rus has the same basic proteins as its better known relatives, half of the amino-acid building blocks those proteins are made from are different. The new isolate may also encode a few novel gene products whose function is, as yet, unknown. In terms of genetic sequence, therefore, there are considerable differences between it and previously known coronaviruses.

How the new coronavirus came to be so different from its relatives—whether through mutation or through having picked up genetic bits and pieces from other organisms—is still a mystery. And just as uncertain, for the moment, is how these genetic features relate to the virus's ability to spread and to cause disease. In the meantime, having the sequence to hand may help to improve the sensitivity of diagnostic tests now in development, as well as providing targets for researchers to test existing pharmaceutical molecules as a short-cut to finding a drug to treat SARS. In the longer term, the sequence will aid in the search for new vaccines and medicines. As Klaus Stohr, a virologist who works at the World Health Organisation, puts it, the genome sequence opens an important chapter, but the full story of SARS has yet to unfold. ■

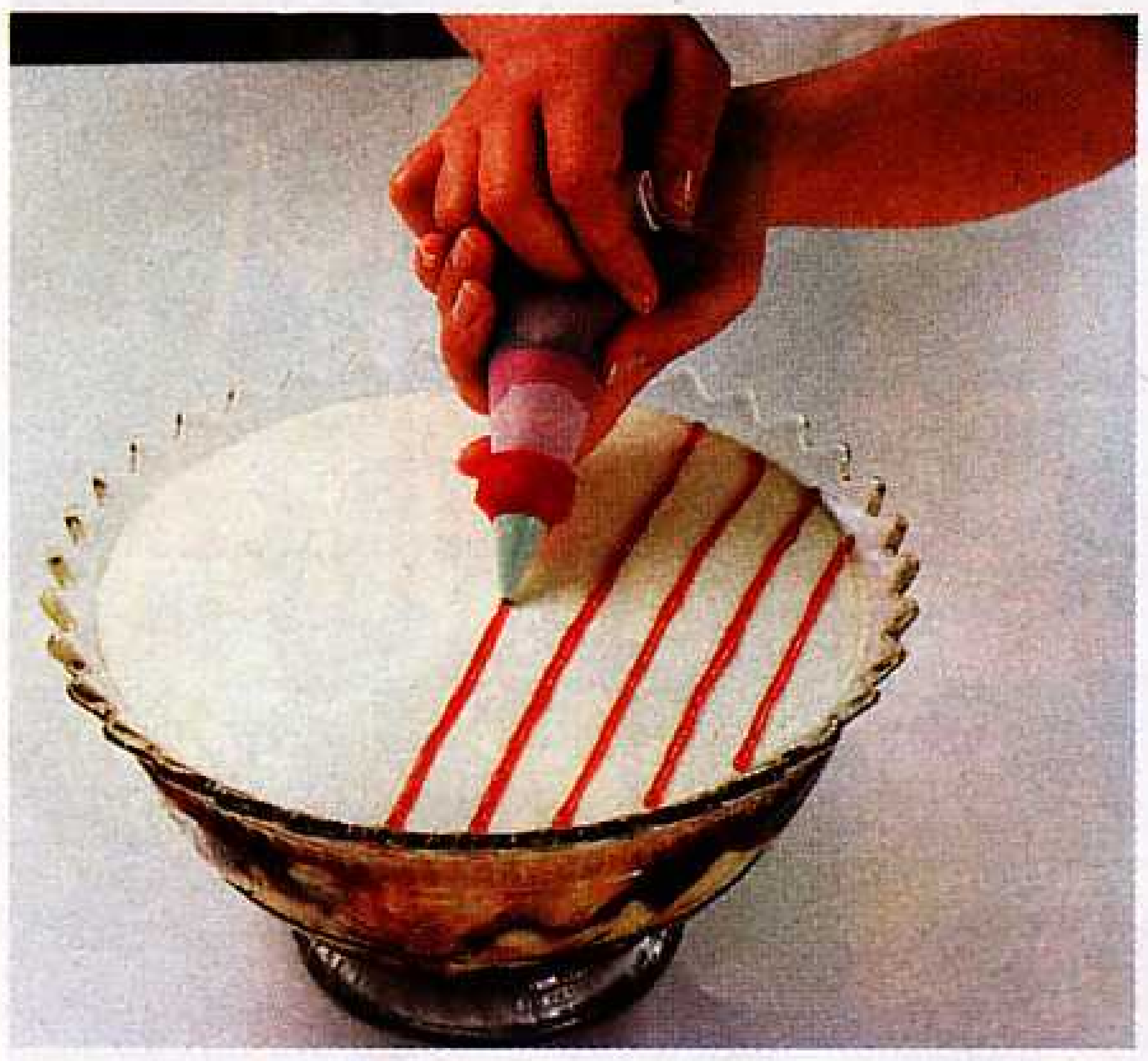
Labs on chips

Lost and found

An old technique may make building chip-sized chemical laboratories easier

LOST-WAX casting is an ancient trick. A sculptor makes a model in wax of the statue he proposes to cast in, say, bronze. He slathers the wax with plaster, lets the plaster dry, heats the whole thing up to melt the wax, and then drains the wax out leaving a statue-shaped hole into which the liquid bronze can be poured.

Jennifer Lewis of the University of Illinois, Urbana-Champaign, and her colleagues are using a similar trick to solve a problem not in sculpture, but in plumbing. The plumbing concerned, though, is rather smaller than that which services the average house. Dr Lewis is trying to plumb so-called labs on chips, in which minute quantities of liquids have to be brought together for such purposes as instant chemical analysis. At the moment, such "microfluidic" devices are restricted to two dimensions. Lost-wax plumbing allows them to be built in three, which can reduce their size, and improve their ability to mix different liquids.



Here's one I prepared earlier

The process, described in this month's *Nature Materials*, starts with a tool that works like a tiny cake icer and which is loaded with a waxy "ink". The icer is mounted above a movable platform, on which the microfluidic device is to be formed. The platform's movements under the icer's nozzle are computer-controlled and, as it moves, a thin cylinder of the ink is extruded from the nozzle and deposited on to the platform. The result is a network of waxy trails with diameters as little as ten millionths of a metre.

The platform is then lowered slightly, and the process repeated, building up a three-dimensional scaffold. Once the scaffold is complete, it is covered in epoxy resin and, when that has hardened, the whole structure is warmed to melt the ink, which is then poured out, creating a 3-D pipe network.

In principle, that could be enough to create the desired plumbing, but in practice Dr Lewis has found that another stage is needed. Building the piping scaffold in layers means that each point where two ink-traces meet is, in effect, a joint in the plumbing. Rarely are all those joints needed. On the other hand, it is hard to devise a geometrical arrangement that avoids them, given that the pipework in each layer is being laid down as a continuous cylinder and that the lost-wax method works best if only one connected space is filled with wax. So, to get the plumbing right, she fills the pipes with a second substance—a liquid resin that hardens when exposed to ultraviolet light. Unneeded parts of the network can thus be sealed off at the flick of a laser, and the remaining liquid resin poured out again.

Building microfluidic chips upwards rather than outwards obviously saves space. Their size (or, rather, lack of it) means that chips made this way could form the heart of sensors inserted into people to monitor disease progression. More subtly, the constant twisting and turning of the piping means that liquids moving through such a chip get thoroughly mixed. Since one of the problems with labs on chips is that surface-tension effects in such confined spaces tend to slow mixing down, that is a significant bonus regardless of application. ■

Gamma-ray bursts

A mystery no longer

CAMBRIDGE, MASSACHUSETTS

Gamma-ray bursts are stellar explosions

ON MARCH 29th, a satellite called the High Energy Transient Explorer (HETE) detected a dazzling burst of gamma rays from space. Of all the bursts whose distances from Earth have been measured, this was closest. That meant the burst could be studied in unprecedented detail.

Gamma-ray bursts have puzzled astronomers since their discovery in the 1960s. They are the biggest explosions known, and happen in distant galaxies. Thanks to HETE's watchfulness, they are a mystery no longer. As soon as the burst was detected, telescopes around the world were turned towards it, in the hope of unravelling its secrets. In the end, the unravelling was achieved by a group co-ordinated by Krzysztof Stanek of the Harvard-Smithsonian Centre for Astrophysics, in Cambridge, Massachusetts.

The group's aim was to obtain an optical spectrum. Analysing the spectral details of a heavenly body can reveal its composition. Unfortunately, getting the spectrum of a gamma-ray burst is hard, because the optical afterglow fades rapidly. And in those few cases when astronomers have leapt into action quickly enough, the spectra were like plain canvases, with no discernible colour enhancements.

Astronomers held out the hope that the spectrum of a brighter burst would be more revealing. It was. What the group saw was the light emitted by iron and silicon when they are heated to extreme temperatures and propelled at great speeds. This links gamma-ray bursts to a more familiar type of explosion, the hypernova.

A hypernova, as the name suggests, is a super-supernova. It is the result of a star about 30 times more massive than the sun collapsing in on itself, and then exploding. The nuclear reactions that take place as a result produce heavy elements such as silicon and iron in large quantities.

Astronomers have suspected a link between gamma-ray bursts and hypernovae for a while, but until now have not been able to prove one. The new discovery does so. Models of the process suggest that the gamma rays that a hypernova emits would be focused into narrow beams. Only if one of these beams happens to point towards Earth is the observed result a gamma-ray burst. Otherwise, only the visible explosion is seen. Before, there had been only circumstantial evidence that hypernovae cause gamma-ray bursts. Now, that evidence is iron- and, er, silicon-clad. ■