

## In this issue

### The Monte Carlo method — cutting the Gordian knot

Debashish Chowdhury reviews (page 456) current understanding of disordered magnetic materials based on the use of the so-called Monte Carlo method. If one counted the number of times this name appears in contemporary scientific literature, the total would be impressive indeed! This city on the Mediterranean, chiefly known for its gambling industry, has unwittingly lent its name to a major preoccupation of many physicists and chemists (not to mention others). The idea is to solve otherwise awkward problems by the equivalent of tossing coins or throwing dice inside a computer. The basic rules of statistical mechanics, unchanged from the time of Boltzmann and Gibbs, give the relative probability for two different states of a system to occur at temperature  $T$ . The state which is higher in energy by  $E$  is rarer by a factor  $e^{-E/kT}$ ,  $k$  being Boltzmann's constant. The observed properties of the system are to be calculated by summing over all the states of the system with this 'Boltzmann weight'—something easier said than done. Cases where this can actually be done exactly are rare enough that the inventor of each genuinely new one is guaranteed a place in the theoretical physicists' Hall of Fame beside Onsager, Yang and Baxter (to name a few). But there are many cases—like the disordered magnetic materials of Chowdhury's article—that do not lend themselves to such exact solution. Approximations abound but are often uncontrolled—a sceptic could well distrust the results they give. The Monte Carlo philosophy is to fashion in the computer a 'coin' whose tosses give the Boltzmann weight. This gives a fair sample of the system behaviour at a given temperature. The coin has to be tossed many times. (The reader is invited to toss a coin a hundred times to see how disappointingly far from half the fraction of heads can be—typically ten per cent.) Of course, many subtleties and ingenious tricks have emerged over the years.

Is this physics? A traditionalist would be deeply disturbed that the

method is a black box from which purely numerical answers emerge. A radical might well point out that the job is to find out the consequences of starting assumptions as accurately as possible, and one is no more restricted to pen and paper than geometers are to ruler and compass. More reasonably, one might ask what insight emerged in each instance, independent of the tool used. But in any case, the Monte Carlo method has come to stay.

R. Nityananda

### Logging water-logged areas

The introduction of canal irrigation in the Punjab caused the groundwater level to rise in some regions by as much as 25 cm per year from 1895 to 1960. Since 1960, in some regions water levels have risen by almost 50 cm every year, and many places have become 'water-logged' (which is the term used when the groundwater-table is less than two metres from the surface). Some of the causes are recharge from canals, inadequate drainage, and poor outflow owing to limited withdrawal of groundwater because of its saline and brackish nature. It is of the greatest importance to note when and where water-logging occurs to initiate precautionary measures.

Advances in remote-sensing technology have come in handy for not only monitoring natural resources but also for mapping water-logged areas. LANDSAT images indicate that there is a decrease in the water-logged area in south-west Punjab. But field studies by K. P. Singh (page 464) show that this is not so and that the water-logged area continues to increase in extent. Water-logged areas can be picked up by LANDSAT if the capillary rise in the soils is high and the topsoil zone is near saturation. If, on the other hand, the capillary rise is low, the topsoil is not saturated and will not have a sufficiently different reflectance to be distinguished in LANDSAT images. The author's conclusion is that great caution has to be exercised in interpreting LANDSAT data and that it is important to combine data from LANDSAT images with field data.

### Mango lore, mango lure

H. R. Parikh and V. V. Modi show (page 468) that artificial ripening of mango induced by abscisic acid involves *de novo* protein synthesis. During the ripening process, levels of sucrose, fructose and total sugar increase while acid content decreases. The sugar-to-acid ratio contributes to the appealing taste of mango.

A chronicler of 1563 says of the mango: 'Certain *mangas* [*sic*] of Guzerat were not large but of surpassing fragrance and flavour and having a very small stone. Those of Balaghat were both excellent and big. The doctor had seen two that weighed 4 arratels and a half [i.e. 4.2 pounds].' Blockman, 1598: 'The mango (*amba*) is unrivalled in colour, smell and taste. Some gourmands place it above musk-melon and grapes.' Bernier, 1669: 'The best come from Bengale, Golconda and Goa. I do not know any sweetmeat more agreeable.'

But the mango did not always get such a good press. Pliny (probably quoting Theophrastus) says: 'There is yet another tree which beareth a fruit which is long, not straight but crooked, with a most delectable taste. But this gives rise to colic and dysentery.' 'Wherefore Alexander published a general order against eating it.' There is however a faint suspicion that the fruit that gave the Macedonian army dysentery might have been some other fruit. Ibn Batuta, 1334: 'No other tree gives so much shade but this shade is unwholesome and whosoever sleeps under it gets fever.' The same charge is also levelled against the tamarind tree.

Many attempts were made to improve the mango. 'The fruit of the wild tree is uneatable.' 'It tastes like a ball of tow soaked in turpentine.' Babar, the first of the great Moghuls, says in his *Babarnama*: 'Of the vegetable production peculiar to Hindustan, one is the mango (*ambah*). The excellence of the fruit depends on the variety.' The emperor Jehangir says in *Jehangirnama*: 'Muqurrah Khan sent me some mangoes of Gujarat [from present-day Muzaffarnagar, 50 miles from Delhi] everyday by run-

ners up to the twentythird of the month *Mihir* [middle of October] while the normal mango season ends in *Tir* [July]. Obviously Muqurrab Khan managed to prolong the mango season in his gardens.

The characteristic taste of mango has been poetically described: 'The Mango when ripe—the Apples of Hesperides are but fables to them; for taste the Nectarine, the Peach and the Apricot fall short, and it is the wholesomest and the best tasting of any fruit in the world.' One hopes that any treatment to induce ripening will not remove the mango's celebrated flavour.

#### **Antifilarial role for a relative?**

The cashew plant, *Anacardium occidentale*, is in the same family of flowering plants as the mango. And like the mango, the cashew is a cash

crop. It is grown for its edible nut, which is the true fruit of the plant and hangs below a fleshy 'pseudocarp'. M. Suresh and R. Kaleysa Raj report (page 477) that cashew-nut shell extract has antifilarial activity. The active substance is cardol, a phenolic compound, known earlier from cashew-nut shell extract. The authors report that cardol, tested against the filarial parasite of cattle, which is very similar to the human parasite, is 100 times more active than diethyl-carbamazine, one of the few drugs currently used against human filariasis. WHO estimates that filariasis affects the lives of nearly a billion people, mainly in Africa, South-East Asia and, to a lesser extent, Latin America.

#### **Food safety testing**

Polynuclear aromatic hydrocarbons

(PAHs) are formed as a result of thermal degradation of organic matter. They have been detected in cigarette smoke and polluted air, besides other environments and products, and in several food items. Many PAHs have been shown to be mutagenic in the Ames *Salmonella* assay. There is a high degree of correlation between *in vitro* mutagenicity, as assessed by the Ames test, and carcinogenicity *in vivo*. S. Narender Sivaswamy *et al.* have detected (page 480) benzo[*a*]pyrene, chrysene and 1,2,5,6-dibenzanthracene in several South Indian food items. These PAHs are mutagenic in the Ames test, and have been shown to cause cancers in experimental animals. The authors suggest that the PAHs present in the widely consumed food items tested may have a role in the incidence of gastric cancers in South India.