New Scientist

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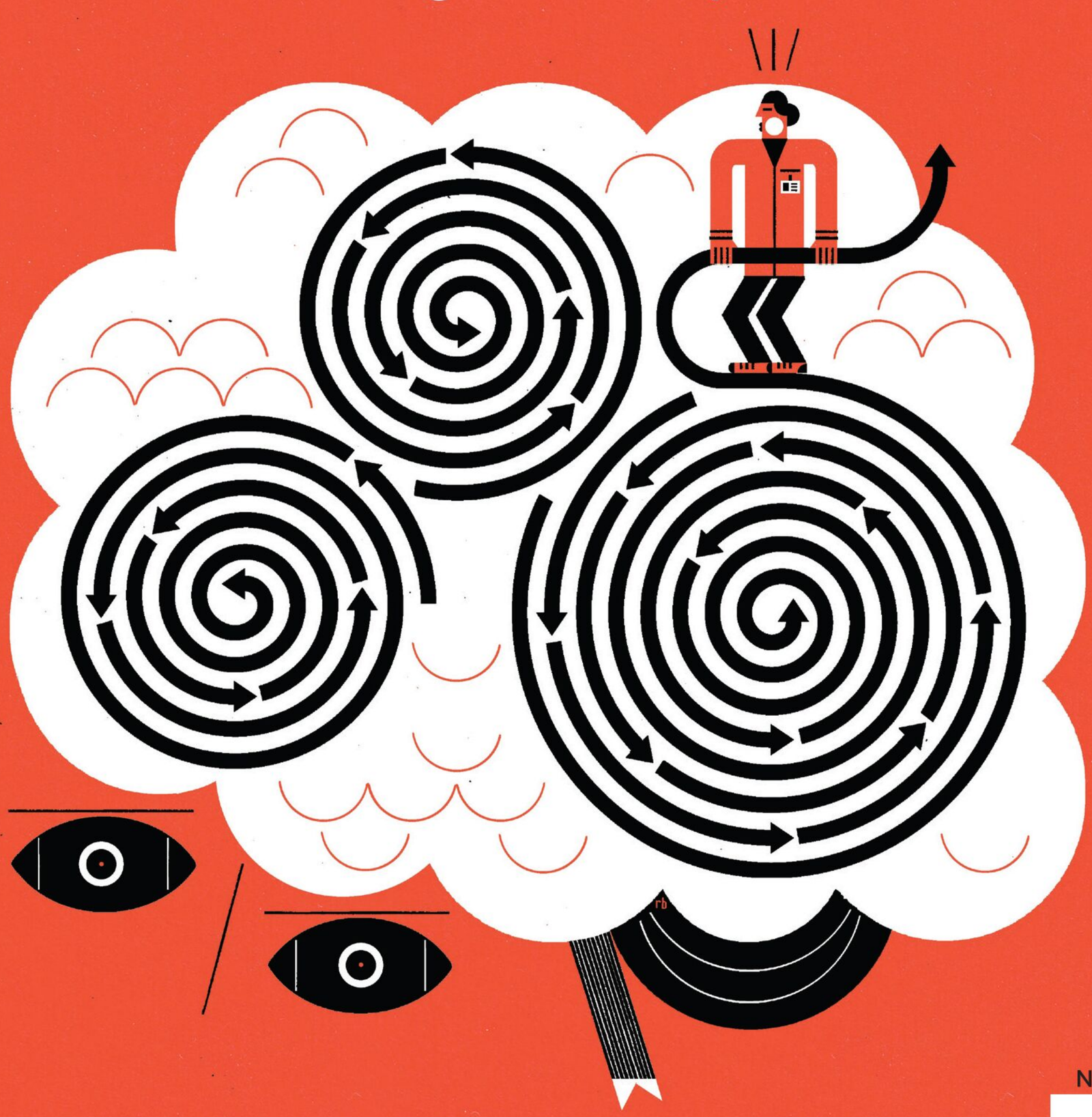

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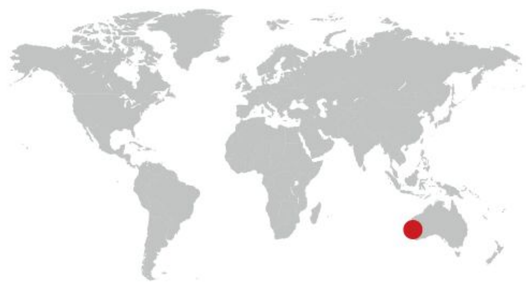
PLUS ASTEROID TAKES EARTH BY SURPRISE / THE MATHS OF POURING WINE / **SMART SPEAKER DETECTIVES** / **EXPERIMENTAL MPOX VACCINE** / WHAT IS IT LIKE TO BE A DOG?

Field notes Woodside Energy's Karda facility, Perth, Australia

Are humanoid robots the future of space exploration?

James Woodford pulls on a control headset and takes NASA's impressive Valkyrie robot for a spin to find out



I AM standing before one of the most advanced robots in the world and am awestruck by its humanoid form. Part Transformer, part *Star Wars* stormtrooper and with hands that look like they can crush beer cans, at 1.8 metres tall and weighing 120 kilograms, NASA's Valkyrie robot is an intimidating figure.

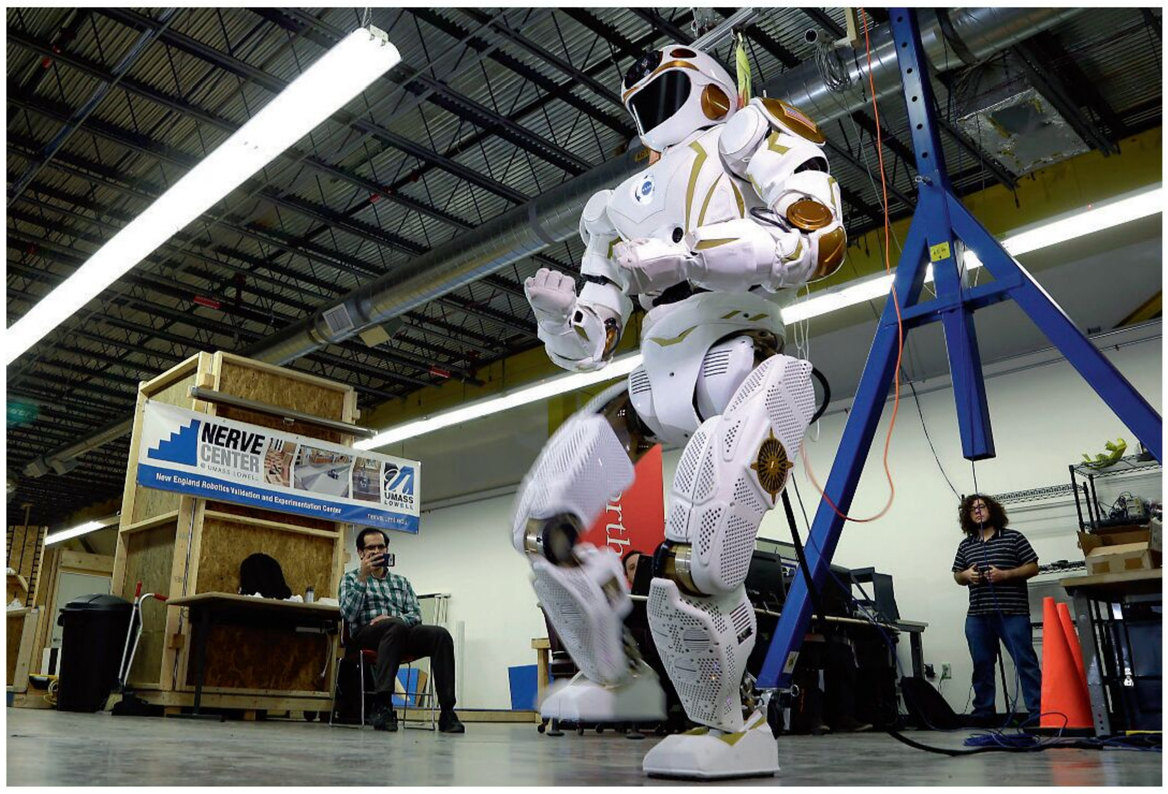
But it is the face that most transfixes me. Where the eyes, mouth and nose should be is a cavity filled with whirring and flashing sensors, including lidar detectors that give the robot both a three-dimensional view of the world and an impenetrable, no-nonsense expression.

That is apt, because while current fashionable advances in AI, like ChatGPT, aim to automate office work and creativity, the people behind Valkyrie are more focused on jobs that are too dangerous for humans – both on Earth and, one day, in space.

NASA has five Valkyrie robots around the world, but the one I am visiting today is at the Karda facility in Perth, Western Australia, a lab owned by Woodside Energy, an oil and gas company. With its large-scale offshore infrastructure, the global energy giant makes a good partner for exploring how humanoid robots could be sent into inhospitable environments to complete dangerous tasks.

Valkyrie's two arms and legs and complex manipulation are particularly impressive, says Woodside's Gabrielle Pennock, who, like the rest of the team, shortens the robot's name to Val and calls it "she".

"That is unique with Val," says Pennock, "And I think she's probably the most complex – the digital integration of her systems, the sensor technology, that level of complexity. I don't think we really see that in any of our other robotic platforms."



AP PHOTO/ELISE AMENDOLA/ALAMY

Above: NASA's humanoid robot, ready to be inhabited via virtual reality; below: James Woodford takes a selfie with Valkyrie

Valkyrie is being put through its paces at the Karda facility so researchers can work out what it would take to get a humanoid robot onto offshore facilities or into space.

At first, I just watch as it is controlled via virtual reality, walking, spinning and bending steadily. Even so, I note the straps dangling from an overhead gantry. At a conservative cost of over $2 million, NASA doesn't want Valkyrie falling over.

"It's possible you could have an artificial human, like Data from *Star Trek*, but it's a long way off"

JAMES WOODFORD

Then, it is my turn. One of the team calls me over and fits me with a VR headset. I open my eyes and the room before me has been transformed into a digital rendering of the lab. In front of me, I can see a digital Valkyrie. On the floor, there is a digital hexagon and I am instructed to walk towards it. As soon as I am on the hexagon, my body looks and feels like it has merged into the robot's. Its arms become my arms and all of me is subsumed within it. In each of my hands I am holding a controller from which, in the digital-scape, two laser-like beams emerge pointing to the ceiling.

I am instructed to say the command to release Valkyrie into my control. But, with its name origins in Norse mythology, I misunderstand when Woodside robotics engineer Andrew Sherry instructs me to say "Thor everything". I am baffled until he realises my confusion. "T-H-A-W, thaw everything," he says, again.

Uttering the words, it is as if I can feel the robot wake up – a sensation the researchers describe as "riding the skin". I tentatively begin to move my limbs and can see the movement reflected in the virtual reality environment. Sherry confirms that the robot, standing a few metres in front of me, is following suit in the physical world. I move my head, crouch or bend and so does Valkyrie.

After a few minutes, I begin to feel more confident and dip my head in a full bow but, in my exuberance, I have bent too far for the gantry straps and Sherry tells me to straighten up. He asks me to say "freeze everything". As soon as I repeat the command I can sense the decoupling of Valkyrie from me and I step backwards, feeling myself emerge from its body. With that, the session is over and the robot is moved by trolley to a secure storage room.

So, have I just had a preview of what it will be like to explore space in a robot body? Not exactly, says Shaun Azimi at NASA's Johnson Space Center in Houston, Texas. He says none of the five Valkyries will ever go to space, but future robots that incorporate their technology will. In fact, while my time controlling Valkyrie felt high-tech, these versions are now over a decade old and may soon be retired, says Azimi.

Getting legless

One issue is that Valkyrie was built to walk in the gravity of Earth, but a zero-gravity version probably wouldn't need legs. Instead, the focus of the next generation will be on safety and reliability because the margin for error in space or harsh environments on Earth is small. Those who deploy humanoid robots need to be certain, for example, that they won't need a gantry to stop the robots falling over.

"The physical capability of Valkyrie is really strong, but where everybody's trying to catch up right now, including current industry, where the billions of dollars are

pouring in, is the intelligence and the adaptability, the resilience, the safety and predictability right to where we can have a robot that can always take the correct action," says Azimi.

While NASA built Valkyrie in-house, he says its successor will probably be the result of a challenge set by NASA for others. Then universities and commercial companies will innovate.

For example, he says, knowledge gained from the Valkyrie programme combined with advances from other research teams around the world will be directed to solving problems like gathering material from the surface of the moon's south pole.

As my time with Valkyrie begins to wrap up, I have a sense that I have witnessed a technology that is the beginning of a future that hasn't quite arrived. My mind is racing at the potential for a science fiction future of humanoid robots. Imagine combining large language models like ChatGPT with Valkyrie's manual dexterity, along with recent advances such as a robot overlaid with living human skin. Can a human-like robot be that far away?

"I think it's possible that you could have an artificial human, something like Commander Data from *Star Trek*, but I think it's a long way off," says Azimi. He says it is easier to envisage something like Hal from *2001: A Space Odyssey*, a computer voice embedded into a spaceship's systems, than a fully realised android.

In the meantime, Valkyrie and her successors have important work to do in Australia grappling with a space-like environment, says Azimi. "You can see sort of natural parallels to a future lunar or Mars base and that gives us the kind of proving ground in a realistic environment," he says. ▮

Infectious diseases

Experimental mRNA vaccine could help fight mpox

Carissa Wong

AN mRNA vaccine for mpox developed by biotech company Moderna has shown promise in monkeys, raising hopes that it could help to tackle the ongoing outbreak in West and Central Africa. Other vaccines for the virus exist, but a new vaccine based on mRNA technology would have advantages.

Nigeria, which has had 35 confirmed cases of mpox so far this year, has become the first country in Africa to gain mpox vaccines, with the arrival of 10,000 doses of the JYNNEOS vaccine. This shot contains a weakened form of the related vaccinia virus and helped high-income countries, such as the UK and US, curb cases during a global mpox outbreak in 2022.

mRNA vaccines, which began being used widely during the covid-19 pandemic, contain instructions for cells to produce viral proteins, so the immune system can learn to recognise them. Unlike other types of vaccine, they can be developed and manufactured quickly once the genome of a virus has been sequenced.

Galit Alter at Moderna in Massachusetts and her colleagues created a vaccine containing RNA sequences encoding proteins present in a family of viruses that includes mpox. They gave six macaques the mRNA vaccine and six a so-called MVA vaccine similar to JYNNEOS, while six macaques were unvaccinated. All the vaccinated animals survived a usually lethal dose of the virus, while five out of six unvaccinated animals died.

On average, animals that received the mRNA vaccine also had far fewer skin lesions than those that received the MVA vaccine or were unvaccinated (*Cell*, doi.org/nf8n).

The results stand a good chance of being replicated in humans, says Paul Ananth Tambyah at the National University of Singapore. A human trial has begun, with results expected next year.

Although the mRNA approach shows promise, the JYNNEOS vaccine works well against cases caused by the clade II variant that circulated in 2022. The current outbreak involves a different variant – clade Ib – but it is close enough to the earlier variant that the JYNNEOS vaccine should still work, says Jean Claude Udahemuka at the University of Rwanda.

"Countries in the West have vaccines in stock, and they should provide these to African countries"

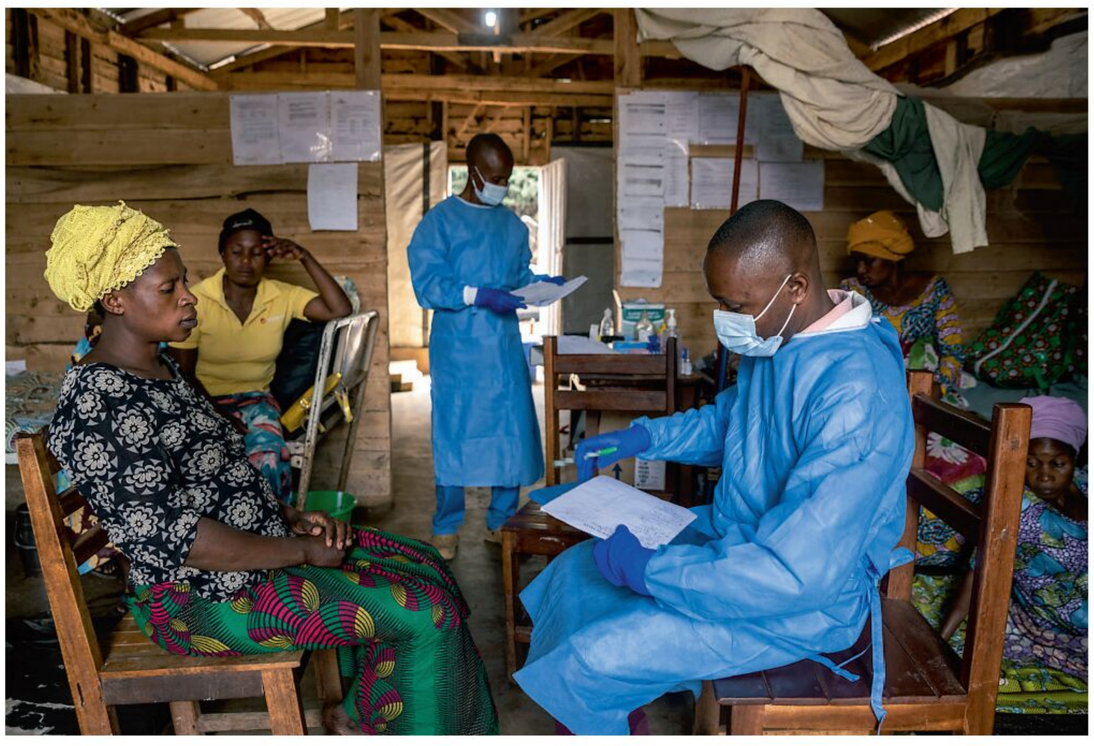
So are mRNA vaccines needed? Some researchers fear that the mpox virus, formerly known as monkeypox, could mutate, rendering existing vaccines less effective. In that case, mRNA vaccines will be needed, says Ranjit Sah at St. Elizabeth's Medical Centre in Boston.

Investing in mRNA vaccines against mpox would also help to boost vaccine supplies fast, says Ananth Tambyah.

However, mRNA vaccines must be kept frozen, making it hard for them to be used where cold storage and distribution infrastructure is limited. This means they are likely to benefit high-income countries rather than the countries worst affected, which will have to rely on access to existing vaccines.

"Some countries in the West have vaccines in stock, and they should provide these to African countries and other countries that are at risk, because people have to look at this as one boat that we are all in, and if it sinks, everyone will sink," says Udahemuka. ▮

An mpox treatment discussion in Kavumu hospital in the DRC



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