100 YEARS AGO

Many of our readers who are acquainted with Mr. Percy S. Pilcher, and others who have only heard of him through his great enterprise and keenness in constructing and using aërial machines, will be very sorry to hear that his accident on Saturday last has proved fatal, and that he died at 2.40 on Monday morning. Mr. Pilcher, during the last few years, had been making a considerable number of experiments with the object of constructing a soaring machine which would propel itself. The writer of this note was present at one of his trials in August 1897, at the time when he was at work in designing a small light engine for propelling his machine, and communicated to this journal an account (with illustrations from photographs) of his experiments on that occasion ... . Like his forerunner Otto Lilienthal, Mr. Pilcher has come to the same sad end, and now his name must be added to that already long list of pioneers in aërial navigation. The experiments causing the fatality took place on Saturday last at Stanford Hall, the seat of Lord Braye, near Market Harborough. We gather from the *Times* that after several ineffectual attempts to start, a signal was given about twenty minutes past four, and Mr. Pilcher rose slowly in the machine until he had travelled about 150 yards, and had risen to a height of 50 or 60 feet. Then a sharp gust of wind came and the tail of the apparatus snapped. Instantly the machine turned completely over and fell to the earth with a terrible thud, Mr. Pilcher being underneath the wreckage.

From *Nature* 5 October 1899.

50 YEARS AGO

A symposium on "Psychological Studies of the Quality of the Population" was held by Section J (Psychology) at the Newcastle meeting of the British Association, with the president of the section, Sir Godfrey Thomson, in the chair. Prof. P. E. Vernon (London), introducing the subject, outlined the well-known facts of the differential birth-rate not only between different social classes but also between families of different intelligence-level within the same class. Most authorities agree that this should lead to a decline of 1½ or more points of average intelligence quotient per generation, and that the numbers of very bright children be halved, of feeble-minded children doubled, before the end of the century.

From *Nature* 8 October 1949.

Box 1: Condensation of like minds

Further proof of the vitality of the field of Bose–Einstein condensation came at a meeting last month*, when experts in atomic physics, condensed-matter physics and quantum optics converged to discuss developments ranging from substrates for quantum computation to new types of trapped quantum fluids.

As discussed in the main text, Bose–Einstein condensation depends on the development of a coherent quantum phase across the fluid. Like any physical quantity, however, this phase is subject to thermal fluctuations, which are notoriously strong in low-dimensional materials and can alter or destroy condensation. Experiments that trap and cool gases of atomic hydrogen against a liquid helium surface have provided evidence of coherence in a dilute two-dimensional quantum fluid (T. Hijmans, Univ. Amsterdam; S. Jaakola, Univ. Turku).

Other developments foreshadow new directions for trapped quantum systems. The essence of computation is the controlled transformation of input into output by the execution of a well-defined sequence of operations. Over the past few years it has been realized that if these operations are quantum mechanical in nature, dramatic advances in computational speed can, in principle, be achieved. Practical realizations of these schemes, however, have lagged behind theory. A new possibility is that regular lattices of cold atoms could be used for this purpose, and there are schemes for obtaining and manipulating such an array (P. Zoller, Univ. Innsbruck).

Bose–Einstein condensates are no longer the only quantum gases around. Although bosonic atoms such as ^{87}Rb can undergo condensation, others like the fermionic atom ^{40}K are forbidden from occupying the same quantum state, in the same way that electrons within atoms cannot occupy the same orbital and spin state. (Whether an atom is a fermion or a boson depends on its total internal angular momentum.) In the first realization of a dilute atomic Fermi system[8], nearly a million ^{40}K atoms were trapped and cooled to below microkelvin temperatures. By trapping the atoms in two internal states, and then cooling them, it has proved possible to overcome the fundamental quantum-mechanical limitations on the evaporative cooling of a single fermionic species (B. DeMarco and D. Jin, JILA and Univ. Colorado, Boulder). As predicted theoretically, the cloud contracted upon cooling until it reached a limiting size set by the Pauli exclusion principle. The search for pairing of atoms at still lower temperatures (analogous to the pairing of electrons in superconductors) promises to drive further developments in this new class of trapped quantum gases. **D. S. R.**

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* *Bose–Einstein Condensation in Atomic Vapours*, San Feliu de Guixols, Spain, 11–16 September 1999.

Matthews *et al.*[2] imaged the quantum phase of a vortex using an ingenious scheme that again takes advantage of the two-component nature of their condensate. They used an appropriately designed pulse of microwaves to simultaneously and coherently transfer atoms from the resting condensate to the vortex condensate. After the pulse, all of the atoms have the same internal state, and the resulting condensate is the sum of the two pre-pulse condensates (Fig. 1d), which corresponds to a displaced vortex[4]. This *in situ* superposition experiment elegantly demonstrates the 360-degree phase rotation of the vortex, a result that had been implied by the classic experiments of Vinen[5] and Yarmchuk *et al.*[6] in liquid helium, but never imaged so directly.

The generation of vortices in a Bose–Einstein condensate promises to illuminate the intimate details of the relationship between condensation and superfluidity, a link established by over 60 years of studies on liquid ^{4}He. Superfluids are characterized by their ability to support dissipationless flow. In a conventional fluid the disorderly microscopic motions of the constituent particles are ultimately responsible for viscous drag; in a Bose–Einstein fluid this mechanism is suppressed by condensation. In the same issue of *Physical Review Letters* as the JILA group's report[2], Ketterle and his collaborators at MIT described evidence[7] for a critical velocity for dissipation in a Bose–Einstein condensate. (These and other developments in the field were presented at a lively conference in Spain last month — see Box 1.)

Superfluids can also support circulating currents that persist indefinitely, a phenomenon that can be understood in terms of the stability of vortex-like states of flow. Future observations of the relative motions of the core and periphery of a vortex, and the mechanism by which vortices enter and leave the condensate, will provide a deeper understanding of the link between superfluidity and condensation. ■

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