

# nature



## SCHISTOSOME GENOMICS

Whole-genome sequences of neglected pathogens *S. mansoni* and *S. japonicum*

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Passage to India

**THE APOLLO LEGACY**  
Can human spaceflight  
inspire again?

**GLACIAL CLIMATES**  
Variations on a theme

**PRIMATE ARCHAEOLOGY**  
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## Net gains

The Moon landing was not the only world-changing event in the summer of '69.

An international, cross-disciplinary survey by *Nature* on page 314 reveals just how powerfully the Apollo programme motivated young people to become scientists 40 years ago — a fact today's space scientists ignore at their peril (see pages 325 and 327).

Yet other events in the summer of 1969 would lead to a far deeper empowerment of scientists — and, indeed, many others. Even as *Apollo 11* was putting the first humans on the Moon, Ken Thompson at AT&T's Bell Labs was working to get *Space Travel*, a computer game he'd written for a mainframe computer, to run on a new, smaller machine. That effort led him to join with Dennis Ritchie and others to write a new computer operating system, which they named Unix. The rest is history: Unix triggered a still-ongoing boom in scientific computing, set the pattern for the open-source software movement and, along with its descendants, laid the foundations for the Internet.

Thompson wrote the first version of Unix in four weeks. It was initially for internal use only. But when the code was licensed for use outside of Bell Labs in the 1970s, it was quickly adopted by scientists worldwide. They embraced Unix for its power, simplicity and its ability to let machines interact with multiple users at once. No longer did they have to run stacks of punch cards through huge mainframes and wait hours or days to get their results on reams of fan-fold paper. Now they could just type and the machine would respond.

Timing was also key to the success of Unix. It appeared just as the mainframes were being challenged by a new generation of smaller, cheaper, interactive 'minicomputers' suited to individual departments and research groups. The new operating system could easily be adapted to run on any of these machines. Perhaps most importantly, researchers loved the fact that Unix was written in C, a new

programming language that made it easy for them to write and share applications — and even to refine the operating system itself. They lost no time in doing so, in a flurry of innovation that presaged the open-source movement.

In the 1980s and 1990s, that openness fell victim to shortsighted commercial interests, when infighting among vendors of proprietary Unix machines produced incompatible versions of the operating system. This allowed Unix to be blindsided by an upstart called Microsoft, which quickly acquired a dominant position in the burgeoning microcomputer market with its own operating systems.

Nonetheless, Unix's future had been guaranteed in the late 1970s by the US Defense Advanced Research Projects Agency, which chose a version of the operating system developed at the University of California, Berkeley, as the basis for a number of its projects. And by funding Berkeley to include an implementation of the then-new TCP/IP protocols that underlay the Internet, the agency essentially made Unix Internet-ready. At the same time, the open-source movement became central to the Internet's development, with the Unix clone Linux, written in 1991 by Finnish student Linus Torvalds, coming to dominate.

Today, Linux or some other flavour of Unix runs most of the servers, routers and other elements of Internet infrastructure, as well as most mobile phones and GPS devices. And last week Google announced that it will use Linux as the base for its planned open-source 'Chrome' operating system.

The difference between the development of Unix and the top-down, colossal science and engineering project that was Apollo could hardly have been greater. Yet both are examples of the power of joint efforts. Unix, like Apollo, has earned its place in history. ■

## Nowhere to hide

The G8 has laid down a marker by promising to restrict the rise of global temperatures.

At their annual summit last week, leaders of the Group of Eight (G8) industrialized nations pledged to try to keep the planet from warming by more than 2°C above pre-industrial temperatures — an ambitious goal that has also been adopted by other countries including China, Brazil and South Africa (see page 313).

The absence of any commitment to reduce emissions before 2050 is less promising but — assuming that the G8 can be taken at its word — it shouldn't be a fatal defect. If warming is to stay within those two degrees, the global 'decarbonization' project must be tackled without delay anyway.

This will not be cheap or easy. When the two-degree ceiling is translated into a per-capita emissions limit, it is clear that the industrialized world, and particularly the United States, has already generated more than its fair share of greenhouse gases. By continuing to emit at

these levels, these countries are taking up emissions allocations that developing nations need to use to grow. This creates a 'carbon debt' that must be repaid with technology and money, both of which will be necessary if poorer countries are to leapfrog the dirty development pioneered by the industrialized nations.

The only viable strategy is therefore a massive research-and-development drive for energy efficiency in the near term, coupled with a long-term move towards virtually carbon-free energy production by 2040 at the latest. Cap-and-trade regulations can play a part, but they are only the beginning. Smart urban planning, clean transport systems and lifestyle changes will also be important.

History teaches that great advances — such as agriculture, sanitation and mechanization — arrive in bursts. There is hope that, despite an agonizingly slow start, the energy revolution of the twenty-first century can still gain the required momentum. Avoiding long-term investment in high-emission technology will be more important than throwing around potentially unachievable emission-reduction numbers.

The G8 has set a point of reference for the UN climate-change conference in December. Global leaders must now put together a framework that allows — and requires — all nations to do their part. ■