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EDITORIAL

Science, Technology and War

'Genghis Khan was a nomad and the inventor of a powerful war machine – and that conjunction says something important about the origins of war in human history. Of course it is tempting to close one's eyes to history, and instead speculate about the roots of war in some possible animal instinct: as if, like the tiger, we still had to kill to live, or, like the robin redbreast, to defend a nesting territory. But war, organized war, is not a human instinct. It is a highly planned and cooperative act of theft.'

J. Bronowski
The Ascent of Man
British Broadcasting Corporation
1973, p. 64

Jacob Bronowski in his television series 'The Ascent of Man' swept majestically across the centuries as he traced the evolution of science, culture and civilization in the Western world. For Bronowski, 'the largest single step in the ascent of man is the change from nomad to village agriculture'. Civilization grew on the banks of many great rivers and in keeping with his intellectual and religious roots, Bronowski followed the Old Testament and described the rise of agriculture in the Fertile Crescent of the Middle East. His description of Jericho as the 'key that locked' the way of the tribes of Israel 'down towards the Tigris and Euphrates' evokes an image of conflicts for fertile lands. Bronowski estimates that by 6000 BC Jericho was an agricultural settlement and a 'microcosm of history'. Several millennia later the banks of the Tigris and Euphrates are scenes of a war, that may at some future date be marked as a turning point in the history of the West. The war in Iraq, one-sided, pointless and at times, mindlessly brutal, is just over two weeks old. The war's end will be hastened, at least formally, by the enormous technological superiority of the American and British forces, aided by minor participants, who together constitute a 'coalition', which has contemptuously disregarded world opinion, in overrunning a sovereign country. We do not have to look far to seek the causes for this amazing display of arrogance; it is the enormous scientific, technological and economic superiority of the United States, which permits it to act largely unilaterally, in the face of world opinion.

The stated purpose of the war in Iraq has changed gradually over the past few weeks. It began with the per-

ceived threat posed by Saddam Hussein and his 'weapons of mass destruction (WMD)', particularly in the light of the alleged links of the regime in Baghdad with terrorist organizations. But gradually, the focus has changed; liberation of the Iraqi people from a brutal dictator has been trumpeted as the major objective; the war itself being christened as 'Operation Iraqi Freedom'. And, as Iraq is inexorably overrun by vastly superior armies, its enormously productive oilfields have become 'assets' to be secured for the 'future reconstruction' of the country, under American control. The 'weapons of mass destruction' (the definition of 'mass' appears unclear) are presumably, nuclear, chemical or biological weapons. In the prelude to the war, much was made of the use of chemical weapons on earlier occasions by the Iraqis, to quell a Kurdish rebellion and in the Iran-Iraq war. There is, of course, no clear evidence for the use of biological weapons. Nuclear weapons have never been employed in human conflict, after their use by the United States over Hiroshima and Nagasaki, in August 1945.

It is instructive to consider the pattern of usage and development of chemical and biological weapons. Despite the early use of chemical agents in World War I and the systematic use of hydrogen cyanide in German concentration camps during World War II, the widespread use of incendiaries and chemical defoliants reached its peak during the Vietnam War, with the United States resorting to napalm bombs and the spraying of herbicides like Agent Orange (dioxins), with little regard for human toxicity. Recent reports suggest that the US military is contemplating the use of 'chemical calming agents' on the streets of Iraq, in post-war crowd control situations. Clearly, the dangers of such agents on innocent bystanders is emphasized by the casualties sustained amongst hostages during the Moscow theater siege in October 2002 (Knight, J., *Nature*, 2003, **422**, 363). What kind of chemical agents are the Iraqis supposed to be ready to deploy? Many reports suggest that the chemical weapon of choice may be VX, a convenient pseudonym for a molecule that goes by the tongue-twisting chemical name of O-ethyl-S-(2-isopropyl-aminoethyl) methylphosphonothiolate. VX was developed by a British chemist in the early 1950s during a search for new pesticides. VX was found to be too toxic to use and was then the subject of further development by the US military. By the early 1960s full-scale production was possible. Understanding

of its mechanism of action, permitted the development of antidotes as 'auto-injector kits' for the US Army. VX acts as an inhibitor of neural transmission, causes rapid death and is reported to be more effective than its competitor, sarin. Interestingly, the Americans accuse Saddam Hussein of using VX, during the 1988 Halabja massacre, although the element of righteous denunciation appears to have surfaced only long after the event.

Biological weapons do not appear to have been used, thus far, although the 'weaponization' of the anthrax and botulinum toxins was completed by the United States and the erstwhile Soviet Union during the Cold War. The wave of 'terrorist anthrax mailings' in the aftermath of the World Trade Center attacks and the invasion of Afghanistan appear to have been traced to points within the United States. In addition to chemical and biological weapons, Iraq has also been accused of possessing nuclear weapons. It is the search for these 'weapons of mass destruction' that has ostensibly led to the present conflict. Do the Iraqis have the scientific and technological infrastructure to sustain a viable program of weapons development, during a decade-long period of international sanctions and intense surveillance? The view of the former British foreign secretary and leader of the House of Commons, Robin Cook provides a possible answer: 'Iraq probably has no weapons of mass destruction in the commonly understood sense of the term – namely a credible device capable of being delivered against a strategic city target. It probably still has biological toxins and battlefield chemical munitions, but it has had them since the 1980s, when US companies sold Saddam anthrax agents and the then British Government approved chemical and munitions factories. Why is it now so urgent that we should take military action to disarm a military capacity that has been there for 20 years, and which we helped to create?'

In the run-up to the war in Iraq, the worldwide community of scientists, dominated overwhelmingly by the countries of the 'coalition', has been largely silent. One group of US Nobel laureates did address the American president, calling the unilateral move on Iraq as a step that 'would undermine, not protect, US security and standing in the world'. Within the US the powerful scientific community has been cautious in its public statements on the war. Curiously, the flagships of American science have already begun to look for opportunities after the death and destruction. As Donald Kennedy notes in an editorial: 'Finally, there is the task of reconstruction. France and Russia have already sent unfortunate signals that they won't enlist for the peace either. Perhaps others will – but whatever nations and agencies join in, the work will need the full arsenal of science and technology: to repair infrastructure, to deliver aid to civilians, to protect the public health, and to start rebuilding a national economy'. (*Science*, 2003, **299**, 1945). The irony may not have been lost on Kennedy. The full arsenal of American science and technology, laser and satellite-guided smart bombs, cluster bombs and the most powerful conventional explosives available would have been used to decimate Iraqi cities. The battlefield would have also

provided experimental tests for the frightening range of military technologies that US research has successfully produced. Both the destruction and reconstruction of a perceived enemy fuel the science, technology and economic enterprise of the United States. Modern war is increasingly an exercise in using technological tools to inflict maximum destruction. Every attempt to control the 'weapons of mass destruction' has found the United States adopt the self-righteous position that all other countries must eschew development of the very same technologies, that it has found so effective in the conduct of international relations. Indeed, the US position on all international treaties, including non-military agreements like the Kyoto Protocol on Climate Change or the Biological Diversity Convention has not been in step with international opinion. An editorial comment in *Nature* (2003, **422**, 359) takes a cautiously optimistic view on the post-Iraq world: 'Instead, we must hope that an international consensus can be rebuilt, if falteringly at first. Scientific organizations have not had much to contribute to the debate running up to this war. But in its aftermath they should speak up loud and clear to press for internationalism in a world that could otherwise veer towards factionalism and further conflict.'

The response of governments across the Third World, and Iraq is indeed a constituent, has been muted. The increasing power of economic and trade sanctions in a globalized economy and the stranglehold that the countries of the coalition and their supporters exercise on international monetary organizations compels silence. The one inevitability of this war is that Baghdad will fall, as Kabul before it. But, students of history may recall another capital and another age. Almost exactly 28 years ago, in the dying days of April 1975, the last Americans were evacuated from the rooftops of their embassy in Saigon, which was almost immediately renamed as Ho Chi Minh city. In that war too, for almost a decade the B52s rained bombs on Vietnam, in an unassailable demonstration of superior military technology. In the end, 'victory' was still elusive.

The 'war on terror' proclaimed in the aftermath of 11 September 2001 is slowly being transformed into a well-coordinated exercise of 'theft' in Bronowski's definition. But, in these turbulent times it may be opportune to reflect on Bronowski's musings: 'We are a scientific civilization; that means, a civilization in which knowledge and its integrity are crucial.' Addressing himself to an undoubtedly Western audience he added: 'Science is only a Latin word for knowledge. If we do not take the next step in the ascent of man, it will be taken by people elsewhere, in Africa, in China. . . . Humanity has a right to change its colour.' Bronowski's conclusions after his broad sweep through the ages may strike a chord: 'We have not been given any guarantee that Assyria and Egypt and Rome were not given. We are waiting to be somebody's past too, and not necessarily that of our future.'

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