THIS WEEK

EDITORIALS

DRUGS Research down the drain can help to fight crime **p.280**

WORLD VIEW Lifting of US chimaera ban offers opportunity **p.281**

HAWAII Warmer islands spread disease to kill birds **p.283**

Unit of contention

The United States' refusal to use SI units for radiation measurement is confusing and dangerous. It's time to catch up with the rest of the world.

There are two types of nation: those that use the metric system and those that have put a man on the Moon. The reliance of the United States on feet and pounds, along with its refusal to embrace metres and kilograms, baffles outsiders as much as it warms the hearts of some American patriots. But it is time for the country to give up on the curie, the roentgen, the rad and the rem.

Instead, US regulators and scientists should adopt the appropriate SI units for the measurement of radioactivity. They should do so not only for the sake of international harmony, but also to protect the health and safety of US citizens.

After years of wrangling, on 29 September the National Academies of Sciences, Engineering, and Medicine will hold a workshop to discuss whether the United States should adopt the international system of units for radiological measurements. The negotiations will affect everyone from NASA astronauts and air crews to emergency responders.

The rest of the world signed up some time ago. In the 1970s, the International Committee for Weights and Measures adopted a clear set of SI units to describe radiation exposure. The curie, an inspiringly named but clunky measure of radioactivity, was replaced with the becquerel. The roentgen, describing air ionization, became a measurement in coulombs per kilogram. The rad, which quantifies absorbed dose, was superseded by the gray. And the rem, which describes the dose that causes the same amount of biological damage as a rad, was replaced by the sievert.

In case of a nuclear accident, this last quantity is the most crucial. Sieverts capture how people's immediate radiation exposure might translate to future health effects. In 2011, after a tsunami swamped the Fukushima Daiichi nuclear power plant in Japan, the International Atomic Energy Agency and Japanese authorities used sieverts to describe releases of radiation from the three failed reactors.

As fear spread and the public and media clamoured for information, the last thing anybody needed was a load of complicated conversions. It was hard enough for most to sort out the difference between millisieverts and microsieverts, never mind then having to convert those to rems. Yet US officials insisted on generating hazard maps using rems. And that meant that people, including those in the danger zone, could not tell at a glimpse what was really happening.

Yes, it is possible to use both sets of measures, and to follow the rem numbers with the sievert numbers in brackets. In practice, this is what many US regulatory agencies do. But it is simply too awkward. The Australian government has publicly criticized the US system for creating confusion.

In the middle of an international nuclear-radiation incident, should emergency-response officials huddled in a situation room really need to whip out their calculators? Remember NASA's Mars Climate Orbiter, which was lost in 1999 when someone forgot to convert between imperial and metric units (even though they had plenty of time to check) — the spacecraft broke apart in the Martian atmosphere rather than smoothly entering orbit. Imagine if such an embarrassing error involved the life and safety of millions of people here on Earth.

Many US experts know that they need to make the switch. Officially, the government encourages agencies to use SI units. And unlike with everyday measures of distance and mass, Americans don't have a deep and lasting emotional bond with radiological measures, and could easily be brought to understand sieverts. During Fukushima, many US news agencies gave up on even trying to convert, and simply used the international sievert measures.

"In the middle of a radiation incident, should emergency-response officials need to whip out their calculators?"

So why not make the change? The US nuclear industry claims it will be expensive, with millions of dollars needed to update software and hardware and to retrain workers. (In 2012, the country's Nuclear Regulatory Commission, which technically oversees the industry but is widely sympathetic to it, quashed an effort to switch to SI units.) But the US nuclear industry's suppliers also sell to European manufacturers, and so are well equipped to adapt.

In the eighteenth century, French scientists proposed the metric system, and then French officials imposed it. US researchers should follow their lead, and then US regulators should make the change, and require the industry to follow.

In 1914, an article in *Nature* bemoaned the fact that the metric system was slow in catching on: "Why do people go on agitating? Well, the reason is the necessity for such a system." A century on, the United States is running out of reasons not to bring its radiation measurement into the modern era. ■

No way out

Questions abound over the deportation and subsequent house arrest of a physicist.

Physicist Adlène Hicheur had no idea that his life was about to be turned upside down when he joined a video conference from his home in Rio de Janeiro, Brazil, this summer to discuss his paper 'Studies of Bc + Meson decays to three-body final states at LHCb' with collaborators at CERN and elsewhere.

Police waiting downstairs whisked him to the airport, where he was summarily deported the same day. Since then, Hicheur has since found himself in a disturbing situation, detailed in a News story on page 287.

Brazilian authorities sent him to France, where Hicheur has a 2012 conviction for terrorism-related offences (and served a short prison

sentence). The French authorities placed him under house arrest, operating under sweeping detention powers given to them as part of the state of emergency declared after terrorist attacks in the country.

Leaving aside the fact that Hicheur's conviction has been vigorously contested by many scientific colleagues, a fundamental legal principle in a democracy is 'double jeopardy', which says that someone cannot be tried twice for the same offence. Yet this is effectively happening to Hicheur, both in Brazil and France. Likewise, another principle is that those who have served their sentence should have the right to pursue a new life unhindered — yet Hicheur, who by all accounts was successfully making a fresh start after moving to Brazil in 2013, and contributing productively to the country's science, has been denied this chance.

Whether one agrees or disagrees with Hicheur's house arrest — and many of his colleagues have denounced it as brutal, unjustified and unnecessary — at least it has a semblance of legal logic under the exceptional temporary situation in France.

That cannot be said of Hicheur's ejection from Brazil, which in the absence so far of a valid explanation seems to smack of arbitrariness linked to pre-Olympics tension and recent widespread coverage by Brazilian media of his past conviction. Moreover, the haste and circumstances of the action seem to violate Brazilian law, human rights and international treaties to which Brazil is a signatory.

The incident is all the more perplexing because Brazil's justice minister acknowledges that Hicheur was a law-abiding citizen during his time in the country, and France has not raised any new allegations against him. It is also difficult to reconcile the physicist described by his colleagues with the account of Hicheur in the French interior ministry's house-arrest order, which says there are "serious reasons" to think that he constitutes a security threat.

The reaction of Ignacio Bediaga, head of the group at the Brazilian Center for Physics Research in Rio de Janeiro where Hicheur first worked when he came to Brazil, echoes that of many of the deported physicist's colleagues: "Hicheur performed an exceptional job, showed exemplary moral and ethical behaviour and a great willingness to collaborate with the group." He adds that at no time did anyone in the group perceive anything amiss with Hicheur's conduct.

Science allowed Hicheur, a Franco-Algerian citizen born in Algeria, to reach the heights of working on the Large Hadron Collider 'Beauty' experiment, better known as LHCb. After he became a *persona non grata* in European research organizations following his conviction, his international colleagues helped to find him a place to start afresh in Brazil and continue his science.

"The haste and circumstances of the action seem to violate Brazilian law."

Hicheur deserves a fair and full hearing. The best route could be the Brazilian courts, and colleagues and academics there deserve support alongside Hicheur's lawyers for their efforts to pursue the case. Were Hicheur's deportation revoked, this might open the way for his return to work in Brazil, and thus make it easier for France to lift his house arrest.

In France, Hicheur is appealing his detention. But in the current climate of fear, the judicial machinery may be harder to mobilize.

French President François Hollande and his government, in their engineering of the state-of-emergency laws, have to their credit sought a difficult balance between giving police extra powers to help them fight the terrorist threat and preserving fundamental liberties and civil rights. But there is nonetheless the risk that such measures will be misused.

And if an intelligent and articulate individual such as Hicheur (a Muslim) with a bevy of support from his scientific colleagues can find himself helpless, what then of the many others with much less capacity to defend themselves? Fairness, freedom, the rule of law and human rights — including the right to a defence — are the basis for a democracy. It is not easy in these times to defend these values, much less for someone convicted in the past of terrorism-related offences, but defend them we must. ■

Bowled over

Assessing the contents of the toilet bowl in the name of crime prevention.

When they flush the toilet, most people don't think about what happens next. But for several hundred students at a private university in Washington state five years ago, what happened next was that scientists spied on some of their most intimate personal details. The researchers identified times of stress, probed the ethics of the students and calculated how many of them were bending the rules by taking drugs to help them with their degrees. The students had no knowledge of this at the time. And they probably still don't.

Likewise, the citizens of dozens of European cities have no idea that their sewage is being sifted through right now, officially to protect them; or that the police are studying the results to track crime. The toilet bowl and its contents, once extremely private, are becoming very public indeed. It's called wastewater-based epidemiology. Improved sensing techniques and analysis have made the contents of sewers and waste pipes a powerful source of data. And where there are data, there are researchers. Because although people may tell lies, the urine they send down the drain rarely does. Around for a decade or so, this analysis of waste water has mostly been used to obtain information that people would prefer others did not have — their use of illegal drugs, chiefly. Drugs broken down in the body leave telltale traces of metabolites, some of which can be found, quantified and back-calculated to work out how much of the original substance was present. Combined with a reliable estimate of the number of people who have, well, contributed a sample to the sample, the analysis can offer guidance on average consumption and how it changes.

Some of the results are more worth noting than truly noteworthy. Cocaine use, unsurprisingly, peaks at the weekend. People in smaller towns and cities prefer amphetamines. And anyone watching the Netflix show *Narcos* — which chronicles the life and times of notorious drug lord Pablo Escobar — will be unsurprised to hear about the truly colossal amounts of cocaine that pass through the residents and into the waste water of the city of Medellín, Escobar's one-time heartland.

Even the study that involved the Washington students merely seemed to confirm what most people already accept: healthy university students take prescription-only medicines as 'smart drugs' to try to boost their cognitive abilities at exam time (D. A. Burgard *et al. Sci. Tot. Environ.* **450–451,** 242–249; 2013).

A paper in the journal *Forensic Science International* this month offers an intriguing new possibility. Swiss researchers describe how they hooked up with drug-enforcement investigators to use wastewater analysis to shed light on the structure of drug markets, the criminals who controlled them, and how much influence police operations had on supply (F. Been *et al. Forensic Sci. Int.* **266,** 215–221; 2016). The results are not foolproof — analysis of cannabis metabolites is chemically tricky, for example, and cannot distinguish between all sources — but the study did report some successes.

Heroin use in Lausanne was estimated by measuring morphine in the sewers and subtracting what was known to have been prescribed medically. Between October 2013 and December 2014, the scientists estimated that average daily consumption of pure heroin in the city was 13 grams. During the study, the police arrested two dealers, and analysis of phone records and interviews with users suggested that the dealers sold about 6 grams a day between them — about half the total market. This supported police intelligence that heroin, unlike other drugs such as methamphetamine, was supplied by a small number of local dealers who could be effectively targeted. You can flush, but you can't hide. ■