omy—have a similar double-whammy: a greater risk for SARS-COV-2 infection and a high share of older workers (see chart 2 on previous page). In Britain jobs that fall into this category include security guards, plumbers and bricklayers. Employers need to follow stricter measures to shield such workers from infection. These could include reassigning the vulnerable to less risky tasks, stricter hygiene, rules that ensure physical distancing in the workplace and routine checks for symptoms.

All of these fine-grained prevention strategies would depend on the continued collection of data about the prevalence of infection in various groups. Increased testing capacity and better tests for current and past infection are making that easier. If these can be rolled out quickly and reliably, the next waves of covid-19 cases should be smaller and less damaging to social life and national economies. ■

Covid-19 in the young

Suffer the little children

Youngsters, too, are affected by SARS-COV-2

SOMETIME IN FEBRUARY or early March a six-month-old girl was admitted to a hospital in the Stanford area of California. She had a fever, a blotchy rash, mild congestion and cracked lips, and was refusing to eat. Her doctors diagnosed Kawasaki disease, a rare paediatric illness originally identified in Japan in 1967.

Kawasaki disease is poorly understood, but is suspected to be the result of an overreaction by the immune system to some as-yet-unidentified stimulus—which some past evidence suggests may be a coronavirus. If untreated (which is usually a result of misdiagnosis, precisely because it is so rare), it can result in potentially lethal cardiac complications. Recognise it in time to treat it, though, and patients normally recover. And in this case it was recognised, and the patient was treated appropriately. Moreover, as part of that treatment—because, although she had no respiratory problems she did have a fever—her doctors screened her for covid-19. The tests came back positive.

Not long after this incident, doctors in New York City started reporting a surge in cases of Kawasaki disease. In a typical year, New York might see a few dozen instances. The city's health department has now confirmed 147 cases since the covid-19 epidemic began—though how many of these were in children infected with SARS-COV-2 is unknown. In Britain, meanwhile, the South Thames Retrieval Service, which provides intensive care to children in parts of south-east England, including London, handled eight Kawasaki cases during a ten-day period in mid-April. All these patients, one of whom died, tested negative for the virus, but positive for antibodies related to it.

South Thames would normally expect to see one or two Kawasaki patients in a period like this, so eight might just about have been written off as a blip—except for the overlap with those antibodies and the fact that, in the week after the team concerned submitted their report, they documented a further 12 cases. Something odd, it seems, is going on.

The strongest evidence yet that something odd is indeed going on comes from Italy, in the form of a paper published in the *Lancet* by Lorenzo D'Antiga, a paediatrician at Pope John XXIII hospital in Bergamo. This city has one of the worst local covid-19 epidemics in the country. Dr D'Antiga noted early on in it that children with Kawasaki-like symptoms were arriving at his hospital at a substantially increased rate.

Between the beginning of 2015 and February 17th of this year Pope John XXIII had admitted only 19 such patients. Between February 18th and April 20th it received ten. This is equivalent to a monthly incidence 30 times that of the previous five years. Nor was the number of these cases the only odd thing. The previous 19 had had an average age, on presentation at the hospital, of three. The 2020 patients have an average age of seven-and-a-half.

Spotting this anomaly led Dr D'Antiga to collect nose swabs and blood samples from his Kawasaki patients, regardless of their other symptoms, in order to search for signs of the virus. The results were intriguing. Only two of the swabs tested positive—an indication that a patient has a current, active infection. Eight of the ten children, though, had pertinent antibodies. These included the two with positive nose swabs. But the other six had clearly been infected in the past. Moreover, further blood samples revealed that nine of the ten recent patients, including the two with negative antibody tests, had markedly reduced white-blood-cell and lymphocyte levels—traits commonly seen in adult covid-19 patients who are severely ill.

How far the implications of all this extend is not yet clear. The elevated Kawasaki caseload may be seized on by those who would like to keep schools closed in the face of the epidemic. The illness does, nevertheless, remain rare, and recognising it early leads to a good prognosis. That argues for vigilance, rather than the continued interruption of children's education. More positively, understanding how the virus interacts with the immune system to produce these symptoms may help to develop weapons with which it can be defeated. ■

No joke

Photovoltaics

Solar's new power

Cells are getting better at converting sunshine into electricity

SOLAR ENERGY has had a good crisis. In many parts of the world skies clear of pollution have helped photovoltaic power stations, which convert light into electricity, become more productive and reliable. Declining demand, meanwhile, has seen coal- and gas-fired stations taken offline. In Britain, on April 20th, solar generation peaked at 9.7 gigawatts. At the moment this happened that represented almost 30% of the country's electricity supply—ten times the usual proportion. In Germany the proportion of solar in the mix reached 23% for an entire week in April, compared with an average of about 8% during 2019.

Though temporary, such figures are impressive. Solar power, they suggest, has come of age. In some ways, however, despite solar's new and shiny image, this is the victory of an old technology.

The first practical solar cell was made in the 1950s at Bell Labs in New Jersey. It had an efficiency of 6% and was horrendously expensive. It did, though, prove to have a killer application in powering the satellites of the superpowers in the forthcoming space race. That kept interest alive.

Gradually, costs came down, efficiencies tripled to 17-20% and applications widened, until the point, now arrived at, where grid managers faced with surplus capacity are preferring solar to fossil-fuel generation. For all that they have got better in detail, though, solar cells have stayed the same in principle. Two layers of ultrapure (99.9999%) silicon, each doped with an additive to make it semiconducting, absorb light and use the energy from this to move electrons across the junction between them, thus generating an electric current.

For gridscale electricity produced in standard solar farms this arrangement is likely to continue. But many people think solar energy has wider potential than that. Some want to redesign solar farms in radical ways. Others see it as having small-scale applications that do not require connection to a grid. Both of these approaches will require efficiencies that standard silicon has never managed to achieve. But both will permit high prices for cells that do so.

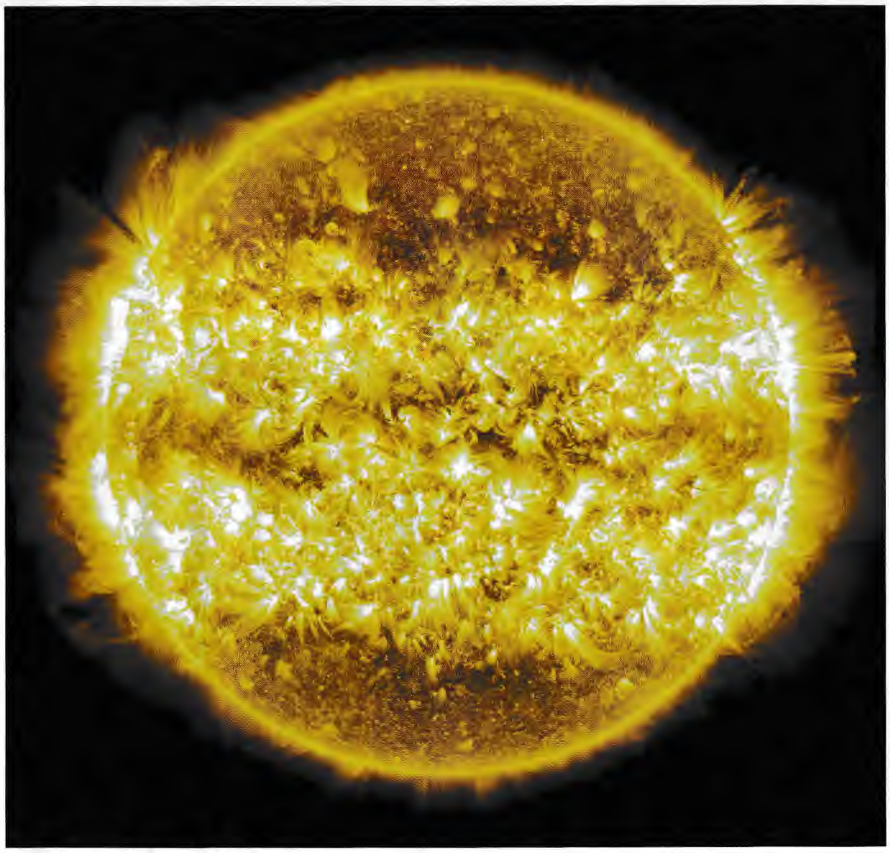
Layer cake

One way to boost a cell's efficiency is to add layers tuned to different parts of the solar spectrum. This means reaching beyond silicon to other materials. So-called III-V semiconductors, made of elements from group III of the periodic table (aluminium, gallium and indium) and group V (phosphorus and arsenic) are one approach. Indeed, gallium arsenide is already used in applications like satellites. John Geisz and his colleagues at the National Renewable Energy Laboratory, in Colorado, have produced a six-junction cell containing various III-V mixtures, each with different light-absorbing properties. This cell has an efficiency of 47.1% in laboratory conditions—a new record, which the researchers reported in *Nature Energy* in April. With further work, they reckon, an efficiency of more than 50% should be possible.

Intriguingly, the efficiency of Dr Geisz's cell rises as more light is concentrated on it. Laid out in standard solar farms it would manage a bit under 40%. The 47% figure comes when it is bathed in illumination equivalent to 143 suns. Roughly speaking, then, a six-junction cell with a suitable arrangement of mirrors concentrating the sun's light onto it could turn out the same amount of electricity as a standard silicon cell that had 400 times the area. Those are the sorts of numbers that disruptive technologies are made of.

Another promising group of materials for making new types of solar cells are perovskites. The original substance of this name is a mineral, calcium titanium oxide, discovered in the Ural mountains in 1839 and called after Count Lev Perovski, a Russian mineralogist. As is often the way with minerals, though, the basic crystal lattice involved can be created from many sorts of atoms. "Perovskite" has thus now become a generic term for any of these variants.

Not all perovskites are semiconductors. But a group based on a metal, such as tin, and a halogen, such as chlorine, bromine or iodine, do have that property. The ingredients of these metal-halide perovskites are, moreover, abundant and inexpensive. One of the leaders in the field of making cells out of them is Oxford PV, a British firm founded in 2010 to exploit work done on perovskites by Henry Snaith of Oxford University. The firm's design is a hybrid structure, known as a tandem cell, that coats a silicon layer with perovskite.



The ultimate power station

This brings two advantages. One is that, like a multilayered III-V cell, a perovskite-silicon tandem cell divides up the job of capturing sunlight. The upper, perovskite, layer is tweaked to absorb light from the blue end of the spectrum. The lower, silicon, layer mops up the remaining wavelengths towards the red end. This makes for high efficiency. In a test in 2018 such a tandem cell set a new record for its type with an efficiency of 28%. Eventually, the firm's engineers think, they can push this into the "mid-30s".

The second advantage of piggybacking the perovskite on silicon is that the cells are fairly easy to make into solar panels using standard industrial processes. That helps keep them competitive with conventional solar panels. A new factory that will do just this is currently under construction in Germany. The hope is that—the pandemic provided—the first panels made in this plant will go on sale next year.

Whether an efficiency in the mid-30s will be enough to displace silicon cells from part of their existing market remains to be seen. Perovskites may, however, have applications doing jobs that silicon cannot manage. For instance, they work well in low light intensities. This has permitted a group led by Thomas Brown of Tor Vergata University of Rome and John Fahlteich of the Fraunhofer Institute's campus in Dresden, Germany, to develop versions which operate at the levels of illumination found inside buildings. The amount of energy in artificial lighting is vastly less than that in sunshine. Nevertheless, Dr Brown and Dr Fahlteich have found, according to a paper they published this month in *Cell Reports Physical Science*, that their cells can achieve a conversion efficiency of up to 22.6%, thereby producing enough juice to run small, low-power devices like wireless sensors and remote-control units, which would otherwise require batteries.

Though it may seem odd to turn artificial, indoor lighting into electricity, given that it has been created from electricity in the first place, the truth is that all such light which does not end up entering a human eye is wasted. This approach simply reduces the level of waste. With the growth of the so-called internet of things, which relies on many different types of sensors, wireless control systems and other bits of electronic kit, such an approach could have wide application. If it works, the label "batteries not included" will go from being a warning to a recommendation. ■