directly to Henry Tizard, the chief scientific adviser to the defence ministry, led to the famous 1941 MAUD Report, which laid out the path to the development of the bomb. It was this that finally convinced Franklin Roosevelt and his advisers to authorize what came to be called the Manhattan Project.

But crediting the University of Cambridge's Cavendish Laboratory with discovering plutonium confuses speculation with investigation. And asserting that the man-made element was "also" discovered by Glenn (not 'Glen') Seaborg is simply wrong. Seaborg and his colleagues at the University of California at Berkeley were the first to precipitate a measurable quantity of element 94 from thorium, the accepted marker of discovery, on 5 March 1941. Both Carl Friedrich von Weizsäcker in Germany and the Cavendish team independently realized early on that transuranics would be highly fissionable, but the MAUD Report focused on isotope separation and a uranium bomb, and that was what Oliphant pushed when he came to the United States in August 1941. Plutonium production was authorized in early December 1941 only because the US physicists Ernest Lawrence and Arthur Compton vouched for it.

Hartcup's implicit model of Allied co-operation is a canny British head attached to a headless but muscular American body. In fact, inventions and discoveries emanated from both sides of the Atlantic as the two nations cooperated at unprecedented levels of trust.

Radar, pioneered in Britain, had the greatest effect on the war. "Radar won the war," US scientists say, "but the atomic bomb ended it." Surely there is more than enough credit to go around.

I found too many mistakes and misstatements in this brief book. Alan Turing's proposal for a punched-tape logic machine did more than merely "anticipate" the modern computer: it worked out its fundamental logic. The scarcity of uranium-235 in natural uranium is not the reason early theoretical estimates of bomb size were so large: people were still thinking in terms of slow neutron fission, which would have required weaponizing a nuclear reactor. (The crucial message Oliphant delivered on his mission to the United States was fast fission with pure uranium-235, a sphere of which has a tamped critical mass of only 15 kilograms.) Heavy water and other moderators don't "limit the multiplication of neutrons", but decelerate and reflect them.

Also, the implosion method of detonating a bomb was not "the responsibility of the British team" at the Los Alamos Laboratory, and although Peierls and Klaus Fuchs contributed to implosion theory there, it was not they alone who "made the implosion possible". Laboratory head Robert Oppenheimer redirected almost the entire Los Alamos staff to implosion work in the summer of 1944; the problem was that difficult. Hartcup properly blames Fuchs for passing secrets to the Soviet Union, but omits to mention the fully equivalent treachery of the American Theodore Hall.

Enough errors of this kind mar the atomic-bomb chapter of Hartcup's book to leave me wondering how reliable he is on subjects I know less about. Gas and bacteria Hartcup sees as "unacceptable weapons". Would that they had been. Applied narrowly to combat, that assessment is accurate, but it should not be forgotten that gas — pure carbon monoxide, carbon monoxide from engine exhaust, and cyanogen-releasing Zyklon — was used to murder millions of civilians in the gas vans and gas chambers of the Third Reich.

Hartcup's three-page conclusion, which purports to include the war's "aftermath", is far too modest. Science did much more than help win the war. By inventing the nuclear reactor, it made available the first new and practically unlimited energy source in human history. By inventing the atomic bomb (and the thermonuclear bomb that followed), it established a natural threshold beyond which war would be suicidal.

Harnessing science to war, the nation-states sought to enhance their power. Instead, science challenged the nation-state, simultaneously limiting its sovereignty and offering its populations the prospect of an abundance that may eventually remove the economic inequities that are the fundamental cause of war. The Second World War made science the most powerful political institution humankind has yet devised. ■

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Science in culture

Realities in wax

A comparative anatomical exhibition at the Deutsches Museum Bonn.

Alison Abbott

When La Specola museum opened its doors to the Florentine public for the first time in 1775, visitors were confronted with what would have probably been their first view of the inside of the human body. They saw detailed, anatomically correct, wax models of body parts, fed by their networks of blood vessels and supported by bones, tendons and muscles.

The collection was commissioned in 1771 by Grand Duke Leopold I of Tuscany, and over the next decades grew to more than 1,400 specimens. It was housed, along with other scientific exhibits, in the grand duke's *Wunderkammer*: public access to the new scientific knowledge was in the spirit of the times, which became known as the Age of Enlightenment.

Returning from Florence in 1786, Goethe reported that "three-dimensional anatomy ... has been practised in Florence for many years at a very high level, but it can only flourish where science, art, taste and technology are integrated in living practice".

The exhibition at the Deutsches Museum Bonn is part of the 'new' movement to bring together the worlds of art and science. The volume of knowledge is now so vast that the interface between the two is not as self-evident as that which sparked Goethe's words of admiration. But the exhibition nevertheless makes a salient point with its juxtaposition of 30 samples of the Florentine wax models — which have never before been permitted to leave their home town — with modern images of the body as seen from within: two-dimensional X-ray photos (some from 1895), three-dimensional computer magnetic resonance tomography, positron-emission tomography, angiography and the like.

Those naive eighteenth-century visitors would have been more impressed by their first confrontation with internal anatomy than we, with our overexposed and dulled senses, could ever be by more sophisticated, and theoretically more spectacular, medical images. ■

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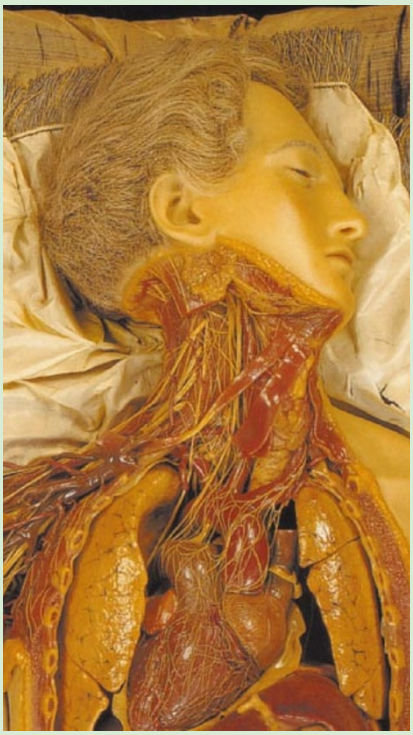
"*La Specola: Anatomie in Wachs im Kontrast zu Bildern der modernen Medizin*" (Anatomy in Wax in Contrast with Images of Modern Medicine) runs until 19 November 2000.



DEUTSCHES MUSEUM BONN