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Stephen Budiansky, *Blackett's War: The Men Who Defeated the Nazi U-Boats and Brought Science to the Art of Warfare*. New York: Knopf, 2013. Pp. xxiii, 306. ISBN 978–0–307–59596–6.

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Stephen Budiansky, a journalist and military historian,[1] prefaces his book with a bold statement: "From 1941 to 1943, a small group of British and American scientists, almost entirely without military experience or knowledge, revolutionized the way wars are run and won. Applying the basic tools of their trade—a thoroughly scientific mindset backed by little more than simple mathematics and probability theory—they repeatedly demonstrated to disbelieving admirals and generals ways to double or triple the effectiveness of the faltering Allied campaign against the German U-boats" (ix). Budiansky's book concentrates on the U-boat war that pitted dedicated British scientists against equally adept and resourceful German scientists, whilst sailors on both sides suffered and very often died. Two thousand eight hundred Allied ships were sent to the bottom of the cold Atlantic, and 784 U-boats (94 percent of the fleet) were sunk by Allied forces (252–53). Budiansky goes beyond these stark statistics to expose what Winston Churchill described as a war "hard, widespread and bitter, a war of groping and drowning, a war of ambuscade and stratagem, a war of science and seamanship" (100–101).

Patrick Blackett, the focus of Budiansky's attention, understood both seamanship and science. Educated at two naval institutions, he was second-in-class at Royal Naval College (RNC) Osborne and top cadet at RNC Dartmouth (26). During World War I, he served on HMS *Carnarvon* and was present at the sinking of the German cruiser *Gneisenau*. During the Battle of Jutland, he served on HMS *Barham*, in a squadron at which the Germans fired some five hundred 12-inch shells with little effect (27). After the war, on 25 January 1919, Blackett arrived at Cambridge University, one of four hundred junior officers the navy sent for a six-month course "with the object of instilling into us some general culture which had been lacking among those who had been whisked to sea in 1914 when very young" (3). About three weeks later, he informed his commanding officer that "the intellectual life of a place like Cambridge" (40) was what he was cut out for. Leaving the navy, Blackett went on to gain both a first in physics and a research fellowship at the Cavendish Laboratory.[2]

Budiansky quotes Robert Wohl[3] on the intellectual climate Blackett encountered at Cambridge: "By the end of the 1920s, most English intellectuals believed the [1914–18] war had been an unmitigated disaster, that England's victory was in reality a defeat, and hence that the men who had caused England to enter the war and to fight it through to the bloody end were either mercenary blackguards or blundering old fools" (69). Churchill termed this "the mood of unwarrantable self-abasement" (68). Then, during the 1930s,

> The Nazis' intensifying persecution of the Jewish scientists in Germany chipped away at both leftist pacifism and centrist apathy in the British scientific community. Blackett, for all his continued entrenchment with Marxist ideas about the role of science in advancing the working class, and his more than passing gullibility in accepting Soviet assertions about the USSR's unsurpassed support of scientific research, had parted company early with the pacifist party line of the British left on precisely this point. [By 1940,] the Royal Society had add-

1. His previous books include *Battle of Wits: The Complete Story of Codebreaking in World War II* (NY: Free Pr, 2000), *Air Power: The Men, Machines, and Ideas That Revolutionized War, from Kitty Hawk to Iraq* (NY: Viking Penguin, 2004), *Her Majesty's Spymaster: Elizabeth I, Sir Francis Walsingham, and the Birth of Modern Espionage* (NY: Viking, 2005), *The Bloody Shirt: Terror after Appomattox* (NY: Viking, 2008), and *Perilous Flight: America's Intrepid War with Britain on the High Seas, 1812–1815* (NY: Knopf, 2011)—review at *MiWSR* 2012-007.

2. The reviewer served as Administrator of the Blackett Laboratory, which houses the Department of Physics at Imperial College, London.

3. *The Generation of 1914* (Cambridge, MA: Harvard U Pr, 1979) 109.

> ed its support for the compilation of a Central Register of British scientists who could be called upon to assist the war effort, a proposal quickly accepted by the government; some 7,000 scientists were enrolled, including 1,175 physicists. (82, 85)

Shortly after the start of World War II, Blackett was appointed a scientific officer at the Royal Aircraft Establishment at Farnborough and eventually joined the Tizard Committee, renamed the Committee for the Scientific Survey of Air Warfare. He noted that "many of the operational problems which arise when new equipment comes into service require for their solution the aptitude of the scientific research worker: for he is trained to apply scientific methods to elucidate hitherto unknown and complex phenomena" (87). Air Marshall John Slessor, a self-confessed supporter of operational research, countered that "the most important factors in any battle are the factors of leadership, morale, courage and skill, which cannot be reduced to any mathematical formula" (235).

Blackett recruited brilliant but occasionally bizarre colleagues. For example, E.J. Williams, elected Fellow of the Royal Society in his thirties, "tended to veer from shyness to argumentativeness; he had a 'wildness and unexpectedness in his behaviour' that would burst out in startling ways with those he got to know. He drove a car, Blackett said, 'with complete disregard of the laws of dynamics.' Another friend recalled that his sense of time 'was practically non-existent.' Williams would not uncommonly work until three or four in the morning and then phone a friend excitedly, only to be overwhelmed with remorse upon discovering he had awakened his victim" (138). Williams jumped right into the most pressing dilemma at the time: why were the aircraft of Coastal Command sinking so few submarines? (141). He eventually showed that air attacks would be far more effective if concentrated on U-boats caught on the surface or within fifteen seconds of diving, before they could evasively change course. Adjusting the depth setting and spacing of depth charges led to a dramatic increase in kills (144). Blackett and another colleague, J.H.C. Whitehead, showed that doubling the size of an Atlantic convoy increased by only a sixth the number of escort vessels needed to provide the same protection (225).

The effectiveness of new equipment could be overstated. The invention of asdic (sonar) "meant that the submarine should never be able to present us with the problem we were faced with in 1917" (87), opined the author of a British naval staff report. It was even suggested that asdic should be declassified, to convince potential enemies of the uselessness of submarines so they would not build any! (90). Conversely, the navy resisted the immediate introduction of radar: it first demanded, and got, its own radar research laboratory to address the special problems of operating and maintaining the equipment at sea (107). Weakly funded, naval radar was deployed late and was chiefly air-oriented. Churchill himself diverted attention to the submarine threat, and the "first anti-surface vessel, or ASV, radars [began] arriving in spring 1941. Installed on the corvettes and other escort vessels, they made an immediate impact on the [U-boat] battle" (108).

After Churchill became Prime Minister, he acquired a forceful, impetuous scientific adviser, Prof. Frederick Lindemann (later Lord Cherwell). To the rest of the scientific community, this was a mixed blessing: while Lindemann convinced Churchill of the value of science, he often allowed his own pet schemes to absorb scarce resources and clung to his positions long after they had been discredited. Blackett joked: "If anyone in the Air Ministry [aligned with Lindemann] 'added two and two together to make four,' suspicions would arise that 'he had been talking to Tizard and Blackett' and was 'not to be trusted'" (201). Blackett summed up the myopic service response to one scientific report: "Let us have no more of these miserable statistics, which only paralyse the brain and freeze the blood" (202).

Churchill, nevertheless, called for a statistics department to provide him with a steady flow of data, and enthusiastically showered the scientific community with often impracticable Churchill-Lindemann research projects. One of these, however, the degaussing of ships, proved spectacularly successful (106). Statistics and intelligence overlay the U-boat war, but the Government Code and Cipher School (GC&CS) was stuck in a time warp. "Of the twenty-one academics brought into GC&CS during the first weeks of the war, only three were mathematicians. All the rest were from the humanities and came through the usual channels; they had, in the words of GC&CS's head, Alastair Dennison, been recruited by 'men now in senior positions' at Oxford and Cambridge who 'had worked in our ranks during 1914–18'" (109). Early output from GC&CS's

home, Bletchley Park, often met service apathy. Having broken the German merchant navy's code, Bletchley informed the Admiralty that German ships heading for Bergen had been ordered to report their position at stated intervals to the War Office in Berlin. An Admiralty staff officer rebuffed this valuable information as nonsense: ships would report to *naval* headquarters not army headquarters. Hitler invaded Norway shortly afterwards (111).

Asdic, radar, and increasingly centralized control of British anti-U-boat scientific research and operations gradually made an impact. From the U-boat perspective, the Happy Time they had enjoyed before the science-aided Royal Navy began to sink many of their number gave way to gloom. (There was a brief, second Happy Time when overconfident America entered the war and offered easy targets against its still illuminated eastern seaboard.) Budiansky describes the lives of U-boat personnel in considerable detail, from their final moments in 1918 (4) through their arduous but well rewarded duty in World War II (120) up to their second surrender in 1945 (250–51).

When America entered the war in December 1941, it underwent the same learning curve that the British had endured two years earlier. "The command structure of the U.S. Navy was a holy mess. Responsibility for antisubmarine warfare was split among a dozen different commands; no one was in charge. Actual control of antisubmarine patrols along the Atlantic coast rested with the admirals who commanded the separate naval districts based at each of the major ports … but the ships themselves belonged to the Atlantic Fleet" (177). The man President Franklin Roosevelt appointed Navy commander in chief after Pearl Harbor, Admiral Ernest King, was brilliant, capable, and confident, but also bullheaded, ruthless, and vindictive (178). Indeed, King's own daughter allegedly observed "My father is the most even-tempered man in the navy. He is always in a rage" (179). Under King's direction, US capability and US-British military and scientific cooperation gradually improved. "In late March [1943] the first American escort carriers began appearing in the Atlantic; these were small ships that carried twenty-four fighters and navy attack planes and extended air cover across the Atlantic to the convoys" (242). In Britain, Bletchley Park had made several crucial breakthroughs, and by November 1943, science, intelligence, and the two navies had broken U-boat morale: "an increasing number of [U-]boats were declaring 'mechanical difficulties' during their outbound transit of the Bay of Biscay and turning back to port" (244).

The scientists' major achievement during the Second World War was to establish a permanent presence within the higher echelons of the armed services and to inaugurate a new academic discipline—operational research. Aircrews remarked that British scientists "might be mad, but they got results" (206). Patrick Blackett continued to distinguish himself after the war. In 1948, he won the Nobel Prize in physics and that same year published the pro-Soviet/anti-American *Military and Political Consequences of Atomic Energy*.[4] Prime Minister Clement Atlee commented that "The author, a distinguished scientist, speaks on political and military problems on which he is a layman" (257).

Blackett's War is a well-written, thoughtful book[5] that sympathetically portrays and assesses the German, British, and American participants in the U-boat War. It will appeal to a broad readership, not least the military historian.

4. London: Turnstile Press. Interestingly, during the 1980s, the Head of Physics at Imperial College was also chairman of Scientists against Nuclear Armaments (SANA).

5. Comprising a preface (ix–xi), useful map and chronology (xii–xxiii), eleven chapters (3–261) featuring many interesting photographs and useful diagrams, notes (263–80), a bibliography (281–91), and an index (293–306).