows the waters, he knows the equipment, and he takes ownership of both," says Remsen.

Klimm's knowledge of marine biology runs deep, too. "If you want to understand something about the squid life cycle, you will learn more in ten minutes talking to Bill than you will spending a week talking to so-called experts," says Joseph DeGiorgis, a squid neurobiologist at Providence College in Rhode Island, and an adjunct faculty member at the MBL.

A LIFE AT SEA

H. William Klimm III was born with Cape Cod fishing in his blood. His grandfather was a fisherman and lobsterman who owned a boatyard in Hyannis Harbor, Massachusetts. His father was a commercial fisherman operating out of Falmouth, who collected squid for the MBL as a sideline for 45 years — until the age of 88.

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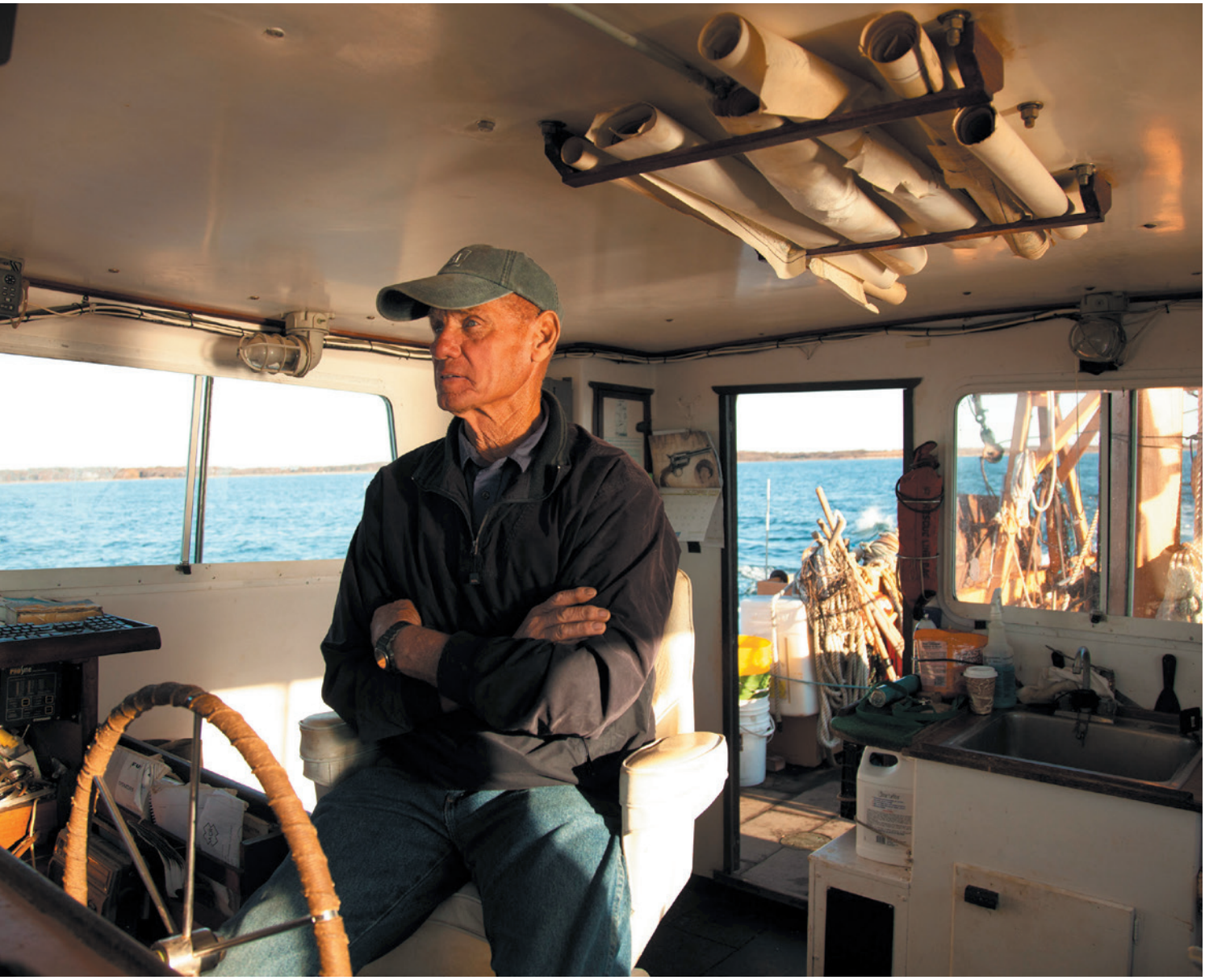

Klimm himself started fishing commercially when he was 23 years old. He caught cod, flounder, swordfish and lobsters for 30 years, until a boat fire cast him ashore in 1990. He fixed boats in Boston for five years before landing the MBL position. At the age of 60, after decades of long trips at sea, Klimm was finally home every night after work. "My wife calls it a toy job," he says.

David Bodznick, who studies the neurobiology of behaviour at Wesleyan University in Middletown, Connecticut, has spent summers at the MBL for more than 30 years, researching electrosensing in skate. "You could really tell when [Klimm] came on board that changes had been made," he says. For example, Klimm installed new reels and altered the nets to minimize damage to the squid and other animals. "The whole operation became more efficient," says Bodznick.

When Klimm and Sullivan reach their destination at Menemsha Bight, they drop a large net into the water, tow it along for 25 minutes, pull in the line and sort through the catch — all without exchanging a word. "We do it so many times that we don't have to talk about it," Klimm remarks afterwards. Large squid (those 25 centimetres long or more) go in one bucket; medium in another. Any small or damaged animals get tossed to the squawking seagulls overhead.

"You will learn more in ten minutes talking to Bill than you will spending a week talking to so-called experts."

A majority of the hundred or so squid collected today will be used to train neurosurgeons attending a week-long teaching course at the MBL. Some will go to the nearby Woods Hole Oceanographic Institution, where scientists are investigating the effects of ocean acidification on squid physiology, and 10–20 go to a visiting researcher at the MBL, Yuyu Song, who is studying how misfolded proteins affect neurotransmission in the squid's giant synapse. "The *Gemma*, her captain and the MBL collecting expeditions are all very dear to me since a big part of my research would have been impossible without them," says Song, a neuroscientist normally based at the Yale School of Medicine in New Haven, Connecticut.

Back in port, Klimm talks about what he does with his free time, gesturing across the dock to his "play boat", the *Sea Dog IV*. That is where he and his wife can be found most weekends in the summer, tooling around Martha's Vineyard and the Nantucket Sound. "For years and years and years I've done that — stepped from one boat to the other," he says. "It's kind of stupid, I suppose, but that's what I do. That's what I do." ■

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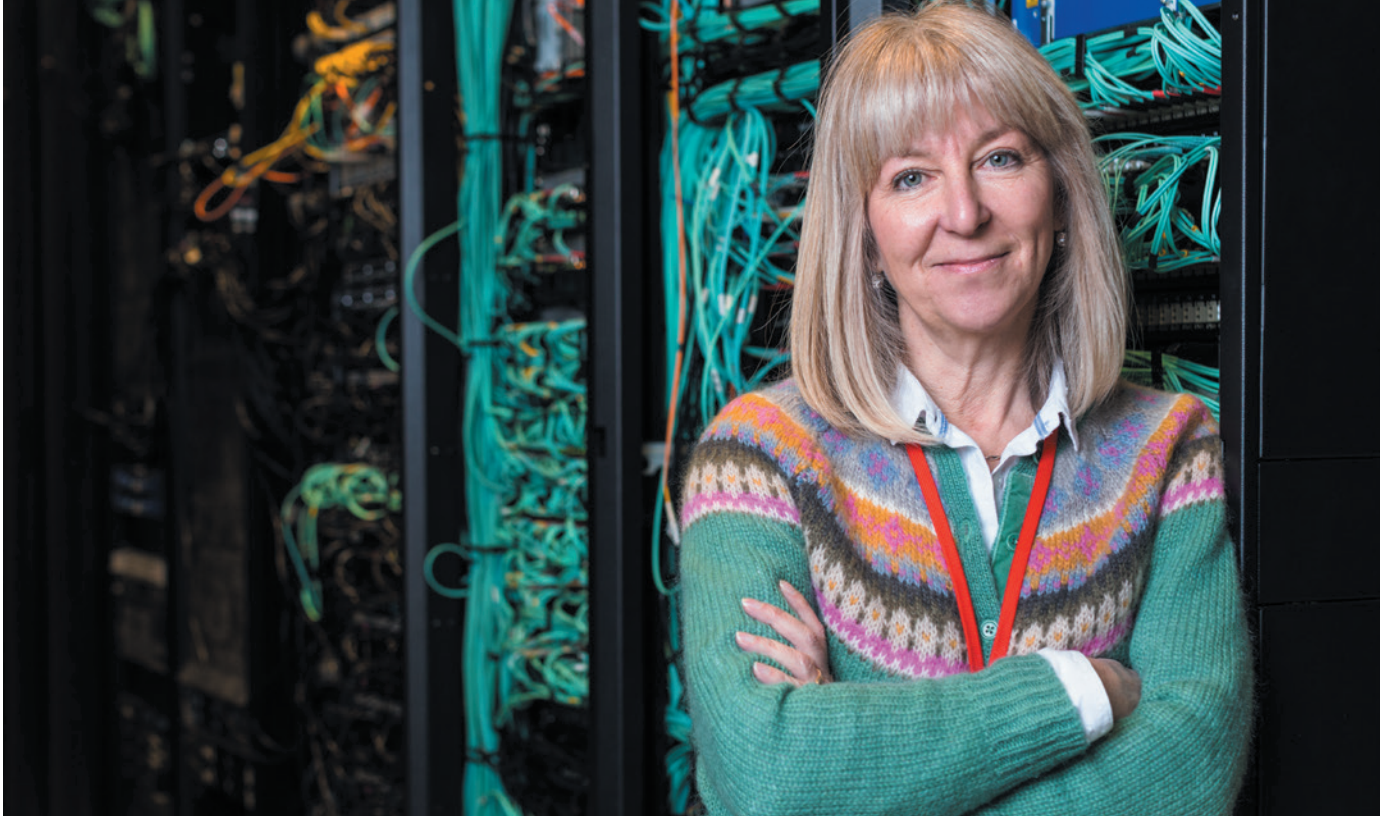

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The data mechanic

BY EWEN CALLAWAY

When Dawn Johnson opens the doors into her workspace, the first thing you notice is the roar. The noise comes from whirring fans, which are required to cool the towering stacks of 16 computer servers that form walls of black and silver. Bundles of multicoloured cables, as thick as small trees, trail upwards like an electrical rainbow.

"If anything goes wrong, I'll be the first port of call," Johnson says, standing beside a toolbox the size of a shopping trolley. "I'll rip 'em to bits and find out."

Computational biologists the world over rely on Johnson to do that, even though most do not know her. That's because Johnson is a computer-hardware engineer at the European Bioinformatics Institute (EBI) in Hinxton, UK. The servers that she keeps running hold one of the world's most extensive collections of molecular databases — from an archive of DNA-sequencing data to the leading repository of protein structures. The machines that she and her colleagues maintain hold a whopping 60,000 terabytes of data, and people at around half a million unique Internet addresses use these data each month. A blip in availability is not an option. "It's imperative that it's there 24/7," says Johnson.

For Johnson, bearing the weight of the bioinformatics world on her shoulders was particularly burdensome late last year. Besides the centre in Hinxton, the EBI data had been spread across another two locations in London, but a contractor change meant that they had to move to a single location in a nearby town — and Johnson had to coordinate it. She and a small team of fellow engineers had to ensure that there was adequate space, power and cabling for the move, which involved roughly 9,500 computers connected by 850 power cables and 3,400 network cables. "The complexity of that is hair-raising," she says, with a relaxed shrug. Still, the move went "incredibly well", says Steven Newhouse, head of technical services at the EBI — with Johnson playing a crucial part in coordinating the logistics. The success meant, of course, that the researchers who rely on the EBI never so much as noticed. "Very few scientists appreciate the size of the computing infrastructure that they depend on nowadays," says Newhouse.

When she is not at her desk dealing with the ins and outs of such projects, Johnson spends her time in the Hinxton data centre, which the EBI shares with the neighbouring Wellcome Trust Sanger Institute. Johnson and her colleagues install, maintain and repair the machines that feed the centres' seemingly insatiable hunger for data storage — which is projected to reach 2 exabytes (2×10^{18} bytes, or 2 million terabytes) by 2016. There are occasional emergencies. Several years ago, a cooling-system failure forced Johnson to rush into work on a Saturday to keep the servers from overheating. She spent a stressful weekend getting the centre back online, so as to minimize the disruption to researchers.

Computers were not the first machines that Johnson learned to rip apart. "My father's a mechanic and an engineer, and so I was always in the garage with him fixing and tinkering with cars, and that was really what I wanted to do," Johnson says. "But it was 1979 when I left school. They just didn't hire lady mechanics." She went into secretarial work at a firm in Cambridge, UK, that sold and serviced computers for businesses. After a few years, her boss asked her what she wanted to try next, and she opted to work as a computer engineer. She was the only woman on the team.

"When I was in the field, I was a novelty, I guess. But it was quite good. All the guys wanted to help me get on and succeed, and all the women saw me as sort of a stand for women's lib and rights and stuff and were really on my side as well," she says. Even now, "I don't meet many other women in my career, which is a shame".

Johnson's move into the bioinformatics world happened by chance. In the 1990s, she was doing contract work on mainframe computers at the Sanger Institute, which had a leading role in the Human Genome Project. She remembers a celebration to mark the completion of a draft human-genome sequence. "I saw that happening and thought I would like to be a part of that," says Johnson. A hardware-engineer job opened up five years ago, and she jumped at the opportunity. "It's great when I drive into work and hear people on the radio talking about the latest studies," she says. "I'm very proud and lucky to be part of it." ▪ SEE EDITORIAL P.527

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