The Janus-face of Techno-nationalism

Barnes Wallis and the "Strength of England"

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Barnes Wallis has long been the most famous British engineer of the twentieth century. Celebrated for his invention of the "Bouncing Bomb," used in the "Dam Busters" raid during World War II, he has been the subject of the immensely popular and still well-known British film *The Dam Busters*, released in 1955, and a major BBC television documentary in 1967 and two biographies, one in 1973, the other in 2005.[1] The Bouncing Bomb and the Dam Busters raid have been the subject of numerous popular books, while his representation in *The Dam Busters* has itself received attention from historians. In 2001, a public poll made him one of the hundred "Greatest Britons" ever—the only other engineers on the list were Isambard Kingdom Brunel, James Watt, and Frank Whittle.[2] But fame is not power, and there

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1. *The Dam Busters* (1955), directed by Michael Anderson, and Glyn Jones, *Why Not? Why Not!* BBC Television documentary, broadcast on 19 January 1967, National Film Archive. The authorized biography was published in hardback and paperback during his lifetime (with a new edition in 1981): J. E. Morpurgo, *Barnes Wallis: A Biography* (London, 1981 [1973]); subsequent citations of this work refer to the 1981 edition. The recent biography was published as part of a series of popular history books by Icon that included the biography of one other engineer, Frank Whittle: Peter Pugh, *Barnes Wallis: Dambuster* (London, 2005). Also informative are Alfred Pugsley and N. E. Rowe, "Barnes Neville Wallis," *Biographical Memoirs of Fellows of the Royal Society* 27 (November 1981): 603–27, and N. W. Boorer, "Barnes Wallis—Designer (1887–1979)," *Aeronautical Journal* 85 (1981): 414–29. Wallis's letters to his fiancé and subsequent wife have also been published; see Mary Stopes-Roe, *Mathematics with Love: The Courtship Correspondence of Barnes Wallis, Inventor of the Bouncing Bomb* (Basingstoke, U.K., 2005).

2. On his wartime work, see Stephen Flower, *A Hell of a Bomb: The Bombs of Barnes Wallis and How They Won the War* (Stroud, U.K., 2002), and Stephen Flower, *Barnes Wallis' Bombs: Tallboy, Dambuster, and Grand Slam* (Stroud, U.K., 2004). The most significant works on the "Dam Busters" raid are Paul Brickhill, *The Dam Busters* (London, 1952), and John Sweetman, *The Dambusters Raid* (London, 1999); the most recent is Jon-

were postwar engineers who had greater influence and were more grandly decorated than Wallis.[3] In interesting and important ways, however, Wallis stood for engineers as a whole and their power and influence, or lack of it, for many decades. Although his fame as an engineer and representative of British engineering endures, his powerful and distinctive vision of a future England and English engineering—the one most clearly articulated by an engineer during the postwar period—does not.[4]

In a series of speeches and interviews from the 1950s to the 1970s, Wallis denounced England's decline and put forward a program for its redemption.[5] The creativity of its engineers and their new technologies of trade and communication, he argued, could arrest national decline and reinvigorate the British Commonwealth. Wallis spoke with authority, and his arguments were taken up and debated by both supporters and detractors. While many of these arguments were not original, they nevertheless reflected and provided a prominent example of what was taken to be a central problem of British science and technology in the postwar years: inadequate support from the British government. He did not restrict himself to rhetoric—he attempted to materialize his ideology through his designs. Wallis designed supersonic swing-wing airplanes and merchant cargo-

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athan Falconer, *The Dam Busters Story* (Stroud, U.K., 2007). The literature on his representation in *The Dam Busters* film argues that the film depicts him as the archetypical English boffin ("boffin" being a common British term in the postwar period for a stereotypically individualistic, eccentric, intelligent, and yet somewhat socially inept scientist or researcher); see R. A. Jones, "The Boffin: A Stereotype of Scientists in Post-War British Film (1945–1970)," *Public Understanding of Science* 6 (1997): 31–48; John Ramsden, "Refocusing 'The People's War': British War Films of the 1950s," *Journal of Contemporary History* 33 (1998): 35–63; and Christopher Frayling, *Mad, Bad, and Dangerous? The Scientist and the Cinema* (London, 2005), 184–86. On Wallis as one of the "Greatest Britons," see http://news.bbc.co.uk/1/hi/entertainment/tv_and_radio/2208671.stm (accessed 3 August 2007).

3. Although he was not elevated to a peerage, Wallis was knighted in 1968. He was also the recipient of numerous other honorary degrees and awards, including the Ewing Medal (1945), Fellow of the Royal Society (1945), Founder's Medal of the Air League (1963), Honorary Fellow of Churchill College (1965), and Fellow of the Aeronautical Society (1967). Engineers knighted soon after World War II included the jet engine designers Harry Ricardo and Frank Whittle (both in 1948). Engineers reaching the peerage after that included the aeronautical engineer George Edwards and the nuclear engineer Christopher Hinton.

4. An exceptional and more recent techno-nationalist vision of a future Britain that is akin and specifically linked to Wallis is Roy Sherwood, *Superpower Britain* (Cambridge, 1989).

5. Wallis referred to England and the strength of England throughout his rhetoric, yet he also spoke of the British Empire, the British Commonwealth, and sometimes Britain. Although Wallis himself did not comment on the relationship between Britain and England, it is clear that for him the two were virtually synonymous: England, for Wallis, was at the heart of Britain as well as the Empire and the Commonwealth. When discussing Wallis's rhetoric I will use his terms, but for the purposes of this essay his use of "England" and "English" should be considered synonymous with "Britain" and "British."

JANUARY
2008
VOL. 49

carrying submarines, both of which he viewed as quintessentially English technologies that would counter U.S. commercial and Soviet military threats. Individuality, craftsmanship, high technology, and anti-gigantism were, he believed, all aspects of English technology that stemmed from the uniqueness of the English character.

This technological nationalism was backward-looking in character: Wallis sought technological solutions to Britain's decline that drew on particular notions of technology and empire from the interwar period. He envisaged a "second Elizabethan Age" in which a mercantilist, even autarkic, Britain would be at the heart of a strengthened British Commonwealth. Wallis's views on the British Empire, the Commonwealth, "New Elizabethanism," morality, and the family were typical of the postwar political Right. Indeed, he had close associations with Conservative members of Parliament (MPs) (and, later, the far-right "Monday Club"), and he was much exercised by nonwhite immigration into Britain. Like many on the Right at that time, he was notably anti-American.[6] This particular mix of beliefs is of some significance because it reminds us that enthusiasm for high technology and progressive thinking should not be conflated—the two are not always congruent in twentieth-century ideologies.

Wallis provides an example of technological nationalism as a *critique* of the technological policies of the state, as well as of leading engineers and of industry. This point is of interest, as most studies of technological nationalism characterize it as an ideology of the state and do not inquire into the politics of engineers.[7] Exceptions are to be found in the work of Jeffrey Herf and Gabrielle Hecht, who have studied the politics of engineers and technocrats. There are clear similarities between Wallis and the four German engineers studied by Herf who were active in the Weimar and Nazi periods, and the French nuclear engineers studied by Hecht: all were nationalistic in their thinking about technology and wanted to create technologies bearing national characteristics.[8]

6. On British Conservatism, see W. H. Greenleaf, *The British Political Tradition*, vol. 2: *The Ideological Heritage* (London, 1983), chaps. 6 and 7.

7. Most such studies deal with non-British cases; prominent examples include Maurice Charland, "Technological Nationalism," *Canadian Journal of Political and Social Theory* 10 (1986): 196–220, and Richard J. Samuels, *Rich Nation, Strong Army: National Security and the Technological Transformation of Japan* (Ithaca, N.Y., 1994). A similar concept is presented for the Soviet case in Paul R. Josephson, *Totalitarian Science and Technology* (Atlantic Highlands, N.J., 1996), and, in relation to aviation, in Peter Fritzsche, *A Nation of Fliers: German Aviation and the Popular Imagination* (Cambridge, Mass., 1992) and Guillaume de Syon, *Zeppelin! Germany and the Airship, 1900–1939* (Baltimore, 2002).

8. Jeffrey Herf's study of the writings of Viktor Engelhardt, Marvin Holzer, Eugen Diesel, and Heinrich Hardensett can be found in Herf, *Reactionary Modernism: Technology, Culture, and Politics in Weimar and the Third Reich* (Cambridge, 1984), 152–88. For the argument that Greek engineers during the late 1930s also displayed a "Greek version of Reactionary Modernism," see Yiannis Antoniou, Michalis Assimakopoulos, and Konstantinos Chatzis, "The National Identity of Inter-War Greek Engineers: Elitism, Ration-

Historians examining the ideologies of right-leaning engineers have almost exclusively focused on interwar and Nazi Germany. In the historiography of U.S. engineering and British science, those figures with left-wing politics have gained the most attention, including, for example, the American engineer Charles Steinmetz and the British scientists J. D. Bernal and Patrick Blackett.[9] Yet it is becoming clear that there existed a powerful right-wing technocratic impulse in postwar Britain, as well as widespread nationalistic technological enthusiasm.[10] In fact, we can only make sense of Wallis's story and his ideas within the context of a new *postdeclinist* historiography of postwar Britain. This approach no longer takes the complaints of scientists and engineers as evidence for the state of science and engineering, but instead problematizes their rhetoric and its relationship to wider discourses within society, as well as to historians' own accounts.[11] This detailed study of Wallis, who was a remarkably well-known engineering ideologue, gives us a clearer picture of how declinist narratives of British history, in which technology was central, were constructed and used (fig. 1).

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alization, Technocracy, and Reactionary Modernism," *History and Technology* 23 (2007): 241–61. See also Gabrielle Hecht, *The Radiance of France: Nuclear Power and National Identity after World War II* (Cambridge, Mass., 1998).

9. Ronald Kline, *Steinmetz: Engineer and Socialist* (Baltimore, 1992), and Zara Witkin, *An American Engineer in Stalin's Russia: The Memoirs of Zara Witkin, 1932–1934* (Berkeley, Calif., 1991). The most crucial collective studies of U.S. engineers and their ideologies remain Edwin T. Layton Jr., *The Revolt of the Engineers: Social Responsibility and the American Engineering Profession* (Baltimore, 1986), and David F. Noble, *America by Design: Science, Technology, and the Rise of Corporate Capitalism* (Oxford, 1977). An exceptional study of a left-leaning German engineer is Donald E. Thomas Jr., *Diesel: Technology and Society in Industrial Germany* (Tuscaloosa, Ala., 1987); for an example of a study of a right-wing Anglo-Australian engineer, see Philip Gissing, "Sir Philip Baxter, Engineer: The Fabric of a Conservative Style of Thought" (Ph.D. diss., University of New South Wales, 1999). Typical among studies of left-leaning British scientists is Gary Werskey, *The Visible College: A Collective Biography of British Scientists and Socialists of the 1930s* (London, 1978).

10. See the critiques of the historiographical emphasis on the technocratic Left in David Edgerton, *England and the Aeroplane: An Essay on a Militant and Technological Nation* (London, 1991), and David Edgerton, *Warfare State: Britain, 1920–1970* (Cambridge, 2006). On postwar "bipartisan technological chauvinism," see P. David Henderson, *Innocence and Design: The Influence of Economic Ideas on Policy* (Oxford, 1986), 68–70. A case study of the disastrous effects of misguided government nationalistic technological enthusiasm is Duncan Burn, *Nuclear Power and the Energy Crisis: Politics and the Atomic Industry* (London, 1978), 8–11, 150–93. On the airplane, technology, and Englishness, see Edgerton, *England and the Aeroplane*, and Richard Weight, *Patriots: National Identity in Britain, 1940–2000* (London, 2002), 215–39. On British technological nationalism during the interwar period, see Bernhard Reiger, *Technology and the Culture of Modernity in Britain and Germany, 1890–1945* (Cambridge, 2005), chap. 8.

11. The older historiography of twentieth-century Britain was itself largely declinist regarding British science and technology; prominent examples, among many, included Martin Weiner, *English Culture and the Decline of the Industrial Spirit, 1850–1980* (Cambridge, 1981); Correlli Barnett, *The Audit of War: The Illusion and Reality of Britain as a*

JANUARY
2008
VOL. 49

FIG. 1 Barnes Wallis with a model of the Swallow concept. (Courtesy of the Science & Society Picture Library.)

Within the Military-Industrial Complex

Born in Ripley, Derbyshire, in September 1887 to a well-educated middle-class family (his father was an Oxford University–educated medical doctor), Barnes Neville Wallis attended, on a scholarship, the prestigious public school Christ's Hospital until the age of seventeen, whereupon he joined the marine engine manufacturer Thames Engineering Works as an apprentice. In 1913, he moved into airship design with Britain's leading arms company, Vickers, and in the 1920s, after a few months teaching mathematics at a school in Switzerland, he went to work on the design of the R-100 airship. In the 1930s and during World War II, Wallis worked on

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Great Nation (London, 1986); and Meredith Veldman, *Fantasy, the Bomb, and the Greening of Britain* (Cambridge, 1994). An early postdeclinist work is Edgerton, *England and the Aeroplane*. For analyses of the effects and significance of declinism, see Deirdre N. McCloskey, *If You're So Smart: The Narrative of Economic Expertise* (Chicago, 1990), 40–55; David Edgerton, "The Prophet Militant and Industrial: The Peculiarities of Correlli Barnett," *Twentieth-Century British History* 2 (1991): 360–79; W. D. Rubenstein, *Capitalism, Culture, and Economic Decline in Britain, 1750–1990* (London, 1993); Barry Supple, "Fear of Failing: Economic History and the Decline of Britain," *Economic History Review* 47 (1994): 441–58; David Edgerton, *Science, Technology, and the British Industrial Decline, 1870–1970* (Cambridge, 1996); Jim Tomlinson, *The Politics of Decline: Understanding Post-War Britain* (Harlow, U.K., 2001); and Edgerton, *Warfare State*.

various aircraft projects for Vickers (most prominently on the structural design of the Wellesley and Wellington bombers), although he is best remembered for his development of the Bouncing Bomb.[12]

Wallis's wartime work brought him significant recognition, both from the government—from whom he received the honor Commander of the British Empire (CBE) in 1943 for his work on bomber design—and from the media. He was feted on the front pages of the national press in 1944 as the "quiet, deep-thinking scientist" who designed the bomb that sank the "unsinkable" German battleship *Tirpitz*.[13] The release of the immensely popular British film *The Dam Busters* in 1955 ensured Wallis's continued popularity. Michael Redgrave's portrayal of him reinforced his existing public persona as the archetypal introverted scientific genius who helped Britain win the war, and this is how he is still remembered today. Media and public interest remained high throughout the 1950s and 1960s, reaching its height in 1967 with a screening of a BBC documentary on his life.

Wallis built up significant contacts and influence in government and industry during World War II, and in 1945 he was offered the directorship of an independent research department by the chairman of Vickers. He stayed there (Vickers Aviation was eventually consolidated into the British Aircraft Corporation) until his retirement in May 1971. At Vickers, Wallis worked on several research projects, the most significant of which were related to his variable-geometry aircraft designs. These occupied him throughout his postwar career until his death in 1979.

Wallis's postwar designs were never built, however, as government funding for them began to dry up during the late 1950s. Disappointed, he turned increasingly to the public arena to air his views on science and technology, and he went on to become a prolific and engaging speaker. In numerous lectures, as well as in the many media interviews he gave during the 1950s through the 1970s, Wallis discussed his own research projects and linked them to the state of the nation, future technology, and the need for more creative engineering. Among his many lectures and speeches, his "The Strength of England" lecture in particular is worthy of note. He first gave this lecture at Eton College in 1957, thereafter repeating it in various forms at least thirty-nine times over the next fifteen years at institutions linked explicitly to science and engineering—schools and universities, military and civil-service establishments, learned societies, and science and engineering firms. The content of his talks, his engaging style, and his celebrity ensured an enthusiastic reception, and he was often asked to return and present again at the same venue. Prominent renditions included the versions given as the Christmas Lecture at the Institution of Civil Engineers in 1959 and

12. The best history of the raid is in Sweetman (n. 2 above).

13. Although unusual for an engineer of that time, his picture appeared in some articles, including "Tirpitz Sunk: Full Story," *Daily Mail*, 14 November 1944, and "Unsinkable Sunk," *Daily Express*, 14 November 1944.

at the Engineering Materials and Designs Exhibition at Earl's Court in 1963 (both of which attracted significant newspaper coverage), and the Presidential Address to the Engineering Section of the British Association for the Advancement of Science in September 1965 (published in *Advancement of Science* in November 1965).[14]

JANUARY
2008
VOL. 49

The Strength of England

The premise of Wallis's argument was that England had once been a mighty nation that had declined industrially, politically, and morally from World War II onward. He argued that the link between England's golden past, its decline in the present, and the yet-to-be reclaimed future was in the development of particular types of high technologies by inventive and creative engineers.[15] The glory of England's past, he argued, lay in its imperial might and mercantile dominance: the British Empire, with England at its heart, was the last of a line of powerful global-trading empires that included those of the Romans and the Egyptians. Political and industrial decline were largely due to the loss of empire, the cost of World War II, and, most important, the inability to capitalize on English scientific discoveries and technological advances:

> The real interpretation of the backwardness of this country is that it is a characteristic of the British brain that it is always seeking after truth, and is not particularly interested in what anybody does with the knowledge that it gains. We see this happening in industry time and again. Some clever scientist stumbles on some fact and may write to a scientific paper about it. A few years later we find that Germany, Russia or America has come out with the very thing that has been lying unnoticed in that man's drawer for years.[16]

The decline was not just political and industrial: the strength of the English character had also declined. This was due, he argued, to inward immigration from the new Commonwealth, outward emigration of the English, and

14. Other than "The Strength of England," prominent lectures included two presented at (and subsequently published by) the Royal Society of Arts: Barnes Wallis, "Artist or Engineer," *Journal of the Royal Society of Arts* 61 (1963): 724–35; and Barnes Wallis, "Man the Creator," *Journal of the Royal Society of Arts* 64 (1966): 813–22. His "The Strength of England" lectures received coverage in both the aeronautical and the mainstream press; see for example "Barnes Wallis Talks," *Flight* 77 (1960): 34–35; "Restoring Sea Supremacy for England," *The Times*, 3 September 1965; and "Dr. Barnes Wallis Foresees Air Supremacy for Britain," *The Times*, 12 November 1963.

15. For a general discussion of nationalist "primordialist" polemic, albeit directed toward mass action, see Matthew Levinger and Paula Franklin Lytle, "Myth and Mobilization: The Triadic Structure of Nationalistic Rhetoric," *Nations and Nationalism* 7 (2001): 175–94.

16. Quoted in "Britain Can Have Great Future," *Surrey Comet*, 2 November 1959.

a general decline in patriotism among the nation's youth. The decline manifested itself both in a widespread lack of appreciation for the historically proven importance of technology to the nation, and in an inability to appreciate and recognize the inherent strengths of England and of the character of visionaries like himself.[17]

Wallis's belief in the decline of the nation was widely held across Britain during the 1950s and 1960s. England, it was commonly argued, was a diminishing international power in terms of military strength, international weight, and economic productivity. Science and technology in particular often played the central role in these narratives, the mismanagement of which was identified as both a cause and a symptom of national decline. Some pundits blamed politicians and the civil service, which Arthur Koestler argued, for example, were subjecting Britain to "'rule by mediocracy.' The cult of amateurishness, and the contempt in which proficiency and expertise are held, breed mediocrats by natural selection."[18] For others, the problem lay with the industrial-managerial class, which was afflicted with the same amateurishness. The leftist intellectual Goronwy Rees wrote that:

> There exists at this moment a fantastic wealth of new scientific and technological knowledge, of new techniques and new processes, which if applied to industry would revolutionize Britain overnight. In this sense it is not true to say that Britain's problems are primarily economic ones; the means already exist by which those problems can be overcome. But it is true to say that the great majority of those who form the country's grand committee of management do not have the knowledge or the understanding to apply them.[19]

Wallis's notion of decline was part of a wider postwar discourse, but his ideas about the potential for greatness of the nation and its land (the true "strength of England") were distinctively rooted in interwar and early postwar mercantilist thinking. In his earliest lectures, Wallis argued that Eng-

17. His preoccupation with immigration is most evident in the earliest of "The Strength of England" lectures; see, for example, Barnes Wallis, "The Strength of England," lecture to the Bristol University Engineering Society (12 February 1959), Barnes Wallis Papers, Science Museum Library archive, ARCH: BNW H5. For his argument relating the degradation in the English character to the welfare state, see "I'll Give Them a Last Chance Says Barnes Wallis," *Sunday Express*, 16 July 1967. His argument that English patriotism disappeared in the postwar period can be found in a radio interview with Christopher Brasher, *The Great Inventor*, BBC Radio Documentary (1979 or 1980), British Library National Sound Archive, T2676W C1.

18. Edgerton, *Science, Technology, and the British Industrial Decline* (n. 11 above); Edgerton, *Warfare State* (n. 10 above), 191–229; and Arthur Koestler, "Introduction: The Lion and the Ostrich," in *Suicide of a Nation? An Enquiry into the State of Britain Today*, ed. Arthur Koestler (London, 1963), 7–14, quote on 14.

19. Goronwy Rees, "Amateurs and Gentlemen or the Cult of Incompetence," in *Suicide of a Nation*, 39–50.

JANUARY
2008
VOL. 49

land was inherently strong because it was the "centre of the civilised world," because it had a "readily accessible seaboard," "a widespread system of inviolable communications," "the will to be great," and, last, because of the intellectual power, creative originality, and superior craftsmanship of the English people.[20] He restated these in later lectures in various ways, though by the mid-1960s Britain's geographical strengths became the singular focus of his argument. These he described as "Strength by Sea"—"to say now that all oceans lead to England is to describe a condition as permanent as the surface of the globe"—and "Strength by Air"—"our central position in the World of Trade, upon which our superiority at sea depends, should confer upon us a similar superiority in the air. . . . England's position might well be described as that of the 'Clapham Junction' of the air world." In the air, however, Wallis believed that England was weak because it was, "in the present state of aeronautical engineering, dependent upon the goodwill of a number of foreign countries, even to reach our fellow countrymen in Australia and New Zealand!"[21]

Wallis's concern for England's transport connections to her colonies and Commonwealth dated back to the interwar years. Concern about the potential of intervening sovereign states to disrupt vital imperial air and sea links was then quite commonplace, and Wallis himself had published a call for the development of imperial aerial communication in the journal of the British Empire League in 1927.[22] John Moore-Brabazon's statement in the House of Lords in 1928 that "it is intolerable to think that Persia can decide what route we are to take over her territory" was typical of those seeking to further develop British aviation within the context of the empire during the 1920s and 1930s.[23] In addition, Wallis's concept of "centrality" was itself derived from two works of the interwar period: *The Strength of England* by the naval officer George Bowles (published 1926), and *The World, the Air, and the Future* by the aviation entrepreneur Charles Dennistoun Burney

20. Wallis, "The Strength of England" (Bristol lecture).

21. Barnes Wallis, "The Strength of England," *Advancement of Science* 22 (1965): 393–408. Clapham Junction was then, and still is, the busiest train station in Britain, possibly even Europe.

22. Barnes Wallis, "The Importance of the Development of Our Empire Air Communications of Research and Experimental Work upon Airships," *British Empire Review* 24 (1927): 163–64. There is currently little work on interwar beliefs about the importance of civilian aviation for the British Empire, but there is some brief coverage in Edgerton, *England and the Aeroplane* (n. 10 above), 21, and in Peter J. Lyth, "The Empire's Airway: British Civil Aviation from 1919 to 1939," *Revue Belge de Philologie et d'Historie* 78 (2000): 865–87.

23. See the 1928 air estimates debate in Parliament: "Supply—Air Estimates," in *Official Report, Fifth Series, Parliamentary Debates: Lords* 214 (12 March 1928), cols. 1533–1669, esp. 1603–04. John Moore-Brabazon (1884–1964) was a prominent aviation insider, one-time Conservative MP and Peer, and parliamentary secretary to the Ministry of Transport during the 1920s. He is most remembered for his work during World War II on the planning of postwar civilian aircraft.

(published 1929).[24] Bowles argued for the continuation of British naval supremacy by illustrating how Britain was at the center of the world's geographic landmasses and of global oceanic trade routes. Using various global projections, he claimed that this "sea-centrality" was at the heart of English commercial and imperial supremacy, just as a similar sea-centrality had been the source of power for earlier global empires. Burney's concerns, on the other hand, were with aviation, and in particular, the aerial high technology of his day: the airship. With an early background in naval engineering, he went on to become an MP and to establish the Airship Guarantee Company, which built the R-100 and where Wallis worked as chief engineer during the 1920s. Burney extended Bowles's concept of sea-centrality to the air. Although Britain's sea-centrality had served the nation in the past, he argued, the future of the British Empire required England to capitalize on its "air-centrality." Only through the development of commercial aviation for the service of empire, as opposed to military aviation, was this possible. Wallis, in his postwar speeches, agreed with Bowles's and Burney's mercantilist conceptions of current and future British imperial might, although he spoke not of empire but of the Commonwealth.[25]

Wallis argued that, threatened as it was by Soviet military power and U.S. commercial competition, England would continue its postwar decline unless these inherent English advantages were used and strengthened. The English, he proclaimed, were "in danger of losing our independence, and, instead of remaining the centre of a world-wide Commonwealth, of becoming ourselves a satellite of the U.S.A." He argued that the greatest threat from the United States was in the world market for commercial aircraft, which it was already beginning to dominate by selling technically inferior though cheaper aircraft. Giving in to the temptation of buying U.S. aircraft and aviation technology would destroy the English aircraft industry, the sustenance of which was a strategic and commercial necessity. Not only should England indigenously develop aircraft, he argued, but she should develop a distinctly and characteristically English technology that would then become both a source of national pride and of national wealth through export.[26]

24. George F. S. Bowles, *The Strength of England* (London, 1926), and Charles Dennistoun Burney, *The World, the Air, and the Future* (London, 1929).

25. The intermingling of mercantilism, empire, and aviation is aptly demonstrated by the interwar journal *Air*, the official organ of the Air League of the British Empire, whose stated aim was: "To ensure the fullest development of British civil and commercial aviation. To secure the maintenance of adequate air forces and of reserves for Empire and Home Defence. The nation's civil aviation is a measure of its commercial efficiency. The Empire is handicapped by air-ignorance—Help us to conquer it!" It should be noted that mercantilism was not uncommon in the postwar years: P. David Henderson, a government economist in the 1960s, noted that it was surprisingly widespread among policy makers at the time (Henderson [n. 10 above], 68–70).

26. Wallis, "The Strength of England" (article), 393–408, quote on 406. On Anglo-

JANUARY
2008
VOL. 49

Wallis further stressed that for England to reverse its postwar decline it had to excel not just in aviation, but in a broad range of technologies. Engineers were to play the leading role here by developing creative technologies that would not only be of commercial and industrial benefit, but also of strategic value. The problem, he argued, was that engineering was not attracting the quality of people the profession demanded and that was requisite in order for the nation to prosper, a situation for which he blamed both the inadequacies of the English education system as well as a lack of interest among the young. For Wallis, this decline in the quality of engineers, who should have represented the cream of English talent and intellect, was symptomatic of a wider decay and moral decline within English society, which no longer instilled national pride in its young or provided them with suitable role models.[27] Wallis called upon government and industry to provide engineers the opportunity to develop high technologies, as well as a national education effort to teach technology to children and thereby start producing many more high-quality engineers. "It is a pity," he noted in 1967, "that in this country the inventor is regarded as a sort of back-room boy whose salary can be kept low and whose presence may be practically ignored."[28]

This passionate interest in scientific and technological education manifested itself in his involvement with his alma mater, Christ's Hospital. As well as monetary donations, he gave lectures and speeches there on engineering and took an active (and at times controversial) interest in the school's science and technology syllabus. His official biographer noted the elitist nature of Wallis's determination to "create at least one educational institution which could provide the reservoir of leadership that must exist if technological advance is to be exploited." In his "Artist or Engineer" lecture given to the Royal Society of Arts on 24 April 1963, Wallis argued (generating much controversy in the process) that as engineering was the most demanding human endeavor, the brightest and most motivated children should become engineers rather than artists.[29]

Wallis underscored the importance of engineers as the source of England's future power and wealth by comparing modern-day engineers to the Elizabethan explorers of the old English Empire. "The second Elizabethan

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American commercial-aircraft rivalry during the 1950s and 1960s, see Jeffrey A. Engel, *Cold War at 30,000 feet: The Anglo-American Fight for Aviation Supremacy* (Cambridge, Mass., 2007), 125–86, 216–51.

27. See Barnes Wallis, "Talks and Reminisces," BBC Radio Interview (1971), British Library National Sound Archive, NP1907W BD1; and Wallis, "Man the Creator" (article, n. 14 above), 813–22.

28. "Address by the President's Guest, Dr. Barnes Wallis, C.B.E., F.R.S.," *Inventor* 7 (1967): 6–15. See also Wallis, "The Strength of England" (article, n. 21 above), 393–408.

29. Morpurgo, *Barnes Wallis* (n. 1 above), 368 (quote); and Wallis, "Artist or Engineer" (n. 14 above), 724–35. There was widespread interest in the reform of science and

age thus offers us," he stated in 1965, "the possibility of an adventure in engineering and in seamanship that, at least as far as the industrial transport between England and the external world of trade is concerned, satisfies the condition that we must encourage the spirit of adventure, particularly in industry."[30] In 1959, he advised young engineering students at Bristol University that "nuclear-power applied to marine engineering offers careers of adventure and profit to young engineers and scientists in this new Elizabethan Age that can only be equalled by those for the great captains and seamen of Elizabeth I's days."[31]

Wallis's references to a new Elizabethan Age were part of a wider discourse, at its peak in the early 1950s, of the dawn of a brighter, more adventurous era in British history: the "New" or "Second Elizabethan Age." Centered around the 1951 Festival of Britain and the coronation of Elizabeth II in 1953, this "New Elizabethanism" promoted traditional conservative values for the modern age, with an emphasis on science, technology, and individual heroics.[32] Aviation played a prominent role in this discourse: the queen's consort, Prince Philip, became the "Prince Albert of the Jet Age," for, as reporter Philip Gibbs argued, it was aviation and the "new knighthood" of airmen that embodied this new technological age, an age which "will be recorded as our heroic age, for one reason above all—the adventure of flight, the annihilation of time and distance by supersonic speed."[33] Gibbs's description of Neville Duke, the Hawker Siddeley test pilot, is particularly telling:

> I thought he looked and talked like a scientist rather than a typical pilot, if there is such a thing, and of course all test pilots must be in some degree men of scientific knowledge and curiosity, deeply interested in the technical progress of flight and its future possibilities, especially now that the jet engine opens up incalculable devel-

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technology education at that time; see Gary McCulloch, "A Technocratic Vision: The Ideology of School Science Reform in Britain in the 1950s," *Social Studies of Science* 18 (1988): 703–24.

30. Wallis, "The Strength of England" (article), 393–408.

31. Wallis, "The Strength of England" (Bristol lecture, n. 17 above).

32. Earlier declinist histories failed to recognize this enthusiasm for technology; rather, scholarly comprehension of "New Elizabethanism" had to await the advent of postdeclinist history. See Robert Bud, "Penicillin and the New Elizabethans," *British Journal for the History of Science* 31 (1998): 305–33; Weight (n. 10 above), 215–28; and Michael Dobson and Nicola J. Watson, *England's Elizabeth: An Afterlife in Fame and Fantasy* (Oxford, 2003), 227–51. On the role of the Festival of Britain in the promotion of a particular view of science and technology, see Sophie Forgan, "Festivals of Science and the Two Cultures: Science, Design, and Display in the Festival of Britain, 1951," *British Journal for the History of Science* 31 (1998): 217–40.

33. Philip Gibbs, *The New Elizabethans* (London, 1953), 73. Another well-known example of "New Elizabethan" values is A. L. Rowse, *An Elizabethan Garland* (London, 1953).

JANUARY
2008
VOL. 49

> opment of speed with a thousand new problems and unknown vistas in the future.[34]

Wallis continuously emphasized the importance and Englishness of ingenuity in his lectures and personal correspondence. "The genius of an Englishman certainly lies in his individuality," he declared in 1967, "and always has and so long as we maintain our national characteristics, always will."[35] In a letter to Conservative MP Harry Legge-Bourke, he claimed that it had been this quality which had driven technological development in Britain:

> I have been compiling a list of outstanding aircraft with their dates, and the names of the individuals who designed them. No great work, whether in Science or Engineering (or Art for that matter) has ever been conceived or carried through all its birth-pangs by a Committee or Consortium, and this applies to Ships (e.g. the late Sir James McNeil, who designed the Q.E. and Q.M. personally) to aircraft to turbines (Parsons) to jets (Whittle) and so on through an endless procession of the great technologists.[36]

"Great technologists" were required to continue their work; just as it was the individual heroic explorer who had once made Elizabethan England great, it would be the individual inventor, through his creativity, who would make England a great (technological) nation once again.[37] "The whole future of civilization will rest in the mind of the inventor and the engineer," he lectured in 1967, "rather than the classicist or the administrator."[38] Wallis's emphasis on the importance of the individual heroic inventor not only for technological change, but also for the nation and for civilization, has a certain pedigree within British engineering discourse. The concept of the "heroic engineer" had wide currency in nineteenth-century Britain (as in, for example, the biographies penned by the engineer Samuel Smiles), and the prominent writer on engineering, L. T. C. Rolt, argued for the primacy of individual craft values within engineering throughout the 1940s and 1950s and into the 1960s.[39] Wallis's emphasis on

34. Gibbs, 100.

35. Jones, *Why Not? Why Not!* (n. 1 above).

36. Barnes Wallis to Harry Legge-Bourke, 20 December 1965, Harry Legge-Bourke Collection, Leeds University Library archive, MS 742/400. Legge-Bourke (1914–73) was an Eton-educated Conservative MP who, through his interventions in the press and in Parliament and through his direct lobbying to leading government ministers, became one of Wallis's most strident supporters during the late 1950s and early 1960s.

37. Most prominently, Wallis focused on the creativity of the engineer in "Man the Creator," a lecture given at the Royal Society of Arts on 23 March 1966 and subsequently published in its journal; see Wallis, "Man the Creator" (article, n. 14 above), 813–22.

38. Wallis, "Address by the President's Guest" (n. 28 above), 6–15.

39. On nineteenth-century notions of the "heroic inventor," see Christine MacLeod, "James Watt, Heroic Invention, and the Idea of the Industrial Revolution," in *Technological Revolutions in Europe,* ed. M. Berg and K. Bruland (Cheltenham, U.K., 1998); and

individuality and craft values should also be considered within the context of his workplace, for throughout much of his career, the British aviation industry was essentially a craft industry centered around small firms and design teams, and, as we will see, he often argued against consolidation within the aviation-design industry.

For Wallis, engineers were to contribute to England's mercantilist future by providing technologies that would allow the country to trade securely and profitably. Innovative, commercially high-value technological products were to play a role, but so also were military and communications technologies. It is in this second regard that Wallis felt that he could contribute by using his inventiveness to devise the two technologies he claimed would protect England's mercantile trade and communication and thus restore English power: the cargo submarine, and the swing-wing supersonic aircraft.

Of these two technologies, the merchant submarine was the more speculative. In his "The Strength of England" lectures, Wallis argued that by deploying scores of fast-moving, deep-diving submarines, it would be possible to place England's entire merchant fleet underwater and thus secure Britain's vital mercantile interests from Soviet aggression. The reduced underwater resistance, leading to speeds "three or four times as fast as the equivalent surface merchantman"[40] as well as the ability to travel under the arctic icecap, he argued, would make this underwater merchant fleet more cost-efficient than the surface variety. In the early 1960s, he suggested a nuclear power plant for the submarine, although later in the decade he designed a hybrid kerosene and liquid-oxygen plant to power it instead. In a 1971 *Engineer* magazine interview, he revealed that his submarine was to have a square, cross-sectioned hull to reduce underwater drag, enabling it to travel at thirty to forty knots several thousand feet below the surface.[41]

In an unpublished article, Wallis noted that he was inspired "by an enquiry from the late Sir Henry Tizard during the closing stages of World War II, as to the possibility of towing submarine vessels containing petrol, to Malta." British wartime interest in cargo submarines was probably prompted by German, Italian, and Japanese use of cargo submarines during the war and, in the German case, during World War I as well. He

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Christine MacLeod and Alessandro Nuvolari, "The Pitfalls of Prosopography: Inventors in the *Dictionary of National Biography*," *Technology and Culture* 47 (2006): 757–76. On Samuel Smiles's "heroic engineer" biographies, see T. P. Hughes, "Introduction," in Samuel Smiles, *Selections from Lives of the Engineers* (Cambridge, 1966); and S. Dentith, "Samuel Smiles and the Nineteenth-Century Novel," in *Perceptions of Great Engineers: Fact and Fantasy*, ed. Denis Smith (London, 1994). On Rolt, see Ian Mackersey, *Tom Rolt and the Cressy Years* (London, 1985).

40. Wallis, "The Strength of England" (article, n. 21 above), 393–408.

41. Wallis, "The Strength of England" (Bristol lecture, n. 20 above); and Barnes Wallis, "*The Engineer* Interview: The Inventor is the Man behind Management," *Engineer*, 1 April 1971.

JANUARY
2008
VOL. 49

revealed that some research into the feasibility of cargo submarines was carried out by the Royal Navy in the immediate postwar period, but it had been quickly abandoned. Had nuclear propulsion been available then, he argued, it might have succeeded. The Soviet and U.S. navies continued research and design work on gigantic cargo submarines until the 1970s, but none were built.[42]

Another inspiration was Commander William Anderson's *Nautilus 90 North*, a heroic tale of the first underwater journey beneath the arctic icecap by the USS *Nautilus*, the U.S Navy's first nuclear-powered submarine (launched in 1954).[43] In 1958, Anderson captained the submarine from Pearl Harbor to the Bering Strait, and then onward under the North Pole to the Greenland Sea. The trip was hailed by both the British and the U.S. press as a historic achievement, and U.S. president Dwight Eisenhower decorated Commander Anderson with the Legion of Merit. The presidential citation noted that the *Nautilus* had pioneered a submerged sea-lane between the Eastern and Western hemispheres and that this pointed the way for "further exploration and possible use of this route by nuclear powered cargo submarines as a new commercial seaway between the major oceans of the world."[44] This suggestion was repeated by Admiral G. B. H. Fawkes in his foreword to *Nautilus 90 North*. Published in 1959, this account arrived after Wallis had already started to mention merchant submarines in his lectures; he referred to it in every lecture thereafter, and he recommended it to others in his personal correspondence.

Supersonic-transport aircraft followed merchant submarines as the second of Wallis's crucial high technologies. In his "The Strength of England" lectures, he emphasized the need to ensure England's continued aircentrality through the introduction of a fleet of fast, long-range, high-flying passenger or cargo aircraft. Variable-geometry designs—those featuring wings that would sweep back for supersonic flight—could fulfill, as he put it in his earlier lectures, the "urgent necessity for consultation and conference between all members of the British Commonwealth." This design, he believed, would allow a maximum speed well in excess of three times the speed of sound. With cruising altitudes of over 100,000 feet and using air routes over the Arctic, he envisaged that his aircraft would be able to make the crucially important trip to Australia or New Zealand without stopping in potentially hostile countries anywhere in between.[45]

42. Barnes Wallis, "The Strength of England," unpublished draft for *The Times*, 23 October 1963. See also Norman Polmar and Kenneth J. Moore, *Cold War Submarines: The Design and Construction of U.S. and Soviet Submarines* (Washington, D.C., 2004), 221–43.

43. William Anderson, *Nautilus 90 North* (London, 1959).

44. "Nautilus Sails under the Pole and 1,830 Miles of Arctic Icecap in Pacific-to-Atlantic Passage," *New York Times*, 3 August 1958.

45. Wallis, "The Strength of England" (Bristol lecture). The Concorde, by comparison, had a cruising speed of around Mach 2 and a cruising altitude of about 60,000 feet.

From the early 1960s onward, Wallis's reasoning on the need for long-distance, nonstop aircraft began to shift away from the necessity for Commonwealth communications and focused instead on the "large and still rapid increase of passenger and freight traffic."[46] U.S. manufacturers, he noted, were cornering the market even though the English could potentially produce aircraft that were just as efficient in transportation as the larger American ones. His long-range, supersonic, variable-geometry aircraft, being relatively small in size (with passenger numbers of around 120 to 150 per aircraft) and able to fly from short "Dakota Airstrips," could challenge the increasing U.S. dominance of the commercial aircraft market by providing an English alternative. Not only would his supersonic airplanes exploit England's air-centrality, but in the face of U.S. competition, they would maintain and guard it in a distinctly English way.[47]

Wallis's attempts to actualize the technologies required to fulfill his technological visions failed. He developed submarine designs during the 1960s, and although there was some initial interest in military variants, the British navy quickly deemed his designs too expensive to develop. The British government and Vickers's submarine budgets were already committed to the production of hunter/seeker nuclear submarines; neither Vickers nor the government appears to have considered developing Wallis's submarine for commercial use. Consequently, other than a few preliminary tests in a water tank and material tests for the proposed engine, the concept did not make it past his drawing board.[48]

Wallis's vision of future English global aviation also relied on his own designs for variable-geometry aircraft. He had obtained significant funding from the government and Vickers for his proposed aircraft designs immediately after World War II. This funding flowed throughout the late 1940s

46. Wallis, "The Strength of England" (article, n. 21 above), 393–408.

47. In his public lectures, the airplane Wallace advocated was to have a civilian role as a commercial-transport and passenger jet, but in his pitches to the government he proposed a multipurpose military jet. See Barnes Wallis, "The Air Defence of Great Britain," paper presented at the Department of Aeronautical Research and Development at Vickers-Armstrong (Aircraft) Limited, 13 July 1953, Barnes Wallis Collection, Churchill Archives Centre, WLIS 4; and Barnes Wallis, "Note on the Development of 'Variable Geometry' Aircraft," 14 October 1960, Barnes Wallis Papers, Science Museum Library archive, ARCH: BNW ED6/1. "Dakota Airstrip" was the term used at the time to describe relatively short—and rough and ready—runways.

48. On postwar British submarine policy, see Tom Wright, "Aircraft Carriers and Submarines: Naval R&D in Britain in the Mid-Cold War," in *Cold War, Hot Science: Applied Research in Britain's Defence Laboratories, 1945–1990*, ed. Robert Bud and Philip Gummett (London, 1999), 147–83. Evidence for government rejection is fragmentary; for government concerns over the propulsion system's development costs, see letter, Alfred Sims to Anthony Buzzard, 24 February 1966, Barnes Wallis Papers, Science Museum Library archive, ARCH: BNW F1/2. Vickers also expressed an unwillingness to give technical support to Wallis's design proposals; see letter, David C. Ingram to Barnes Wallis, 1 February 1967, Barnes Wallis Papers, Science Museum Library archive, ARCH: BNW F2/1.

JANUARY
2008
VOL. 49

and 1950s, by which time his designs had crystallized into the Swallow—a high-flying, tailless, supersonic swing-wing jet, which remained a major military-research project at Vickers until, to Wallis's bitter disappointment, technical problems coupled with a high-level government reassessment of defense aviation priorities led to the curtailment and eventual cessation of funding by the early 1960s. Attempts by Wallis and Vickers to interest the U.S. government in the project also ultimately failed; after some collaboration and funding through the Mutual Weapons Development Programme during the late 1950s, the Americans continued development of variable-geometry aircraft on their own and eventually produced the F-111 fighter-bomber.[49] Vickers, the Ministry of Supply, and the Americans had all concluded that Wallis's designs were too expensive and ambitious—"super-ambitious" and "futuristic" in the words of historians. Wallis had envisaged a tailless airplane with wing-mounted engine nacelles, and with pitch, turn, and roll controlled through the differential swinging of wings rather than through conventional control surfaces. U.S. interest was in a simpler swing-wing design that incorporated both conventional control surfaces and a low-set tail-plane. The Ministry of Supply, meanwhile, although willing to consider variants of Wallis's designs, eventually chose to terminate funding as concern about the rising costs of British aircraft projects, particularly the TSR.2, grew.[50]

49. Although Swallow was initially a code name given to a generic variable-geometry aircraft suitable for various roles (military transport, fighter-bombers, and so on), after the withdrawal of government funding it crystallized into a commercial passenger and cargo aircraft on Wallis's drawing board. Some contemporary estimates put the sunk costs of the Swallow at £1.5 million; see "Parliament. Cost of Vickers Swallow: Government Share 80 Per Cent," *The Times*, 20 May 1958, and "Swallow Jet Decisions: Minister Explains," *The Times*, 23 May 1958. On the relationship between the Swallow and U.S. variable-geometry research, see Erik M. Conway, *High-Speed Dreams: NASA and the Technopolitics of Supersonic Transportation, 1945–1999* (Baltimore, 2005), 53–54.

50. On the complexity and expense of Wallis's designs, see Derek Wood, *Project Cancelled: The Disaster of Britain's Abandoned Aircraft Projects* (London, 1975), 197; and Alfred Pugsley and N. E. Rowe, "Barnes Neville Wallis," *Biographical Memoirs of Fellows of the Royal Society* 27 (1981): 603–627. For the official Vickers history of the Swallow, see J. D. Scott, *Vickers: A History* (London, 1962), 347–50; and Charles Gardner, *British Aircraft Corporation: A History* (London, 1981), 209–11. For the relationship between Swallow and subsequent variable-geometry aircraft research in the United Kingdom, see Wood, 167–90. The termination of funding is also discussed in Morpurgo, *Barnes Wallis* (n. 1 above), 420–27; and Pugh (n. 1 above), 160–66. Wallis subsequently became immensely critical of both the British government and the British Aircraft Corporation for their preference for fixed-wing supersonic aircraft (in particular the Concorde) over variable-geometry designs. In contrast to most of the vehement critics of the Concorde during the 1970s (for example, Andrew Wilson, *The Concorde Fiasco* [Harmondsworth, U.K., 1973]) who argued that a supersonic transport should not have been built at all, Wallis argued that it would have been a success had it been based on variable-geometry design; see "Sir Barnes Wallis Sees No Future for Concorde," *The Times*, 3 April 1971. The "Tactical Strike and Reconnaissance" aircraft "TSR.2" was the best-known of Britain's

The future that Wallis envisaged for England was to be a glorious one: wealthy, technologically supreme, and first among the nations of the world. To describe such a future as straightforwardly *modern*, however, would be to miss some of its key features. The first of these was that England's future was at the center of a Commonwealth that would help England endure hard times by providing counsel, military aid, and raw materials. England, in return, would be the senior partner and guiding light, the guarantor of open trade routes and supplier of both technology and high-value manufactured goods.

Technologies clearly played a key role in Wallis's future England, though only flexible, decentralized high technologies that could be manufactured domestically and economically. Moreover, contrary to the sorts of technologies that engineers of the period are generally thought to have preferred, Wallis was not favorably disposed toward "gigantism."[51] He consciously positioned his supersonic aircraft design counter to what he argued to be the trend toward large aircraft and centralization in the aviation industry. It was designed to carry a small number of passengers and moreover to help shift aerial traffic away from gigantic centralized airports and toward smaller ones situated throughout the country. In addition, he wanted his high technologies to be flexible ones that could be put to use in a variety of places and in a variety of ways. His supersonic aircraft was designed for both commercial and military requirements and, because it was designed to cover long distances nonstop, it would dispense with the need for national and global networks of large landing strips and refueling depots.

For Wallis, only those high technologies that could extend and protect England's mercantile empire, bind the Commonwealth together, or reverse the decline of the nation were worthy of attention from the country's engineers. In order to fulfill these functions, the requisite technologies had to be aesthetically and creatively designed, and they had to be thoroughly *English* in character. He considered the nongigantic airplane to be an English technology. Rocket and spaceflight technology, on the other hand, was to be avoided, not only because it threatened airplane-based aviation, but also because he believed the rocket to be inherently un-English—a German technology.[52] U.S. aviation technology, he believed, tended toward gigantism and lacked creative design, especially in comparison to British technology.

Wallis's vision of an England-centered Commonwealth that spread across the world and was connected through supersonic aviation was not

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many cancelled aviation projects during the 1950s and 1960s; see Humphrey Wynn, *RAF Nuclear Deterrent Forces: Their Origins, Roles, and Deployment, 1946–1969* (London, 1997), 501–45.

51. The classic critique of engineers as giganticist and centralizing is Langdon Winner, *The Whale and the Reactor: A Search for Limits in an Age of High Technology* (Chicago, 1986), 47–58.

52. Wallis, "Talks and Reminisces" (n. 27 above).

JANUARY
2008
VOL. 49

an entirely fantastical ideal during the early 1950s. Britain at that time was not only committed to its substantial imperial holdings, but also to an international network of airfields connecting them. In 1956, for example, the secretary of state for air produced a memorandum calling for the creation of new air routes to Australia. Construction of new airfields along these new routes was "urgently required to enable us to fulfil our Commonwealth commitments in emergency, and to preserve the link with the proving and testing grounds [for nuclear weapons and ballistic missiles] in Australia and the Pacific."[53] As late as 1958 the editor of *Aeronautics* would call the "high-speed airliner" the "prime necessity, the sole guarantee of continued cohesion and continued existence" of the British Commonwealth.[54] By the 1960s, however, this vision was undoubtedly anachronistic; many British colonies had gained their independence, ties among the Commonwealth nations themselves were weaker, and Britain's links with the Continent had grown substantially. Similarly, fleets of merchant submarines and small supersonic aircraft were no longer viable given the trends in aviation and shipping at the time.[55] Wallis himself admitted that "he was probably opposed by everyone else in the industry in believing that the future lies with small aircraft carrying about 60 passengers." Consequently, although his lectures and speeches remained popular, and although many felt that his Swallow should have been built, there is little evidence to suggest that anyone subscribed to his particular technological vision of England's future.[56]

53. Nigel Birch, "The Indian Ocean Air Route," memorandum, 4 July 1956, National Archives, CAB 131/17, DO (56)19.

54. Oliver Stewart, "Editorial," *Aeronautics* 38 (1958): 23.

55. On the British government's commitment to supporting the existing merchant shipbuilding industry, see Ronald Hope, *A New History of British Shipping* (London, 1990), 413–43; on British submarine development, see Wright (n. 48 above), 147–83; on the trend toward large commercial aircraft during the 1960s, see Roger Bilstein, *Flight in America: From the Wrights to the Astronauts* (Baltimore, 2001), 238–39, 262–64.

56. "Trim and Still on Wing," *The Times*, 20 January 1967, 6 (quote). The retired vice-admiral and naval historian B. B. Schofield was one of a few who converted to Wallis's vision of an underwater British merchant fleet; see Schofield, *British Sea Power: Naval Policy in the Twentieth Century* (London, 1967), 234–37. Wallis and his cargo submarine also receive brief attention in Robert E. Walters, *Sea Power and the Nuclear Fallacy: A Reevaluation of Global Strategy* (New York, 1975), 132; and Claiborne Pell and Harold Leland Goodwin, *Challenge of the Seven Seas* (New York, 1966), 106.

Declinism

> *"He finished his lecture with a poetic quotation about a knight who, wounded by a sword, lay and bled away only to rise revitalised and conquer anew. One wasn't sure whether he referred to England or himself—either would have been appropriate."*
>
> **— From a university newspaper's review of Wallis's "The Strength of England" lecture** [57]

Wallis was consistently, and often vociferously, critical of both the British government and the British technological elite. While this view was implicit in his "The Strength of England" lectures, he was much more explicit in his other speeches and interviews. Both politicians and the management of leading large aircraft firms had betrayed the nation by incompetently handling the challenges facing the aviation industry, thereby allowing it to decline. Government bureaucracy, he argued, was reactionary in its attitude to technological innovation and slow in its decision making. This was due to its overly bureaucratic nature and the practice of making decisions by committee, and also because of the career-oriented civil servants within it.[58] He claimed that both decision makers within government and industry leaders were poorly advised by second-rate engineers. The government, in particular, did not fully appreciate the value of technical solutions to the issues facing industry. Wallis's argument was not just that engineers had no say in technology policy, but rather that those who did lacked training and judgment. In his view, only the worst engineers took on management and administration roles in industry and government.[59]

These critiques were, by the 1960s, often couched in the bluntest of terms and were intertwined with a naïve belief that simple technical formulations should be able to sway policy makers. In a private letter to James Stevens, the author of an appreciative article in *Flight* magazine on Wallis's 1959 Christmas Lecture at the Institution of Civil Engineers, for example, he condemned not one but several ministers for their inability to adjust technological and industrial policy on the basis of two mathematical formulas:

> I sometimes feel terribly frustrated by the apparent apathy of the Ministers of Transport, Aviation, and Science, who seem to me to be entirely ignorant of the advantages that we possess, and do nothing to subsidise our shipping or to encourage the development of our supersonic air transport. Surely the curve of Economic Speed and

57. I. C. Carr and I. N. Quarrinton, "Review of Wallis's 'The Strength of England' Lecture at Imperial College," *Felix*, 16 October 1968, 3.

58. Morpurgo, *Barnes Wallis* (n. 1 above), 274–75.

59. Wallis discussed this belief in some detail in "The Engineer Interview" (n. 41 above).

JANUARY
2008
VOL. 49

> Height taken in combination with the well-known Breguet Range Formula should be sufficient to convince the dullest administrator that if we do not develop supersonic transport (and that in the near future) we shall lose our immense initial advantage to others who will develop their airports for this purpose ahead of us; and once trade routes are firmly established they will, I think, take a great deal of altering.[60]

Wallis's forthright attitude and often outright hostility to the civil service may well have alienated potential supporters and contributed to the failure of his projects. This hostility was well-known in both civil service and engineering circles by the early 1950s, and by late in the decade it had entered the public domain through the press, particularly in relation to the termination of funding for his Swallow project.[61] Indeed, the press largely bought into Wallis's critique and by the 1960s had come to view the cancellation of the Swallow project as yet another case of a lack of government support for a groundbreaking British invention that was subsequently developed by the Americans. Wallis's biography, which was of continuing interest to the mainstream press, was often told as one of an inventive genius spurned by an uninterested government—as in, for example, a prominent color spread in the leading Sunday magazine, *The Sunday Times Colour Magazine*.[62] This rejection of his ingenuity was presented as being symptomatic of longer-standing government indifference and/or incompetence regarding British scientific and technological ingenuity. The aviation correspondent of the communist daily *Morning Star*, for example, listed Wallis's swing-wing technology as a crucial example among other British inventions, including commercial computers, the hovercraft, and the hydrofoil, which had been "starved of support" by the British government and subsequently developed by the Americans and the French.[63]

Wallis's views of the aviation industry were undoubtedly colored by his experiences throughout his career, and in particular by his perception that Vickers's senior management had not been committed either to his Swallow concept or to his ideas more generally. In particular, the enmity between himself and George Edwards, Vickers's most prominent and influential

60. Barnes Wallis to James H. Stevens, letter, 11 January 1960, Barnes Wallis Papers, Science Museum Library archive, ARCH: BNW H16.

61. Wallis's criticisms are noted in his biographies, as is his "impatience" with people. See Morpurgo, *Barnes Wallis*, 274–75, 419; and Pugh (n. 1 above), 182–83.

62. "High Flier in the First Floor Front," *The Sunday Times Colour Magazine*, 19 January 1964. Other examples: "Storm Rages around Quiet Genius," *Evening News*, 17 September 1957; D. M. Desoutter, "Who Is Hiding Our Polymorph?" *Aeronautics* 38 (1958): 48–50; "Supersonic Travel: The M-Wing, Griffith, and Wallis Scheme," *The Times*, 1 September 1960; and Oliver Stewart, "British Pioneer of Variable Geometry," *The Times*, 10 June 1965.

63. John Moss, *The Scientific Revolution* (London, 1967), 53–54.

aeronautical engineer during the postwar years, demonstrated Wallis's growing distance from the establishment by the early 1960s.[64]

Wallis came to believe that the aeronautical industry that would be best-suited to the needs of the British nation should consist of small firms that, unhindered by managerial bureaucracy, would be able to crystallize the genius of their best aeronautical designers into innovative aircraft. This set him against government-led consolidation within the domestic aircraft industry during the late 1950s and early 1960s, led by Minister of Defence Duncan Sandys, which its supporters claimed was necessary in order to combat inefficiency and overcapacity and to allow the British aircraft industry to compete on an international footing with the Americans. Duncan Sandys's consolidation, Wallis argued, was detrimental to innovation and development and was being pursued solely for personal gain by the heads of the larger aeronautical firms.[65] As discussed earlier, he said that the future of aviation lay in fast-moving small aircraft that could depart from small regional airports; the government, he complained, was promoting slow-moving heavy aircraft that required large national airports.[66]

Wallis's critique reached its widest audience with the broadcast of a television documentary about him: Glyn Jones's *Why Not? Why Not!* which was broadcast on 19 January 1967.[67] The documentary was well reviewed,

64. George Edwards, a contemporary of Wallis, was the most senior aeronautical engineer at Vickers Aviation during the postwar years and eventually became president of the Royal Aeronautical Society (1957–58) and chairman of the British Aircraft Corporation (1963–75). He was knighted in 1957. On Edwards's lack of enthusiasm for the Swallow, see Solly Zuckerman, *Monkeys, Men, and Missiles: An Autobiography, 1946–88* (London, 1988), 217. Wallis himself noted Edwards's lack of support in a letter to his official biographer; see Barnes Wallis to J. E. Morpurgo, Barnes Wallis Papers, Science Museum Library archive, ARCH: BNW A2/3. On the disagreement between Edwards and Wallis over the wing design of the proposed TSR.2 aircraft in the late 1950s and early 1960s (Wallis favored variable-geometry, Edwards fixed-wing), see Pugh, 167. Edwards's biographer diplomatically describes their relationship as "uneasy but respectful," and goes on to argue that although Wallis received the entire accolade for the invention of the Bouncing Bombs, it was Edwards, not Wallis, who conceived of the spin that allowed them to work; see Robert Gardner, *From Bouncing Bombs to Concorde: The Authorised Biography of Aviation Pioneer Sir George Edwards OM* (Stroud, U.K., 2006), 2, 40–49.

65. Duncan Sandys was the Conservative minister of defence from 1957 to 1959 (and then minister of aviation until 1960) whose 1957 white paper first brought government thinking on defense rationalization into the public sphere. A forthright example of Wallis's critique appears in a private letter to Harry Legge-Bourke, 20 December 1965, in the Harry Legge-Bourke Collection, Leeds University Library archive, MS 742/400.

66. Vickers Aviation was unhappy with Wallis's stance against large aircraft; see, for example, Dermot Boyle to Barnes Wallis, 24 October 1963, Barnes Wallis Papers, Science Museum Library archive, ARCH: BNW ED6/7.

67. The documentary was named after a reply that Wallis gave when asked about the feasibility of his supersonic airplane design; see Jones, *Why Not? Why Not!* (n. 1 above). There was also an accompanying article: "Why Not? Why Not!" *Radio Times*, 12 January 1967, 39.

JANUARY
2008
VOL. 49

heavily publicized, and keenly watched. The seven-and-a-half million viewers who tuned in to watch made this the single most successful documentary of Jones's pioneering career at the BBC. The ensuing publicity may also have helped Wallis toward his knighthood in 1968.[68]

The documentary summarized its portrayal of Wallis with its opening words: "Tonight we tell of a prophet who is without honour here in Whitehall—of a man, Dr. Barnes Wallis of Dam Buster fame, whose fertile brain has produced a string of brilliant ideas only to have them fought, sometimes until their death, by the experts of Whitehall." The program thus presented Wallis as an inventive engineer who, despite his wartime success, had seen his Swallow concept rejected by the government. Wallis always had to fight to have his views heard, even during the war. He was, as Jones put it, a "man too far ahead of his time." For this, Wallis blamed not only politicians and civil servants, but also all of those involved in "committee decision making," including, crucially, engineers and scientists.[69]

Although Jones's depiction of Wallis as a spurned inventor was not unique, drawing as it did on a preexisting and widely disseminated image of his subject, the critical framework within which the documentary presented it reflected Jones's personal views on the decline of the nation. In his 1967 book *Britain on Borrowed Time*, written before the production of his profile of Wallis, Jones argued that the British nation was, and had been for a hundred years, in industrial decline. This was due to a misdirection of human resources, an education system biased against "useful skills," and a civil service manned by Oxbridge arts graduates with little technical training. Wallis's career, and in particular Wallis's own narrative about his career, was for Jones powerful evidence in support of his own views—views that he put forward in *Why Not? Why Not!*[70]

A panel discussion on *Late Night Line-Up*, broadcast on BBC television later the same evening, heightened the interest in Wallis. Taking Wallis as its starting point, the discussion ranged widely on the topic of scientific and technological research and development in Britain. Participants included Monty Finniston (an industrialist and former chief metallurgist of the Atomic Energy Authority), Conservative MP Ernest Marples (former min-

68. Glyn Jones (1928–1999) was a left-leaning writer and documentary maker whose strong interest in science and technology led him to pioneer science and technology programming at the BBC. As well as *Why Not? Why Not!* he developed the future technology program *Tomorrow's World*, as well as other documentaries for the BBC and Channel Four; see "Glyn Jones: The Man Who Invented Tomorrow's World," *Guardian*, 12 October 1999. Positive reviews of *Why Not? Why Not!* included "Trim and Still on Wing," *The Times*, 20 January 1967.

69. Jones, *Why Not? Why Not!*

70. Glyn Jones and Michael Barnes, *Britain on Borrowed Time* (London, 1967). In a letter to Wallis, Jones acknowledged that the documentary reflected his own critical view of the civil service; see Jones to Barnes Wallis, 5 February 1967, Barnes Wallis Papers, Science Museum Library archive, ARCH: BNW HA1.

ister of transport), and Anthony Wedgwood-Benn (minister of technology, including aviation).[71] Both Finniston and Marples took the view that Wallis had been poorly treated by the civil service, and that this exemplified the treatment of both innovative ideas and innovative individuals in Britain. Both were, and would continue to be, well-known for their diagnoses of British industrial decline and for this particular critique of government.[72] Wedgwood-Benn, on the other hand, argued that Wallis had received substantial support from government during his career, and he highlighted Wallis's projects that had received funding and had actually been built.[73] He agreed with Wallis on the need for government support for high technologies, but he preferred to fund high technologies other than aviation. According to Jones, Finniston said that Wedgwood-Benn was "very keen to sort out technological priorities for the country as quickly as possible, and I don't know that aircraft rate all that highly. He is interested in the possibilities of underwater exploration, computer development, control systems, machine tools—things which bring direct benefit to large areas of industry quite quickly."[74] Wedgwood-Benn's stance on Wallis's Swallow project was symptomatic of high-level government thinking at that time on science and technology. The Ministry of Technology had been built up by Prime Minister Harold Wilson in the sixties with the express intention of refocusing the state's scientific and technological efforts away from defense and toward civilian projects, and from civilian aviation and nuclear technology to other sectors. Wallis's supersonic aircraft did not fit into this strategy.[75]

Wallis was not the only prominent right-wing British aeronautical engineer to express discontent with government aviation policy during the postwar period. Frank Whittle, widely hailed in Britain as the inventor of the jet engine, was another mercantilist proponent of the British aviation industry. In 1958, he announced that "[i]t can truly be claimed that the aircraft gas turbine is helping to feed the nation." Like Wallis, Whittle spoke

71. *Late Night Line-Up*, BBC 2 Television, 19 January 1967, R. V. Jones Collection, Churchill Archives Centre, RVJO F189. Montague "Monty" Finniston (1912–1991) is most remembered today for his chairmanship of British Steel and for the "Finniston Report" of 1979 on the reform of engineering education in Britain. Conservative MP Ernest Marples (1907–1978) is now remembered most for his enthusiasm for the motorcar and the expansion of the motorway system under his tenure as minister of transport. Anthony Wedgwood-Benn, Labour MP (born 1925, now known as Tony Benn), was minister of technology from 1966 to 1970.

72. See, for example, Montague Finniston, *The World an Oyster and Industry the Pearl* (Birmingham, 1979), and Ernest Marples, *No Choice but Change* (London, 1966).

73. Much later, Wallis's biographer, J. E. Morpugo, agreed with this sentiment in his own autobiography; see Morpurgo, *Master of None: An Autobiography* (Manchester, 1990), 268–69.

74. *Late Night Line-Up*.

75. Jones to Wallis. David Edgerton advances this particular view of the Ministry of Technology in "The White Heat Revisited: The British Government and Technology in the 1960s," *Twentieth-Century British History* 7 (1996): 53–82.

JANUARY
2008
VOL. 49

out *against* the development of large jet aircraft and made similar kinds of arguments in support of his stance; unlike Wallis, however, he voiced support for the development of the Concorde, primarily because of its aero-engine technology.[76] Whittle was also significantly more vocal with his political views: whereas Wallis lectured in private to the far-right Monday Club during the late 1960s, Whittle publicly supported Conservative candidates in several general elections, and in 1964 he called for the forced repatriation of nonwhite immigrants.[77] Like Wallis, Whittle also became a symbol of British technological decline in popular postwar history. Jones, for example, went on to produce a book biography and a television documentary on Whittle in which Jones blamed Whitehall for Britain's inability to capitalize on Whittle's jet engine, thus leading to the eventual demise of the British aircraft industry. Wallis himself argued that Whittle's story of technological innovation versus bureaucratic indifference mirrored his own.[78]

Roy Fedden, another prominent aero-engineer contemporary with Wallis, also criticized politicians, bureaucrats, and the aviation industry for the decline of British aviation. In a 1957 book critical of government aviation policy, he argued that aviation had been and should once again become the foundation for British national might; it was the most important of "all fields of material endeavour. . . . This pioneering, arising from the manufacture of aircraft and all its accoutrements, is spreading all the time into other branches of industry generally, and will continue to do so increasingly over the years." In comparison with Wallis, however, Fedden was much less antagonistic toward the aeronautical establishment and much less inclined to publicly air his views.[79]

76. Frank Whittle, "Britain and the Jet Age," typed manuscript, 15 December 1958, Frank Whittle Collection, Churchill Archives Centre, WHTL, quoted on C7. Whittle (1907–1996) pioneered jet-engine design in Britain during the 1930s and went on to work in the private sector after the war, including stints at BOAC and Shell. For his views on large aircraft, see Frank Whittle, "The Case against Large Aircraft," draft manuscript, n.d., Frank Whittle Collection, Churchill Archives Centre, WHTL C48. For Whittle's views on the Concorde, see Frank Whittle, letter to *The Times*, "Technological Achievement of Concorde and Olympus Engine Needs Full Backing," *The Times*, 15 August 1974.

77. Meetings secretary, Monday Club to Sir Barnes Wallis, 22 March 1971, Barnes Wallis Papers, Science Museum Library archive, ARCH: BNW H82; Frank Whittle, "Speech for Conservative Rally," 24 May 1955, Frank Whittle Collection, Churchill Archives Centre, WHTL A349; and "Send the Immigrants Home Says Whittle," *Sun*, 13 October 1964.

78. Glyn Jones, *The Jet Pioneers: The Birth of Jet-Powered Flight* (London, 1989). Andrew Nahum has argued that Frank Whittle was actually very successful in mobilizing government support for his jet engine; see Nahum, *Frank Whittle: Invention of the Jet* (Cambridge, 2004). For Wallis's take on Whittle, see Jones, *Why Not? Why Not!* (n. 1 above).

79. Roy Fedden, *Britain's Air Survival: An Appraisement and Strategy for Success* (London, 1957), quote on 5. Fedden (1885–1973) designed several innovative aero-engines during the interwar years, and he went on to advise the British government and

Conclusion

It is difficult to summarize Barnes Wallis's overall influence during the postwar period. He struggled and ultimately failed to gain sufficient financial and political support for his postwar technological projects, yet he remained a publicly well-known and admired figure. He was certainly important in terms of his influence on public discourse on technology and British decline. His postwar rhetoric proved popular from the late 1950s to the end of the 1960s, and he was able to speak with authority on technological matters to a wide range of audiences. His considerable oratorical skills certainly contributed to this, as did his continued identification with British engineering and science in this period by the media and the public. Although there is little evidence that his vision of a future England connected to its Commonwealth through a network of merchant submarines and small supersonic aircraft found widespread support, he nevertheless articulated widely shared and commonly held views about the civil service, British technology, and the apparent decline of Britain that seemed to manifest itself through the country's failure to invest in appropriate technologies. Furthermore, Wallis himself symbolized Britain's decline in the eyes of the public by appearing to embody technological skill that, although successfully demonstrated in World War II, had subsequently been squandered by the state. Thus fellow declinists such as Jones, Finniston, and Marples claimed that Wallis's life story showed what Britain could potentially be, yet failed to be. This declinist framing of Wallis's postwar career continued in later works on Wallis and his technologies.[80]

We should recognize, of course, that Wallis's understanding of British science and technology was conditioned by particular political and historical circumstances, and that this understanding is not one with which most historians today would agree. They argue instead that the British government was enthusiastic about technology and that it did invest heavily in aviation during the 1950s and 1960s (although the Labour government tried to rethink aviation spending during the 1960s), and, moreover, that there was no deep-seated British failure of the type that Wallis saw around him.

However, this is not to say that the British government subscribed to the same priorities as Wallis. State policy did not recognize the primacy of engineers or of aviation and other high-tech transport technologies in the way

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NATO on aviation matters. For a biography of Fedden, see Bill Gunston, *By Jupiter! The Life of Sir Roy Fedden* (London, 1978).

80. Most prominently in: David Divine, *The Broken Wing: A Study in the British Exercise of Air Power* (London, 1966), 334; Morpurgo, *Barnes Wallis* (n. 1 above); Wood (n. 50 above); and Robin Higham, "Wallis, Sir Barnes Neville (1887–1979)," first published September 2004, available online at www.oxforddnb.com/index/101031795/ (accessed July 2007).

JANUARY
2008
VOL. 49

that Wallis did. Rather, the country shared and borrowed foreign technology more than Wallis would have liked, and the Conservative and Labour governments from the late 1950s onward attempted to reform the aviation industry and reduce state expenditure on it.[81] His supersonic airplane and submarine designs found little purchase because they were expensive and technologically ambitious, and because they did not fit in with the government's own thinking at a time when it was opting out of technological competition with the United States. Whether the British state itself could be considered "techno-nationalist" at this time, and, if so, how its techno-nationalism differed from that of its declinist critics remain open questions.

The decline of declinism has made it possible to understand conservative engineering ideologies such as Wallis's and to relate them to wider currents within British culture. We now recognize that technocratic thinking emerged in postwar Britain not just from the Left, but also from the Right, and that a prominent engineer of the Right shared in a wider discourse on national identity ("New Elizabethanism") that incorporated technology and indeed articulated it in his own way and for his own purposes. More studies of explicitly right-wing or conservative engineers and their ideologies would allow for the further exploration of these issues. Have conservative engineers been concentrated in particular industries—for example, armaments? How do engineers' ideologies compare to those of other technocrats (particularly scientists) in relation to widespread beliefs such as declinism? Are engineers more techno-nationalistic or more conservative than scientists? This latter is often assumed, although there is little documented evidence.[82] Examining the lives and rhetoric of engineer-ideologues would allow us to gauge the extent to which our histories of technology, and indeed national histories themselves, may have been shaped by the ideological concerns of engineers.

81. See Edgerton, *Warfare State* (n. 10 above), 230–69.

82. Although many current studies of the ideologies of engineers argue that they are *fundamentally* conservative (see, for example, Noble [n. 9 above]), few studies have examined engineering ideologies that are *explicitly* conservative.