THE LAST WORD

by Charles Day

Computing in World War I

This year marks the 100th anniversary of America’s entry into World War I. On 6 April 1917, both chambers of Congress voted overwhelmingly to grant President Woodrow Wilson’s request to declare war on the German Empire. Among the first US military formations to arrive in Europe was US Battle-ship Division Nine, which comprised the battleships Delaware, Florida, New York, and Wyoming and the destroyer Manley. The ships joined the Royal Navy’s Grand Fleet at its base in Orkney on 9 December.

The fastest, most modern warships of the time were propelled by oil-powered steam turbines. Short on oil because German U-boats were sinking British oil tankers, the Royal Navy had asked the US Navy to send older, coal-powered ships instead. Despite their relative age, the battleships of Division Nine were formidable war machines. All of them survived the war.

When the US ships went on training exercises with British ships, it became clear that the British could sustain higher and more accurate rates of fire. Part of the British superiority arose from the three years of experience the Royal Navy had already gained from fighting Germany and its allies at sea. But the Royal Navy also had a technological advantage: the main guns of its largest battleships were controlled by a computer.

Computer control was an integral feature of a new type of battleship introduced a decade before war broke out. Named after their archetype, HMS Dreadnought, the new battleships were equipped with ten or so long-range guns of a single large caliber, rather than a mix of small, medium, and large calibers. If a target’s range, bearing, and speed were known, an aiming command could be transmitted to the gun turrets to direct a single, devastating salvo at the target. And if the aim was off target, a single adjustment sufficed for the second salvo.

The sequence of events that culminated in a Dreadnought salvo began with the use of an optical rangefinder, a binocular-like device that used triangulation to determine the range. Measurements from the rangefinder, including speed and bearing, were fed into a mechanical computer and electrically transmitted to mechanical computers that used lookup tables to determine the guns’ elevation and azimuth at the moment of firing.

The biggest naval battle of World War I, Jutland, took place in the North Sea between 31 May and 1 June 1916. One hundred and fifty-one warships of the Grand Fleet engaged 99 warships of the Imperial German Navy’s High Seas Fleet. Despite the Grand Fleet’s numerical advantage and despite the High Seas Fleet’s lack of computerized fire control, Britain lost more ships: 14 versus 6. Still, the German losses were deemed so heavy that the High Seas Fleet remained at port for the rest of the war. The Royal Navy continued to blockade Germany, while the Imperial German Navy resorted to unrestricted submarine warfare, a strategy that contributed to the US decision to enter the war on the side of Britain and her allies.

One of the British battleships that fought at Jutland was HMS Warspite. The ship not only survived the battle, it went on to serve in World War II with upgraded weaponry and a faster, though still analog, computer control system. During the Battle of Calabria on 9 July 1940, the Warspite’s fire control system succeeded in hitting the Royal Italian Navy’s battleship Giulio Cesare at a range of approximately 24 km. The feat remains one of the longest-range hits in the history of naval gunnery.

Charles Day is Physics Today’s editor in chief. The views in this column are his own and not necessarily those of either Physics Today or its publisher, the American Institute of Physics.