London's polluted water supply was still the subject of satire in 1866.

offered his own interpretations of the facts that they presented to him.

That foul water was the primary mode of cholera's spread was his mantra, and during the 1854 epidemic Snow conducted two studies to test it that would form the basis of his book's famous second edition. The better-known study focused on the Soho outbreak, in late August and early September, which centred around a pump in Broad (now Broadwick) Street. Some 600 people died. Snow used government death-registration data and house-to-house enquiries to map the victims' residences, showing their proximity to the pump. In a number of instances he was also able to confirm that victims had drunk water from the well, into which an open sewer drained. As in much of London, many houses in the locale were not yet connected to central water or sewage systems.

Snow convinced local officials to remove the pump handle, although the gesture was probably symbolic, because the epidemic was already subsiding. He further made his case by showing that several people who lived elsewhere in London had also drunk water from the well, and come down with cholera. Moreover, few residents at a local workhouse with its own well suffered, despite overcrowding. Employees of a nearby brewery were also essentially immune from the epidemic. One of the perks of their job was an allowance of free beer, so they didn't bother with water — a conclusion that Snow, one-time honorary secretary of the Medical Temperance Society, would have found ironic.

The second of Snow's epidemiological studies of 1854 may be referenced less often but was actually even more impressive. Back in 1848, Snow had incriminated two London water companies — one in Lambeth, one in Southwark and Vauxhall — with servicing their south London clients with contaminated water. Between the epidemics of that year and 1854, the Lambeth company switched its source from the Thames in central London to Thames Ditton, an upstream village some 12 miles away, and began to filter its water. In 1854, Snow began the hard task of tracing the contamination.

On the Mode of Communication of Cholera

JOHN SNOW
John Churchill: 1849, 1855 (2nd edition)

That second study involved some 300,000 people, from all occupations, social standing, ages and genders. Getting the relative death rates from cholera for each company was not easy: in many instances the people Snow questioned did not remember which company sold them water, and often houses in the same street were connected to one

IN RETROSPECT

On the Mode of Communication of Cholera

W. F. Bynum reassesses the work of John Snow, the Victorian 'cholera cartographer'.

Tomorrow is the bicentenary of the birth of John Snow, one of the founding fathers of epidemiology and anaesthesiology. His posthumous reputation is much greater than any he enjoyed during life.

Snow's epidemiological fame rests primarily on the second edition of his *On the Mode of Communication of Cholera* (1855), which rests, in turn, on his meticulous mapping of the disease in London and creative use of figures to show how cholera is transmitted. An ascetic man who never married, he died young; but his life was one of discipline, ambition and honest toil.

Born into a working-class family in York, UK, Snow was trained by apprenticeship to general practitioners and some courses in medical schools in north-east England, with little financial backing. He nevertheless

based his career in London. He set up a general practice, worked in the outpatient's department at Charing Cross Hospital and became medical officer to several convalescent homes set up by working men's clubs.

London suffered three severe cholera epidemics during Snow's lifetime, in 1832, 1848–49 and 1853–54. In the first edition of *On the Mode of Communication of Cholera*, published in 1849, Snow extended arguments he had long held: that cholera is a specific disease spread by water contaminated by faeces. At the time it was generally thought to be a nonspecific fever transmitted through 'miasma' in the air. Far from claiming that his ideas were original, Snow scoured the literature and badgered acquaintances such as the epidemiologist William Farr for corroboration. He found some, but in many instances

► or the other supplier almost at random. Snow's revelations encouraged Farr, who was also keeper of statistics at the General Register Office, to use his office to further the analysis. Both Snow and Farr found that householders drawing water from the Southwark and Vauxhall company were many times more likely to die from cholera.

Snow could not identify any specific causative agent, but he argued that the material cause of the disease acted like a living organism, because it could reproduce. Terming it "organised matter", Snow interpreted its incubation period as the time it took for the initial dose to reproduce sufficiently to cause actual disease. He never knew of the Italian microscopist Filippo Pacini's description of the comma-shaped bacillus (which causes cholera) during an 1854 outbreak of the disease in Florence. Snow had died by the time that germ theory became a viable proposition thanks to Louis Pasteur, Robert Koch (generally lauded for discovering the cholera bacillus) and many others.

Snow had another string to his bow: anaesthetics. From the late 1830s he had been concerned with issues surrounding asphyxia and artificial respiration in newborns, and so was an expert on the administration of gases to the lungs. He embraced the arrival of inhalation anaesthesia in 1846. Within a month of ether's first public use in Britain, in December of that year, Snow was researching its chemical properties, and he was administering it for surgeons by the following February.

His general practice soon centred on the administration of anaesthesia in leading London hospitals. He was even called in to give Queen Victoria 'blessed relief' during the births of her last two children. But his lasting contributions lay in the equipment he devised to control dosages of anaesthetic gases, and his research (often on himself) on ether and chloroform, which contributed to the more accurate description of the stages that patients pass through as the anaesthetic takes hold.

Snow was diagnosed with kidney disease more than a decade before his death, and reluctantly, on his doctors' advice, abandoned his vegetarian diet and his total abstinence from alcoholic beverages. One can surmise that his kidney disease contributed to raised blood pressure: he died six days after suffering a stroke, aged just 45.

His reputation then was higher as an epidemiologist than an anaesthetist, and routine filtration of water supplies was still in the future. Both contributions are highly valued now — you can raise a toast to Snow at the pub that bears his name, a stone's throw from the site of the Broad Street pump. ■

William Bynum is professor emeritus of the history of medicine at University College London.
e-mail: bynum2@me.com

Ginkgo trees can live for thousands of years.

BOTANY

A tree for all time

Sandra Knapp relishes a biography of the ginkgo, an arboreal survivor that has outlasted the dinosaurs.

Biographies seem to come in two sorts. The first is a dense compilation of deeds and misdeeds, dates and details of the dead; the second, a hagiography of celebrities still alive and kicking.

Ginkgo is neither. Its subject should by rights be dead, but having outlasted the dinosaurs, is still very much with us. This biography of the ginkgo tree offers a potent mix of science, history and culture, exploring how plants have changed our lives and our planet. And Peter Crane, a palaeobotanist by trade and all-round botanist by nature, is the perfect person to tell the tale.

Lucidly and accessibly, he takes us from the living plant, through its long and fascinating past as seen in the fossil record, and then returns us to the present in sections on the ginkgo in culture and the future of diversity. This tree, he shows us, can be seen as a metaphor for all life on Earth — seemingly fragile, but actually tough and likely to outlive *Homo sapiens*. With its meticulous footnotes, satisfying referencing and gripping narrative, I can see this book becoming a commuter's favourite for scientists and general readers alike.

Ginkgo biloba, as the maidenhair tree was named by the great Swedish botanist Carl Linnaeus, is one of a kind. It is a biodiversity loner, the only species in its genus, family and order. This was not always the case, as Crane shows. Ginkgo relatives first appear

in the fossil record more than 200 million years ago, and the lineage has hung on through great extinctions. Long ago, *Ginkgo biloba* had many relatives, but they have all since died out, as it almost did itself.

As he traces these species' amazing journey, Crane introduces key concepts in evolution — the part extinction plays in producing current patterns of distribution, the fact that where things are not found is as important as where they are, and the role of contingency in creating today's diversity. I loved his equation of the stunning plant-fossil trove in Scotland's Rhynie Chert with the Burgess Shale of Canada, that phenomenal array of Cambrian life-forms made famous by Stephen Jay Gould's *Wonderful Life* (W. W. Norton, 1989). There is another book in waiting there.

Crane's enthusiasm for fossil-hunting is very real. He recounts a stop in 1982 on a road in North Dakota, where he discovered some perfectly preserved ginkgo leaves and seed fossils from the Late Palaeocene (58.7 million to 55.8 million years ago). This extinct

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