In this issue

Nuclear Weapons:
How many does Pakistan have?

A country's nuclear weapons arsenal can only be as large as its stockpile of fissile material. An independent organisation called the International Panel of Fissile Material (IPFM) keeps track of nuclear material available within different nations for both military and non-military uses. According to IFPM's approximation, by the end of 2014, Pakistan's stocks were around 3100 kg of highly enriched uranium and 190 kg of Weapons grade Plutonium – sufficient for making 120–130 nuclear warheads.

But, Lalitha Sundaresan from the National Institute of Advanced Studies, Bengaluru and Kaveri Ashok, Centre for Science, Technology and Policy, Bengaluru suggest that this may be a gross overestimation.

On **page 1042** in this issue, the researchers outline the various non-military uranium and plutonium requirements of the country. Chief among them is feed for Pakistan's nuclear reactors, the oldest being the Karachi Nuclear Power Plant that began operations in 1971 and continues to work till date. The power-plant has been using domestically produced fuel since 1980. In addition, Pakistan has added plutonium nuclear power plants to its national grid. If the requirements of all these units are taken into consideration, it appears that Pakistan would have started facing uranium constraints from 2010 onwards, affecting nuclear weapon production.

The authors peg the available weapons much lower than that proposed by other researchers. Read more in a General Article.

Sunny-side Up
Cleaning solar photovoltaic cells

You have freshly installed solar panels. If you don't clean the surfaces, grime and soot build up, obstructing sunlight, and undermining the efficiency of the whole set-up. This becomes even more challenging when there is continued requirement for power and not a lot of resources to ensure panel cleaning. There have been many advances in technology that could be used to keep solar panels clean and running efficiently for longer durations. Now, scientists from the University of Petroleum and Energy Studies, Dehradun, outline these in a Review Article in this issue.

Apart from designing robots that could aid this exercise, researchers focus on advances that have been made in the field of material sciences. The behaviour of particles is largely determined by electronic properties. So, making the surface of solar cells less attractive to dust would discourage dust from settling over the panels in the first place.

In this context, scientists have proposed a host of options ranging from alignment to angle of inclination, to use of novel materials and robots that aid panel cleaning. Turn to **page 1065**.

New-age Pesticide Application
Less chemical, more protection

Large-scale mist spraying of pesticides generates huge plumes of chemicals, which drift and settle into the ground. The procedure is non-specific. Adjoining areas with no trees receive as much chemical as the target area, wasting the pesticide, besides leading to environmental pollution. To minimize these problems, we need more efficient and effective technologies for pesticide application.

Scientists have suggested a combination of infrared and proximity sensors and colour cameras to detect canopy cover in real time. Using this information, pesticide dispensing units can automatically alter the scale of chemical application. But most such sophisticated setups are beyond the means of majority Indian farmers.

Now, a team of Indian scientists have developed a pesticide application system, based on ultrasonic sensors. The system uses sound waves to judge the presence of trees as it moves across a field. The setup has to be mounted on a tractor and can detect canopy cover for up to 3 metres. This reduces the need to monitor pesticide application. In a Research Article on **page 1115** in this issue, scientists discuss the unit's construction and its performance in a pomegranate orchard.

Predicting Future Cyclones
Clues in the clouds

The Bay of Bengal is frequently hit with torrential rainfall during the monsoon. In the wake of present climate change, this frequency is only going to increase. This highlights the need for better models that could predict the track and intensity of impending cyclones.

A numerical weather prediction system, called the Weather Research and Forecasting Model, allows scientists to model real-world storm events. It could also be used to model completely imaginary scenarios. Using this software, scientists from the IIT Madras simulated cyclone *Vardah*.

This particular storm originated in the Malay Peninsula in 2016 and passed extremely close to Chennai, blocking roads, damaging power structures, and claiming lives. Even though it was believed that the storm would maintain its strength, the cyclone grew in intensity with time.

To study the time evolution of the cyclone, the scientists used two distinct schemes – cumulus and microphysics. While the former removes the heat fluxes generated in clouds, the latter negates the effect of moisture from clouds. These cloud parameters can have a sway on the fate, track and intensity of storms.

On **page 1143** in this issue, read a Research Article on how the schemes can be used to generate better track prediction models for storms in this region.

Sarah Iqbal
e-mail: sarah.iqbalv@gmail.com