100 YEARS AGO

A complimentary dinner was given to Prof. Virchow at the Hôtel Métropole on Wednesday in last week. … Lord Lister, in proposing the toast of the evening, dwelt upon the versatility of the genius of the distinguished guest, his eminence as a pathologist being equalled by his reputation as an anthropologist and antiquarian. He referred particularly to Virchow's "Cellularpathologie," which work, he remarked, "swept away the false and barren theory of a structureless blastema, and established the true and fertile doctrine that every morbid structure consists of cells which have been derived from pre-existing cells as a progeny. Cellular pathology is now universally recognised as a truth. Even those morbid structures which deviate most from the normal structure are known to be derived as a progeny from normal tissue – from normal cells, driven to abnormal development by injurious agencies."

From *Nature* 13 October 1898.

50 YEARS AGO

"Einstein: His Life and Times." By Philipp Frank. – Those who, like the present reviewer, are personally unacquainted with Einstein, will read this book with a shock of surprise. While Dr. Frank's sympathies are all with Einstein, the portrait presented to us is not altogether a pleasant one. We see a man developing early into the traditional type of nineteenth-century 'professor'. He regards himself as free to develop any eccentricity of behaviour, whether those about him like it or not, and to talk shop in season or out of season, a characteristic illustrated by the description of a courtesy visit to a non-mathematical colleague in Berlin, in which, after subjecting his hosts to a forty-minutes discourse on relativity, Einstein left abruptly. This lack of appreciation of the fact that ideas and interests which did not happen to interest him might still be as valuable as those that did may well explain Einstein's difficulties in the Berlin Academy, or his failings as a teacher. Always, apparently, ready to lecture on his researches of the moment or to deliver popular discourses, Einstein was not prepared to teach his students systematically what they had need to learn. – G. C. McVittie

From *Nature* 16 October 1948.

may put a dent in inflation's armour. The inflationary models favoured by theorists are lauded for the simplicity of their predictions, but if these new results withstand further scrutiny then inflation either cannot be so simple, or must be discarded.

Among inflation's predictions is that the distribution of density perturbations in the early Universe should be Gaussian (or 'normal'): a histogram of the density at different points in the Universe should produce the familiar bell-shaped curve. Gaussianity also implies specific forms for the correlation between densities at several different points. The new work provides preliminary evidence that contradicts these predictions.

The Differential Microwave Radiometer experiment on the Cosmic Background Explorer (COBE) satellite has mapped the temperature of the CMB with an angular resolution of seven degrees[5] (Fig. 1). The photons come to us from roughly 15 billion light years away; they were produced about 300,000 years after the Big Bang, when the Universe became transparent and the photons last scattered from electrons in the primordial cosmic plasma. Photons from overdense regions of the Universe lost more energy as they climbed out of deeper gravitational potential wells and are thus redder than photons reaching us from underdense regions.

The distribution of temperature fluctuations thus reflects the primordial distribution of mass, and the observed temperature fluctuation level — roughly one part in a hundred thousand — reflects a similar level of density fluctuations. The distribution appears at first to be roughly consistent with a Gaussian. But there are only a small number of independent 7×7-degree regions on the sky, so there is an error in each point in a histogram constructed from the data, simply from sample variance. Detector noise provides another source of uncertainty. There must, therefore, be some deviations from Gaussianity. Are they statistically significant, or just sampling and noise fluctuations?

Several searches have yielded null results. But there are an infinitude of flavours of non-Gaussianity: a distribution might be wider or narrower, have longer tails than a Gaussian, be skewed and so on. Still more flavours are allowed when correlations between regions are considered — and any deviation in the histogram from a perfect bell curve poses problems for inflation.

Ferreira *et al.*[4] have developed a technique to test for a specific form of non-Gaussianity. They search for this particular correlation between three points on the sky. When applied to the data from the Differential Microwave Radiometer, the search turns up a positive result at the 98% confidence level. As it probes a different form of non-Gaussianity, the result is perfectly consistent with prior null results.

Photonics

Chemistry of light

This picture is of a 'photonic molecule', the latest development in our increasingly sophisticated control of photons. Bayer and colleagues (*Phys. Rev. Lett.* 81, 2582–2585; 1998) have built a range of these structures to test how pure modes of trapped light behave in them.

Until a few years ago, our manipulation of light was crude: creating photons of visible light by heating matter until its electrons vibrate violently enough to radiate; filtering them; bouncing them off mirrors. The light is generally incoherent, and has a wide range of colours. Lasers are a much more refined tool, producing a narrow beam of nearly monochromatic, coherent (in-phase) light.

Even cleverer are photonic-bandgap materials, where scattering off periodic arrays of a dielectric prevents certain wavelengths of light from propagating. Such materials can be used to bend light around corners, and trap it in cavities.

Light can also been trapped in 'photonic atoms'. A semiconductor layer is sandwiched between two mirrors, and an island is etched out of the overall structure. The refractive-index barrier between the

semiconductor and the surrounding air allows photons to leak only slowly out of the sides; this confinement means that only resonant photon modes are excited. This technology may be used to make efficient semiconductor lasers with a single excited mode.

To take the idea a stage further, Bayer *et al.* linked pairs of gallium-arsenide photonic atoms with narrow bridges. As the bridge length was reduced, new photonic states emerged that are similar to the bonding and antibonding orbitals of the hydrogen molecule.

The aim now is to build more complicated photonic molecules to study this photon–matter interaction, and perhaps to learn something, by analogy, about electronic states in real molecules. **Stephen Battersby**