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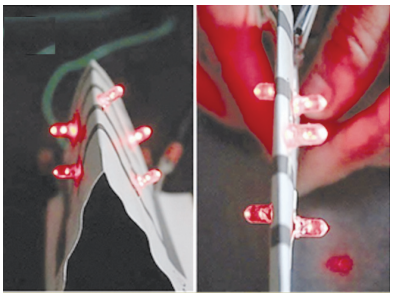
Electricity conducting paper

When paper was invented by the Chinese many centuries ago, humankind stepped into an era of intellectual revolution. Storage and transmission of knowledge and data was no longer confined to the brains of a few individuals, or at the mercy of precarious memory. Today, the paper, continues to pave way for human growth; this time, as an electric device wired with silver nanoparticle circuits.

There are three kinds of inks that are used for printing silver circuits on substrates: organometallic inks, salt-based inks and nanoparticles-based inks. Each of these has certain disadvantages such as high energy costs, tedious processing, and short-shelf lives. As a first in the field, a Research Communication, **page 262**, circumvents these problems by reporting a novel method to print conducting silver circuits, on something as cheap and ubiquitous as office paper.



The method is a cross between ink-jet printing and photographic processing. It involves the three steps of photographic film development: Print, Expose and Develop. Print: The desired networks of silver are first printed on the paper using an ordinary ink-jet printer whose cartridges are filled with silver nitrate and potassium bromide solutions. Expose: This paper, like the negative of a photograph, is exposed to light, leading to the fixation of silver bromide crystals on it. Develop: The paper is then immersed in a developing bath, in which the silver bromide crystals disintegrate to form a highly conducting network of nanowires. These conductive patterns formed boast of a resistance as low as 4 Ω.

This method does not require substantial economic and technological capital and, unlike contemporary time consuming methods, the conductive patterns are formed within minutes of light exposure. Such inventions could perhaps serve as an impetus to encourage widespread adoption of low-cost, disposable electrical devices in the developing world.

The eye of the storm

Weather forecasting is a science that tries to extrapolate a pattern through chaos – the random swirl of winds, the currents in the sea, the spew of volcanoes. Accurate prediction is not possible. Even a flap of a butterfly's wings could perturb a system, which could cascade, domino fall, and birth a cyclone under certain conditions. There are simply too many factors to be considered, and weather forecasting has always been an art of reasoned guesswork throughout the history of mankind. The Babylonians tried to predict weather by observing 'haloes' in the sky; the ancient Chinese developed a detailed weather calendar; and the Native Americans performed rain dances to appease weather Gods. Even today forecasting weather is a challenging task for even the most advanced computers; forecasting weather over complex mountainous terrains, is harder still.

In June 2013, extremely heavy rainfall pelted the Himalayan Uttarakhand region causing devastating landslides and floods. News reports remained divided about the cause of the excessive rainfall; according to them it was caused either by cloudbursts or by the melting of glaciers around Kedarnath. A Research Article, **page 234**, delves deep into this torrential rainfall episode, and searches for scientifically valid reasons.

According to the study, the heavy rainfall over Uttarakhand resulted from the interaction between the westerly winds and south-eastern monsoon currents over Uttarakhand. These monsoon currents had developed because of a low pressure system formed over the Bay of Bengal which wafted towards Rajasthan. During the same period, another wind system, the westerly pulsed in the opposite direction. Both these wind systems clashed headlong and locked over the Uttarakhand region. The 'locking' led to winds being swirled at high speeds, sucking the moisture rich warm air upwards, which condensed and splashed down as rain onto the slopes of Uttarakhand. Further, the intensity of the rain was relentless because it was continually fed with moisture from the Arabian Sea and the Bay of Bengal, resulting in India's worst natural disaster since the 2004 tsunami.

Over a thousand lives and millions of rupees worth of property were lost to the floods. Therefore, to be better prepared for similar disasters, it would be prudent to improve data collection efficiency and better understand the different factors involved. Such an understanding could not only help us portend future anomalies in weather patterns over a particular region, but could also provide insights into other weather systems.

Status check: uncertainty principle

'The more precisely the position is determined, the less precisely the momentum is known, and vice versa', said Heisenberg in his seminal paper on uncertainty. Heisenberg's quest to realize the consequences of uncertainty began with intense debates between him and several other renowned scientists like Schrödinger and Bohr. To help answer the doubts raised by these sceptic rationalists, Heisenberg formulated the gamma ray thought experiment.

In this thought experiment, Heisenberg visualized a microscope that could image particles by beaming gamma rays for illumination. Heisenberg proposed that to 'see' an electron, a gamma ray has to collide with it and beam back into one's eyes. Although the ray could 'photograph' the electron, it would also transfer energy and bounce the electron away, giving the observer an 'uncertain' notion of its velocity.

Even today, the uncertainty principle continues to stimulate active research. A Review Article, **page 203**, discusses the insights gained into this principle over the last few decades.

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