Cyber-security

Crash testing

Recent attacks on the internet could be a prelude to far worse ones

"SOMEONE is learning how to take down the internet." This was the headline of a blog post Bruce Schneier, a noted cyber-security expert, wrote in mid-September. It looked prescient when, on October 21st, Dynamic Network Services (Dyn), a firm that is part of the internet-address system, was disrupted by what is called a "distributed denial of service" (DDoS) attack. (Essentially, a DDoS floods servers with requests until they can no longer cope.) For hours, hundreds of sites were hard to reach, including those of Netflix, PayPal and Twitter.

The attack on Dyn was only the latest in a string of similar ones. On September 20th, for instance, the victim was Brian Krebs, an American journalist who often reports on internet criminals. The server where he hosts his blog became the target of one of the largest DDoS attacks on record (it was bombarded with data equivalent to almost half a percent of the internet's entire capacity). Most of the other recent digital assaults, however, were more discerning—as if the attacker "were looking for the exact point of failure," Mr Schneier wrote in his blog post.

It is not clear who the attackers are, although security analysts suspect they are either Chinese or Russian. At any rate, all the attacks used the same software, called Mirai, whose source code has been leaked online. It mainly scours the internet for devices such as webcams, digital video recorders and home routers in which easy-to-guess factory-set passwords ("12345" or even "password") have not been changed. The program then turns those it can gain access to into a huge army of digital slaves that can be directed to inundate targets with requests. Shortly after the attack on Dyn, XiongMai Technologies, one of the biggest makers of webcam components, announced it would recall some products and provide owners of others with software updates to improve security.

This may help, but not much can be done in the short run other than to appeal to owners of internet-connected devices to change their passwords. To fix the problem properly, Mr Krebs argued in a blog post, the makers of such devices, collectively called the "internet of things" (IoT), would all have to recall vulnerable systems and change their careless approach to security. Since this is unlikely to happen, regulators may have to step in. Indeed, the European Commission is already working on legislation to require better security in IoT devices. Lawsuits against negligent device-makers would also help.

As for the goal of the attacks, it could be something other than to take down the internet. Many fret that such virtual weapons could be turned to full blast just before or on November 8th, when America will elect a new president and House of Representatives, and also many senators and state governors. A DDoS could not paralyse voting machines, for hardly any of them are connected to the internet. But striking all kinds of websites, from those of online media to the government's, could spread chaos—and the feeling that the elections are somehow being "rigged". ■

Schiaparelli's end

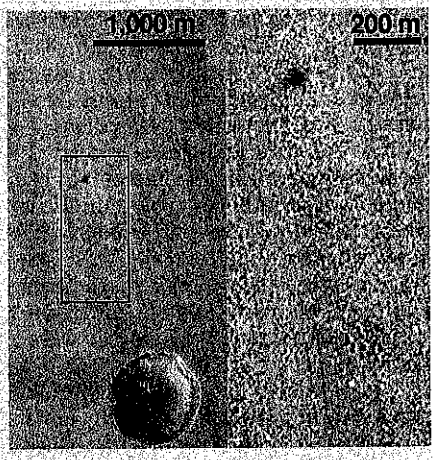
Flash, bang, wallop, what a picture

A Mars probe's impact crater is discovered

THE dark splodge near the top of the enlarged part of this picture of the Martian surface, taken on October 20th by *Mars Reconnaissance Orbiter*, an American satellite circling the planet, is thought to be the crash site of *Schiaparelli*, a European and Russian probe that arrived there on October 19th, but with which contact was lost during its descent to the planet's surface. The white speck near the bottom is likewise believed to be the probe's jettisoned parachute.

What went wrong is not clear. Communication with the craft ended 50 seconds before its scheduled touch down. Data transmitted in advance of this loss of contact suggest *Schiaparelli* jettisoned both its parachute and its heat shield early, and fired its retro-rockets for only three to five seconds, rather than the 30 seconds that had been planned. It probably hit the ground at more than 300kph (200mph).

Since *Schiaparelli*'s main job was to test the landing gear for a future rover its



failure is not, as it were, a complete write-off. It has at least shown that work needs to be done before a more expensive piece of equipment is hazarded in this way. Meanwhile, its companion on its journey to Mars, a satellite called the *Trace Gas Orbiter*, seems to be working well.

Dealing with autism

First, treat the parents

Turning mothers and fathers into therapists helps autistic children

AUTISM may bring a lifetime of disability and difficulty to the most severely afflicted. As children, they often struggle to communicate, are anxious in situations unproblematic for anyone else and may behave in repetitive ways that disturb others. As adults, they may be shunned—or even ostracised.

Medical science has little to offer. Drugs have limited effects, and although there have been claims for many years that therapies aimed at training a child directly to behave in desirable ways (known as behavioural intervention) can work, the evidence they actually do so is poor. All this, observes Tony Charman, a clinical psychologist at King's College, London, leaves parents of autistic children vulnerable to false promises. Only this month, for example, a four-year-old boy had to be taken to hospital in Britain after being subjected to a bizarre array of treatments described as "holistic medicine".

Incidences of such quackery should be reduced by a study published in this week's *Lancet* by Dr Charman and his colleagues. The "Pre-school Autism Communication Trial" (PACT) attempted to answer, once and for all, the question of whether behavioural intervention in autism works—and, in particular, whether it does so in the most severe cases. It is the largest such trial yet attempted, and the one with the longest period of follow up. Its answer was: yes, it does. The PACT team found not only that, if carried out correctly, behavioural intervention has an immediate effect, but also that this effect persists. Even six years after therapy, autistic children could communicate better and had a lower level of repetitive behaviour than ▸▸

did a control group of their peers.

The crux of PACT was the nature of the intervention employed. This was designed to train not the children but their parents. The idea was to alter parental behaviour in ways that would then go on to encourage desirable changes in offspring. Specifically, PACT's intervention trained parents how to communicate with an autistic child. This is rarely a problem with "neurotypical" children, who provide plenty of opportunities for engagement. But autistic children can be difficult to engage with, and their attempts at communication can be so subtle that parents need assistance in detecting them, and advice about how to respond appropriately.

The approach used by PACT involved parents being videoed while playing with their children. Those videos were then replayed to the parents under the tutelage of a speech therapist, who pointed out moments, which might not otherwise have been obvious, when children were attempting to communicate. Even just turning towards a parent may be such an attempt. Having seen when to respond, parents then learned how to do so in the way a therapist would, in order to draw the child out. Parents are thus taught to become therapists themselves.

Family values

This therapy, encouragingly, is neither invasive nor intensive nor costly. It involves sessions once a fortnight for six months, and then a further six sessions, once a month. The results, though not startling, are encouraging. In families who were coached, the percentage of children with severe symptoms (such as having difficulties speaking and learning things) fell from 55% to 46%. In those who formed the control group, and were not so coached, they actually rose—from 50% to 63%.

The study adds to evidence that therapy delivered by parents is helpful for a range of childhood mental-health conditions, including aggression and anxiety. Yet, in the case of autism, some crucial scientific questions remain to be answered. One is whether the age of intervention matters. A second is whether this approach might help less severely afflicted children than those chosen for the study. And a third is whether a similar approach, taught to teachers rather than parents, might permit the method to be extended to schools.

Perhaps the greatest unanswered question, though, is practical. It is how such a therapy might be adopted swiftly and widely. Those involved in the PACT study have already made a start on this. They are creating training materials to be posted on their website, so that therapists who work with autistic children can adapt their methods accordingly. With luck, those methods will spread, and the lives of such children will improve accordingly. ■

Shark behaviour

Waste not, want not

One fish's excretions are another's vital resource

AMMONIA is as repulsive to most marine animals as it is to land-lubbing ones—and for good reason. It is extremely toxic. But there is an exception. Far from being repelled by ammonia, sharks are actually attracted to it. The longtime assumption has been that this is because it is a waste product, voided into the water by fish and other creatures, that signals the presence of potential prey. But Chris Wood and Marina Giacomin of the University of British Columbia, in Vancouver, think there may be more to it than this. As they describe in the *Journal of Experimental Biology*, they suspect that for sharks, ammonia is itself a useful resource.

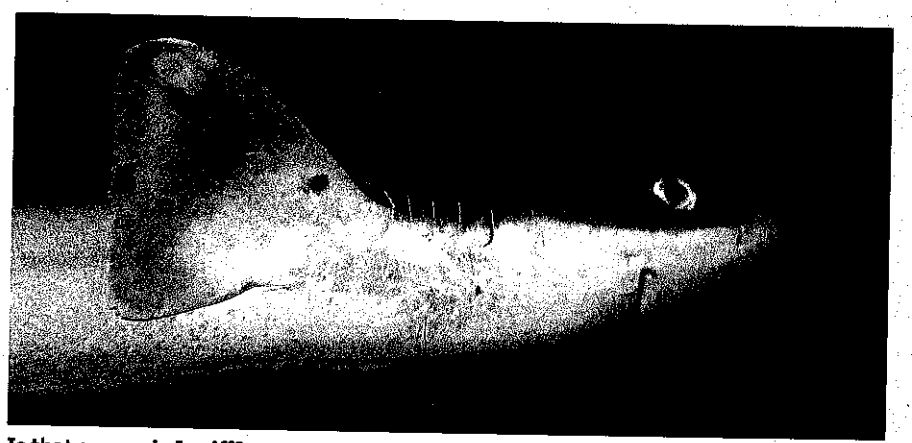
All animals make ammonia. It is a compound of nitrogen and hydrogen produced by the breakdown of amino acids, the building blocks of proteins. Marine creatures can flush it directly into the sea (fish do so through their gills), since it is soluble in water. Land animals often add carbon and oxygen to convert it into urea, which is far less toxic, and store the result in solution in a bladder, for periodic evacuation. Sea creatures can make urea too, though—and in sharks this molecule, which they synthesise in their gills, plays a crucial role in stabilising the salinity of their tissues.

Dr Wood and Ms Giacomin knew from the work of others that sharks forced to swim in water containing unnaturally high concentrations of ammonia absorb the chemical into their gills, convert it into urea and then expel that urea back into the water. The presumption was that this was an anti-poisoning mechanism. That, though, is a slightly odd idea. In the wild, unconfined by an experimenter's tank, it would surely be simpler and safer for a shark to swim away from the dangerous area and avoid the problem altogether. The two researchers therefore wondered if what had been seen in these previous experiments was really an accidental consequence of something else. Given urea's role in shark salinity-stabilisation (a role which it does not play in other groups of fish), they wondered if the animals' eagerness to find water with lots of ammonia in it was as much to do with replenishing their urea supplies as with locating prey. They therefore decided to run some experiments of their own.

To this end, they exposed ten Pacific spiny dogfish (a type of small shark easily maintained in the laboratory) to ammonia concentrations ranging from 100 micromoles per litre (μmol/l), a level commonly found in the wild, to 1,600 μmol/l, an unnaturally high level, while monitoring the water's chemistry closely.

Whatever the initial level of ammonia, they found, that substance's concentration began declining almost as soon as the sharks were put into the tank. The animals were, indeed, absorbing it. They were not, though, automatically excreting the resulting urea. Levels of this in the water rose only when the dogfish were exposed to ammonia concentrations of 800 μmol/l or more. And a closer look at the animals' gills and blood confirmed that they were retaining urea.

All this makes perfect sense. The importance of urea to shark physiology means they have to make it from something. Amino-acid breakdown, the alternative source of its central element, nitrogen, requires otherwise-valuable proteins. Calculations performed by Dr Wood and Ms Giacomin suggest dogfish swimming in ammonia-rich waters would be able to scavenge from those waters almost a third of the nitrogen they need to make urea. That adds up to a tidy saving in protein. So, sharks may well be driven by appetite to swim towards places where their prey have been releasing large amounts of waste ammonia. But, contrary to past theories, the appetite that takes them there may really be for the waste itself. ■



Is that ammonia I sniff?