50 Years Ago

Medical geography could soon benefit considerably from computer graphics … Medical geography is concerned with variations in the incidence of disease in different areas and the link with possible causes connected with elements of the physical, biological and sociocultural environment. As such it is a topic in which maps should be valuable, but they are often of little use because of the time taken for such lengthy and repetitive processes as the calculation and statistical testing of attack rates, fatality rates, standardized mortality ratios and other disease indices. And it takes a long time to represent these indices in cartographic form. Computer graphics — the construction of maps and diagrams using the electronic computer — could have considerable potential in medical geography. They may, by the speed, efficiency and reliability of processing and mapping medical data, lead to a more effective use of maps.
From *Nature* 30 August 1969

100 Years Ago

The Medical Research Committee has issued a report … on the influence of alcohol on manual work and neuromuscular co-ordination. Accuracy and speed in typewriting and in using an adding machine, and accuracy in hitting spots on a target, were used as tests, and both pure alcohol and alcohol in the form of wine and spirit were employed. There was no distinct difference between the two forms of alcohol, and when very dilute (5 per cent.) the effect was about three-fourths as great as when taken strong (37–40 per cent.) for the same amount of alcohol … The degree of effect depended largely on whether the alcohol was taken on an empty stomach or with food; on an average it was twice as toxic under the former condition.
From *Nature* 28 August 1919

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1. Culemann, S. *et al. Nature* **572**, 670–675 (2019).
2. Davies, L. C., Jenkins, S. J., Allen, J. E. & Taylor, P. R. *Nature Immunol.* **14**, 986–995 (2013).
3. Buechler, M. B. *et al. Immunity* **51**, 119–130 (2019).
4. Lavin, Y. *et al. Cell* **159**, 1312–1326 (2014).
5. Udalova, I. A., Mantovani, A. & Feldmann, M. *Nature Rev. Rheumatol.* **12**, 472–485 (2016).
6. Tainaka, K., Kuno, A., Kubota, S. I., Murakami, T. & Ueda, H. R. *Annu. Rev. Cell Dev. Biol.* **32**, 713–741 (2016).
7. Misharin, A. V. *et al. Cell Rep.* **9**, 591–604 (2014).
8. Zhang, F. *et al. Nature Immunol.* **20**, 928–942 (2019).
9. Wang, J. & Kubes, P. *Cell* **165**, 668–678 (2016).
10. Uderhardt, S., Martins, A. J., Tsang, J. S., Lammermann, T. & Germain, R. N. *Cell* **177**, 541–555 (2019).
11. Croft, A. P. *et al. Nature* **570**, 246–251 (2019).

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CONDENSED-MATTER PHYSICS

Superconductivity seen in a nickel oxide

Magnetism alone was thought to be responsible for superconductivity in copper oxides. The finding of superconductivity in a non-magnetic compound that is structurally similar to these copper oxides challenges this view. SEE LETTER P.624

GEORGE A. SAWATZKY

In 1986, scientists unexpectedly discovered that a lanthanum barium copper oxide, $La_{1.85}Ba_{0.15}CuO_4$, becomes a superconductor (has zero electrical resistance) below a relatively high temperature[1] of 35 kelvin. This result triggered one of the most intense experimental and theoretical research efforts in condensed-matter physics. Soon afterwards, many other copper oxides (cuprates) were found to superconduct at temperatures[2] of up to 133.5 K. However, after more than 30 years, there is no consensus regarding the underlying mechanism of cuprate superconductivity. On page 624, Li *et al.*[3] report that a neodymium strontium nickel oxide, $Nd_{0.8}Sr_{0.2}NiO_2$, superconducts below 9–15 K. This material has a similar crystal structure to that of the cuprate superconductors, suggesting that the authors' discovery could lead to a better understanding of superconductivity in these systems.

Superconductivity can occur in a metallic material if the usual repulsive interaction between electrons turns into an attractive one. In this scenario, the response of surrounding atoms to the charge and spin (magnetic moment) of electrons indirectly leads to electron pairing. At a low enough temperature, these paired electrons condense to form a superfluid (a state of matter that flows without friction), which exhibits zero electrical resistance[4]. The key to understanding superconductivity in a given material is to identify the mechanism that provides the 'pairing glue'.

In the conventional mechanism, the spatial displacement of atoms close to an electron forms an attractive region for another electron[4]. An analogy is that of two heavy balls on a spring mattress, whereby the indentation in the mattress made by one of the balls produces an attractive region for the other ball. However, some theoretical work has suggested that this effect is too small to account for the high-temperature superconductivity of the cuprates.

Researchers have therefore considered that the spins of moving electrons might cause deviations in the magnetic order (the ordered pattern of atomic spins) in the cuprates. With respect to the mattress analogy, these deviations represent mattress indentations, and the strong interactions between the spins of neighbouring Cu^{2+} ions represent the mattress springs. To understand how this mechanism works, consider the cuprate superconductor $La_{1.85}Ba_{0.15}CuO_4$, which is obtained from the compound La_2CuO_4 by replacing some lanthanum atoms with barium.

In La_2CuO_4, the electrons of a particular Cu^{2+} ion are prevented from moving by their strong repulsion to the electrons of surrounding Cu^{2+} ions. As a result, the material is an electrical insulator[5]. Each Cu^{2+} ion has an odd number of electrons and a net spin of 1/2. The ions have strong antiferromagnetic order, which means that the spins of neighbouring ions point in opposite directions.

When lanthanum in La_2CuO_4 is partially replaced with barium, electron vacancies called holes are introduced into the system in a process known as doping. These holes migrate to the planes of CuO_2 in the material. If their density is low enough, they act as freely moving charge carriers, resulting in metallic behaviour. The combination of a Cu^{2+} ion and a doped hole has an even number of electrons and a net spin of 0, which causes a severe disturbance in the spin directions of surrounding