



Soldiers load a Stokes mortar, invented in 1915 by engineer Wilfred Stokes for trench warfare.

MILITARY TECHNOLOGY

# Science in the trenches

David Edgerton applauds a study of a scientific elite whose impact spanned two world wars.

Many clichés bedevil our understanding of the role of science in the two world wars. One that has lingered is the idea that the First World War was a chemists' war (poison gas, explosives) and the Second World War belonged to the physicists (radar, the atomic bomb). To judge from past pages of *Nature*, the term 'chemists' war' was not coined until 1920, and then only in reference to a future war, whereas 'physicists' war' was used to

describe mechanization, radio and aeroplanes in the early phases of the Second World War. In any case, both clichés are absurd: experts of all kinds were involved with the military in peacetime, and more so in war.

One of the great virtues of Taylor Downing's lucid and entertaining *Secret Warriors*, on experts in the British First World War effort, is that it is unaffected by such hackneyed ideas. Downing deals with aeroplanes, plastic surgery, new weapons, aerial photography and

poison gas. He blithely ignores chemist and writer C. P. Snow's notorious and fatuous 'two cultures' thesis, because his book also covers the work of historians, journalists, linguists and physicians at the time.

*Secret Warriors* is full of interesting characters, nicely illustrating the deep interconnections between British experts and war. Take Alfred Ewing, former professor of mechanism and applied mechanics at the University of Cambridge, UK. He went on to become Britain's director of naval education in 1903, and had a key role in wartime code-breaking for the Admiralty in London. There he created what was known as Room 40, into which went code-breakers Dilwyn 'Dilly' Knox, Nigel de Grey and Alexander Denniston; they continued their work through the inter-war years and became key members of the UK government's code and cipher-cracking operation during the Second World War at Bletchley Park in Buckinghamshire.

In aviation, the connections and continuities are just as striking. The Cambridge physicist John William Strutt, Baron Rayleigh, was involved in promoting large-scale military aeronautics research from well before the First World War; Britain sent a small air force to France soon after war was declared. Aeronautical problems were rife, and solving them required many scientists, some of whom would become important advisers during the Second World War. The chemist Henry Tizard, for instance, worked on bombsights and went on to become the Royal Air Force's main scientific adviser into 1943, while the physicist Frederick Lindemann became Winston Churchill's personal adviser and a member of the wartime cabinet.

In land battles, the first tank or 'landship', an armoured vehicle with huge caterpillar tracks that took it over trenches, was the work of men associated with the military from before the war. These included the gloriously named naval architect and engineer Eustace Tennyson d'Eyncourt, the director of construction for the Royal Navy, who was a relation of the Victorian Poet Laureate Alfred Lord Tennyson.

There were also innovations and important inputs from those previously unconnected to the military, such as industrial engineers William Mills and Wilfred Stokes, inventors of the Mills grenade and Stokes mortar, respectively. Journalists and historians were brought in to conduct covert and overt propaganda — from great press barons such as Viscount Northcliffe to John Buchan, author of



**Secret Warriors: Key Scientists, Code Breakers and Propagandists of the Great War**  
TAYLOR DOWNING  
*Little, Brown: 2014.*

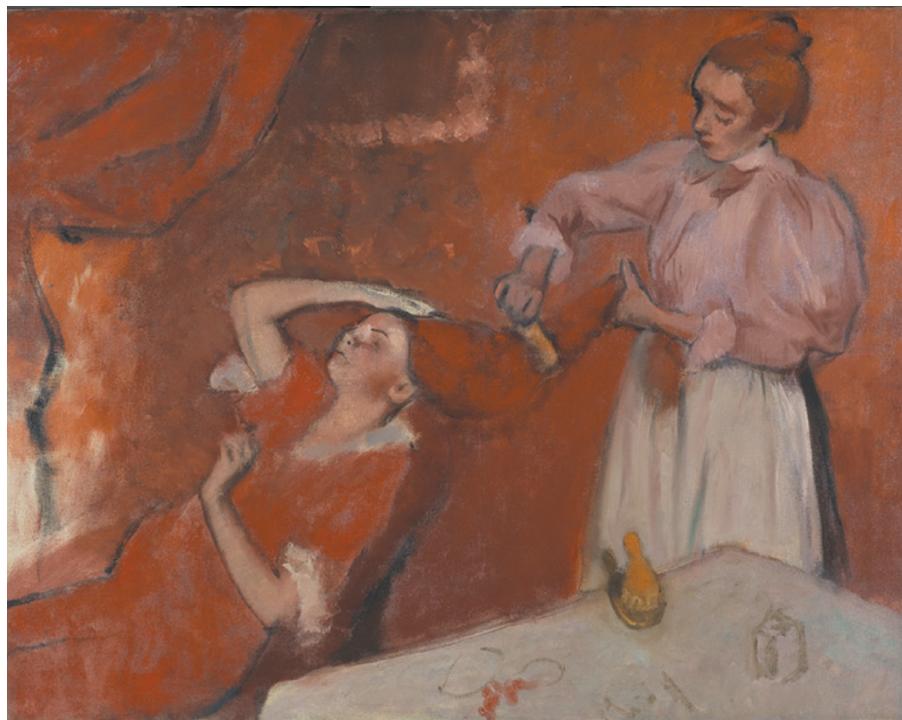
the classic thriller *The Thirty-Nine Steps*.

Along with that huge range of contributions to the war effort, what becomes evident in *Secret Warriors* is the easy relations between different elements of the elite to which nearly all these scientists and scholars belonged. It is fascinating to see how similar the situation was in both world wars, and how many names appear in accounts of both. At least 13 of the men mentioned by Downing were as familiar in the Second World War as in the first.

The straightforward story Downing tells is a refreshing change from older treatments of science and war, including academic ones. These derived from stories scientists wanted to have told — accounts of the military's indifference to science or biographies of conscience-stricken nuclear physicists. Such arguments have led to a lack of frankness about the actual relationship between science and war; even some literary scholars with an interest in science argue that it was only in the Second World War that science and the military became allied. Historians of science with a little more knowledge have even claimed that there were negligible links between the two before 1914. Downing has done a great service by ignoring these risible theses. The connections are long-standing, deep and important to both, and have been celebrated for centuries.

Downing does well to ignore previous accounts that stress an alleged hostility to new techniques among the British elite — a view that has severely distorted our understanding of the history of British science. But a little declinist mud has stuck to his boots, even when he is contradicted by the evidence that he presents. Thus he laments that the British military academy Sandhurst did not teach science, which might seem damning; but he notes elsewhere in the book that Woolwich, which trained engineers and artillery personnel, did. And although it might seem true that British universities were dominated by pure science and the arts, that is to ignore key points in other parts of the book, such as the importance of Cambridge engineering, or the point that many British universities were, to a significant degree, medical schools. In Britain, as elsewhere in both peace and war, science was and remains deeply connected to the military. What now needs to be explained is why so many intellectuals, especially in the sciences, sought to deny or ignore this. ■

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Vermilion, an ancient pigment, features in Edgar Degas' innovative 1896 *Combing the Hair*.

#### SCIENCE OF COLOUR

## Hue and eye

**Barbara Kiser** revels in an immersive show revealing the scientific base coat to 700 years of European art.

For millennia, artists chased the blues — from Egyptian blue frit to ultramarine, azurite, cobalt blue and indigo. Derived from earthbound minerals, metals and plants, these pigments signalled the celestial, tinting the robes of painted Renaissance Virgins by the score, and the saturated sky behind the meeting of god and mortal in Titian's sixteenth-century masterwork *Bacchus and Ariadne*. The hunt for blue — and all the other hues — is a tale as bound up in science and technology as in aesthetics and tradition.

That long, complex quest is chronicled in *Making Colour* at London's National Gallery. The show peers into the luminous slicks of paint in a Monet or a Memling to reveal the chemical and physical traits of the pigments and their origins. In rooms devoted to blue, green, yellow, red, purple, and gold and silver, exemplary paintings are set next to raw materials and the pigments derived from them. Alongside are manufactured objects glazed or dyed with the same colourants, pointing to the fact that up to the nineteenth century, many pigments were by-products of dye manufacture, metallurgy and other industries.

"We are trying to tell the history of materials in European painting in very visual form,"

**Making Colour**  
*The National Gallery,*  
*London.*  
*Until 7 September*  
*2014.*

explains exhibition co-curator Ashok Roy. He heads the gallery's science department, which for decades

has analysed the collection — spanning key schools of European art from the fourteenth to the nineteenth centuries. Over much of that time, artists "needed spectrally powerful colours for their paintings, particularly for the often brilliantly coloured robes of religious figures", notes Roy.

A vast sunburst of colour presides at the start of the show — the 72-colour 'chromatic diagram' devised in 1839 by chemist Michel Eugène Chevreul as a way of thinking about complementary colours. Nearby is Vincent Van Gogh's *Two Crabs* (1889), an electric contrast of hot reds and acid greens that testifies to Chevreul's influence. A cluster of other colour wheels includes that of Johann Wolfgang von Goethe. The German polymath's ideas on colour were muddled, but they opened the way to Chevreul's and influenced J. M. W. Turner, whose palette, smeared with a muddy impasto of russets and greens, is showcased across the room.

Beyond, the near-black walls give a ▶