

1978

Instruments of Darkness

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Recommended Citation

Ellis, M.G. M.W. and Price, Alfred (1978) "Instruments of Darkness," *Naval War College Review*: Vol. 31 : No. 1 , Article 30.
Available at: <https://digital-commons.usnwc.edu/nwc-review/vol31/iss1/30>

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Pensel assigns points to four factors: numbers involved, strategic significance, political significance, and tactical execution. By this scheme history's greatest naval battle (many will agree) was that of Leyte Gulf in 1944. World War II has four other battles in the top 35, eight in that list have B.C. dates, and Trafalgar and The Armada are sixth and twelfth, respectively.

This atlas and chronology will be of value and interest to both the serious researcher and the casual reader.

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Price, Alfred. *Instruments of Darkness*. London: Macdonald and Jane's, 1977. 284pp.

"It seems that every time we go to war we have to re-invent the wheel," Alfred Price ascribes this statement about Electronic Warfare to a USAF officer and uses it as one of the chapter headings of his book. Besides revealing the short corporate memory of the armed services, aggravated by the rigid compartmentalization of experience gained in previous electronic engagements, this quotation also illustrates the cyclic nature of the campaign in the electromagnetic theater of operations of a modern war.

Although subtitled "The History of Electronic Warfare," this book is largely concerned with just one part of it, the long campaign between the Royal Air Force and the Luftwaffe over northern Europe between 1939 and 1945. Nevertheless, many key battles of this campaign turned on the use of electronics.

Using clear, jargon-free language, Price explains and illustrates the principles of electronic warfare and their links with intelligence and general tactics. He also points up another important facet of modern war, the organization and application of scientific effort. The undoubted scientific skills of the Germans had produced electronic

systems superior to those of the British and the Americans by 1939, yet by May 1943 Goering was forced to say "I did hope that even if we were behind we could at least be in the same race."

The centerpiece of the book is the story of the introduction of "window" (the strips of metal foil now known as "chaff" used to confuse radar). The idea of window was thought of in Britain and Germany almost simultaneously but what the decisionmakers did about it reveals much about the direction of scientific effort in both countries and also of how scientific developments must always be closely related to operational developments in the frontline—particularly in the dynamic area of electronic warfare.

The tale also goes through one of those mazes so familiar to students of the subject. Each side thought that if it used a technique first, that technique would be adopted quickly by the other side who would then gain more from it. This cannot be true for both sides, yet both persuaded themselves that it was. Goering ordered the destruction of his force's initial trials report and stringent measures to prevent any leakage of information—all experiments, even those aimed at developing a countermeasure, had to cease.

In Britain, window was found to be highly effective against the radar used by night fighters. RAF Fighter Command immediately asked that Bomber Command not use window until an antidote had been developed. After 4 months, the requisite new procedures and tactics had been developed, and Fighter Command dropped their objections, but then Bomber Command demurred. Their spokesman, Air Marshal Saundby said: "There are only so many tricks that my force can use against the enemy, and once these are exhausted there is nothing." He therefore wanted to use each new trick until it was played out, and as two other forms of jamming ("mandrel" and

"tinsel") had just been introduced, he wished to let these run before using window. Thus the use of window was postponed for another 6 months.

Saundby's thoughts were a mirror of those of General Milch, Luftwaffe Director of Air Equipment, who about the same period said "There is only one worry for us, that the enemy will again catch us on the hop with some radar trickery and we will have to start trotting after him again."

Mandrel, which put noise jamming into the *Freya* early warning radar, and tinsel, which jammed the ground-control radio frequencies, went into service with immediate success. Soon however, the German radar operators got used to mandrel and found how to get round it. They detuned their sets and spread their frequencies and the fighters learned how to home onto jamming. Within 3 months, mandrel had all but lost its effect. Tinsel continued in use until the end of the war, although the Germans were forced to use higher power transmitters and introduce new frequencies. The experience of these two devices shows that Electronic Warfare is a fast-moving campaign where victories are relative, not absolute. Enemy measures, defensive or offensive, can be hampered but never definitely negated. Given time, the adversary will produce antidotes or new equipments immune to the jamming in use.

During all this period the *Wurzberg* ground control radar, the backbone of German Air Defense system, remained unjammed and General Kammhuber, its commander, developed the tactic of coordinating radar, searchlights, flak and night fighters to a high pitch of success. Some of his pilots felt that the system was too rigid and sought to find free-ranging tactics more suited to their personalities. Maj. Hajo Herrman led this group and was allowed limited experiments with day-fighters, using the illumination given by searchlights and the flares used by the British bombers. Nicknamed

"Wild Boar," these tactics were not encouraged as they raised problems of coordination with the flak gunners.

Eventually permission was given for the RAF to use window, and all was set for massive attacks on Hamburg beginning on 24 July 1943. Seven hundred and forty-six bombers attacked that night and the effect of the first use of window was devastating. It appeared as if over 10,000 aircraft were attacking the city. Searchlights, fighters and flak were directed onto false targets and confusion reigned on the German side. Only 11 British aircraft were lost instead of the expected 50. The second night, however, Major Hermann was allowed to use his "Wild Boar" tactics and in the light of fires caused by the bombing started to score successes. By the time the attack was shifted to Berlin, in August, Wild Boar was in full effect, and British loss rates had risen to almost the same level as prewindow days. The 6 months virtual immunity originally hoped for was reduced to a few weeks by the Luftwaffe's swift introduction of tactics only lightly dependent on electronics.

Those responsible for organizing and operating Electronic Warfare equipments and for coordinating E.W. with general tactics will find this book both interesting and useful. They will find that many of their bright ideas have been thought of before, albeit in different parts of the electromagnetic spectrum, perhaps, and under very different conditions. With *Instruments of Darkness* as a guide, the painful reinvention of the electronic warfare wheel may be shortcircuited.

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Reynolds, Clark G. *The Fast Carriers: The Forging of an Air Navy*. 2d ed. Huntington, N.Y.: Robert E. Krieger, 1978. 502pp.

This second edition of *The Fast Carriers*, first published by McGraw-Hill in