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Albert Helfrick, *Electronics in the Evolution of Flight*, College Station: Texas A & M Press, 2004. ISBN 1-58544-413-8. Bibliographic references, index.

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As a military pilot and an aviation historian, I was extremely curious about the prospect of reading Albert Helfrick's recent work examining the intersection of the electronics and aviation industries. Number Nine in Roger Launius's *Centennial of Flight Series*, this monograph traces the development of radio, navigational aids, cockpit instruments, and various electronic aircraft systems from the Wright Brothers to today's "fly-by-wire" jumbo jets. For those readers with an interest in aviation or engineering innovation, this is a generally thorough introduction to the evolution of such systems. Most historians of aviation, however, will find this book disappointing.

Helfrick, a professor of avionics at Embry-Riddle Aeronautical University, walks the reader through the developmental relationship between two engineering fields, electronics and aeronautics. The author explains the need, evolution, and final perfection of today's major avionic systems and is particularly skilled at highlighting the personalities and motives behind these innovations. One of Helfrick's driving themes (p. ix) is that an "unsung group of nerds . . . made it all happen." Moreover, his careful attention to the relationship between the military, industry, and government regulators is especially noteworthy. Occasional forays into the science behind certain avionic systems, especially communication and navigation radio systems, prove fascinating.

A number of flaws make this book less desirable as a work of history. There are no footnotes and no formal bibliography. Most chapters do have a “further reading” section at the end, however. Irritating factual errors detract from the narrative. Specifically, Helfrick denigrates many of the accomplishments of WW1 military aviation. He ignores the wide-spread non-American use of spark wireless transmitters in aircraft, the introduction of continuous wave transmitters, and the use of radio direction finding. Helfrick’s ideas of about WW1 bombing techniques are simply incorrect (p. 78). Although pilots may have tossed bombs out of their cockpits by hand in 1914, bombers of 1918 used sophisticated bomb sights and release mechanisms not unlike those of WW2. His section on WW2 radar development sadly failed to highlight the role of radar in anti-submarine warfare—a role that proved decisive during the Battle of the Atlantic.

Historians will also find Helfrick’s occasional lack of chronology annoying. In his section on inertial navigation systems (pp. 120-21), for example, he explains how and why this innovation developed but gives no dates to help the reader with chronology and context. Likewise, readers will wonder *when* synthetic aperture radar (pp. 111-12) or ground proximity warning systems (pp. 146-48) first appeared.

While at times weak in context, chronology, and factual precision, this book is an admirable attempt to explain the origin of today’s avionic systems. The author easily met his goal of highlighting and appreciating these major engineering accomplishments.



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