GREAT WEAPONS OF WORLD WAR I

WILLIAM G. DOOLY, JR.

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World War I weaponry has been unjustly neglected. There are few source books that give a well-illustrated account of the many weapons that first made their appearance during the First World War —and none so comprehensive as Mr. Dooly's. Yet, because the war presented all the major developments in conventional warfare in their primitive stages, a knowledge of its matériel is essential to an understanding of today's weaponry. This book sets out to fill a gap long recognized by weapons buffs, historians, and interested laymen alike.

It is not intended to be a complete catalogue of all the weapons used in World War I. However, this book does describe and illustrate all the important weapons and system developments—from hand guns to aircraft through artillery, machine guns, grenades, poison-gas cylinders, tanks, trench defenses, battleships,

(continued on back flap)

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Pages 180, 216, 219, 220, 221, 228, 230, 232, 234, 236, 237, 238, 241, 242, 243, 244, 247, 248, 250, 253, 254, 257, 258, 260, 261, 265, 266, 267, 268, 269, 270, 272, 275, 276, 278, 279, 280, 285, 287, 288, 292, 294, 297, 298, 301, 303, 304, 305, 309, 310, 312, 313, 314, 315, 316, 317, 318, 320, 323, 326, 328.

OFFICIAL U.S. AIR FORCE PHOTO

Pages 132, 184, 187, 188, 190, 192, 197, 198, 199, 200, 202, 203, 204, 205, 207, 210, 211, 213, 215, 223, 224, 225.

NATIONAL ARCHIVES

Pages 2, 14, 115.

CHARLES H. YUST, JR.

Pages 27, 28.

MEYERS STUDIO, INC.

Page 121.

THE BETTMANN ARCHIVE INC.

Page 172.

U.S. ARMY

Pages 4, 10, 13, 18, 19, 31, 34, 36, 37, 40, 42, 43, 52, 55, 64, 78, 87, 89, 90, 100, 118, 119, 120, 122, 123, 133, 167.

IMPERIAL WAR MUSEUM

Pages 6, 7, 8, 20, 22, 23, 24, 25, 26, 27, 38, 41, 47, 48, 82, 85, 102, 104, 116, 117, 129, 132, 134, 143, 144, 146, 148, 149, 151, 157, 158, 160, 168, 174, 176, 177, 182, 186, 188, 196, 200, 201, 206, 207, 212, 214, 215, 224, 226.

U.S. SIGNAL CORPS

Pages 8, 14, 15, 16, 32, 35, 44, 49, 50, 56, 61, 62, 66, 68, 70, 71, 72, 74, 75, 76, 79, 81, 84, 87, 88, 89, 90, 92, 93, 94, 96, 98, 105, 106, 110, 111, 112, 124, 130, 131, 134, 135, 136, 142, 145, 147, 155, 156, 162, 164, 166, 170, 188, 195, 208, 215, 222, 291, 306.

CONTENTS

PART II: THE WAR IN THE AIR

PART III: THE WAR AT SEA

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While the author must assume responsibility for any errors in fact or interpretation, including conversion of metric figures to the U. S. system of weights and measurements for many weapons, this assemblage could not have been possible without the assistance made available by the organizations and experts listed here.

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W. G. D.

INTRODUCTION

THE FIRST WORLD WAR was a transition in mammoth conflict between the Civil War and World War II. Some weapons, familiar to General Grant and General Lee, reached their ultimate in the appalling slaughter "over there." Others, just introduced, proved the mightiest tools of the next global clash.

The first conflict was bad enough. Fifty years of nature's balm have not erased its physical ravages from the face of Europe. Apart from the structures that were destroyed, forests were leveled, and even the ground was affected at scenes of massive battles. In some sections of the old Western Front where the earth was churned with mixtures of high explosives and chemicals during repeated bombardments, the soil remains unsuitable for agriculture. Signs affixed to rusting fences proclaim the areas still dangerous.

World War I signified the end of an era when civilians watched their professional champions on the field of battle. It became a war of peoples, reaching back into the homeland not only to conscript awesome numbers of men but also to enroll the talents of the scientist, the engineer, the propagandist, and—most of all—the economic and manufacturing might that ultimately and remorselessly tilted the scales.

In terms of human values, the conflict's toll was incalculable. The Great War, or European War, later renamed the World War, then World War I, took the lives of twice as many men as all the major wars of the previous 125 years combined. It ranks second only to World War II in lives and money expended, yet exacted the larger percentage of casualties among the fighting forces. Casualty figures will never be exact for either war, but estimates listed half of the 65 million men mobilized for World War I as either dead, wounded, taken prisoner, or missing.

This percentage is somewhat higher than for total military casualties estimated among the 92 million men and women mobilized in the six-year World War II period, 1939–1945. For France and Great Britain, World War I was exceptionally brutal in manpower losses. French military casualties of more than 6 million (including 1.4 million dead and 4.3 million wounded) represented eight times the World War II attrition. Great Britain's were four times those of World War II.

There was some reason for the discrepancy. France surrendered speedily after the 1940 blitzkrieg. The British, knocked off the Continent at Dunkirk, did not return to the Mediterranean shores until 1943, and the Channel coast, in 1944.

Lives were extravagantly expended between 1914 and 1918 in utterly insane assaults against twentieth-century firepower. Too much, perhaps, has been made of Napoleon's famous remark that "the moral is to the physical as three to one." But while weapons certainly could not be handled effectively in battle without courage, it was demonstrated that no amount of courage could offset inferiority in weapons. When such an inferiority is recognized, an erosion of morale inevitably sets in. It caught up with the French in the mutinies of 1917, and with the Germans in 1918.

In the all-important land war both the French and German doctrines at the outset were based only on attack, ignoring the importance of defense. The French dreamed of quick victory with their rapid-firing 75mm gun in a Napoleonic-style offensive into the teeth of the invaders. A new school founded on élan had taken over the military and taught its bright-red-pantalooned soldiers to attack with bayonet to the last man.

They did this, and the French armies were shattered at Mörhange-Sarrebourg. In the first days of fighting a British officer wrote:

"Whenever the French infantry advance, their whole front is at once regularly covered with shrapnel and the unfortunate men are knocked over like rabbits. They are very brave and advance time after time to the charge through appalling fire, but so far it has been to no avail. . . . The officers are splendid; they advance about 20 yards ahead of their men as calmly as though on parade, but so far I have not seen one of them get more than 50 yards without being knocked over." (37)

Similarly, the German doctrine called for the cavalry always to attack first, and for the infantry to be dominated by one thought: "Forward, upon the enemy, cost what it may." The Germans practiced this dictum liberally in futile assaults on the Liège forts before bringing up the 420mm "Big Berthas" to reduce them. They advanced in mass formation against rapid-firing British riflemen at Mons, and repeated the tactic again and again in the face of massed French "75's" at the Grand Couronné and in the First Battle of the Marne.

On the Eastern Front, extending for more than 1,000 miles from Riga on the Baltic Sea to the shores of the Black Sea, Russia hurled ill-equipped and poorly trained millions to their destruction before she collapsed in revolution. The worst equipped of the major Allies, the Russians mauled Austria-Hungary and gallantly responded to appeals of the French and the Italians in attacks to relieve pressure at Verdun and in the Trentino. The price that Russia paid in casualties has been estimated at three-fourths of her total mobilization of 12 million men, which some regard as conservative.

The other major front was along the Italian frontier where the Italians rebounded from disastrous defeat at Caporetto to redeem themselves at Vittorio Veneto. Other battlefronts developed in the Balkans, in Egypt, Mesopotamia, and Palestine, and fighting spread to German possessions in Asia, Africa, and the Pacific Ocean. For the first time, a great war was fought on, under, and above the land and the seas.

In this book, however, discussion of the land war is focused on the decisive Western Front, where most of the crucial battles were fought. Here the grossly underrated defensive power of modern weapons threw out of balance all orthodox theories of warfare then in vogue. Generals found themselves commanding enormous forces with which they had no experience in a war of bewildering size and character. Often they were trapped by the stereotyped military training that idolized anachronisms.

Cavalry generals, for example, baffled by the trench deadlock, persisted in attacks founded on cavalry pursuit after the enemy lines had been penetrated by artillery and the infantry. Mass losses of infantry to the machine gun resulted instead. The cavalry, immobilized by crater fields, wire barricades, and the bullet, waited out much of this war in the wings.

As ingenuity and science cracked through, many contrasts and seeming paradoxes appeared. World War I was a memorial to the power of defense, yet it produced the concepts and the prototypes of weapons that dominated the all-offensive struggle of World War II—the tank, the beginnings of air power, and a start on the road to full mechanization and self-propelled artillery.

The 16½-inch "Big Bertha" broke all records for road-mobile size and had its useful place in Germany's nutcracker suite for the destruction of forts. The 75-mile-range Paris Guns were marvels of ordnance engineering, and as such rank more as curiosities than practical weapons of war. On the other hand, great use was made of the French 37mm gun, one of the smallest artillery pieces ever developed.

One of the most effective jobs was done by the stubby little mortars that lobbed big bombs by the thousands into enemy trenches at ranges of only a few hundred yards. The trench mortar was an anachronism that worked—a throwback to the seventeenth century that was rediscovered and refurbished to wreak havoc in World Wars I and II, Korea, and Vietnam.

The frustration of siege war induced the introduction of poisonous gas that temporarily shocked the world, and automatic rifles of a high order. Many of the small arms needed only minor improvements to survive into World War II. Artillery probably was developed to a higher degree of proficiency than any other class of weapons, and many of these pieces were put to use in the 1940s.

The only thing missing to turn static warfare into artful maneuver was mobility. Even that was introduced near the end of hostilities by the French in the form of a two-vehicle gun carriage and limber run by electric transmission.

Spads, Nieuports, Sopwith Camels, and Fokkers! Essential additions to the vocabulary of that restless generation of boys who grew up following World War I. Youth the world over gloried in stories of the knight-errantry of aerial combat—the only real glamour to emerge from the war. Air power, though, was not a decisive strategic factor.

German Zeppelins, while credited with inflicting the first real bombing damage, were tried and found wanting. But the furious pace of airplane development was astonishing. At first unarmed and limited to reconnaissance, planes of 1914 could fly 60 to 75 miles an hour, reach an altitude of 10,000 feet, and barely lift the weight of fuel and pilot.

By 1917, speed and altitude ranges had more than doubled, and fighters sought mastery of the air with synchronized machine guns firing through the propellers. Bombers carried two-ton payloads into enemy homelands. And the French unveiled the Adam of aircraft rockets—slender incendiary missiles fired electrically from the wings into enemy observation balloons.

The war at sea was a story of grim hide-and-seek as German submarines sank ships almost as fast as the Allies could build them, of mines and the development of convoys, of relentless chases to far corners of the earth, of raiders and of the immense battle fleets at Jutland. The epitome of battleships was approached in the "Dreadnoughts"; yet torpedo boats, mosquito boats, and subchasers developed their sting.

The wedding of air and sea power was heralded by the first ship sinking by a torpedo plane and the first aircraft landing on a ship under way. Thus were augured the death of the battleship, even during its ascendancy, and the birth of the most powerful naval weapons of World War II.

This book, then, is intended to offer the reader a general canvas of the major classes and most important of the weapons of World War I, as well as descriptions of how they were used. The text is divided into three major parts—the land war, the war in the air, and the war at sea.

Part I

THE LAND WAR

French 340mm railroad gun, one of the giant artillery pieces in the war, manned by Americans, hurls its 940-pound projectiles upon German railway center 20 miles away.

ARTILLERY

INTRODUCTION

NONE OF THE BELLIGERENTS in 1914 imagined that the conflict would turn into essentially an artillery war of undreamed-of proportions, in which shelling would drain the industrial might and resources of the great nations.

Germany alone had an inkling, and was prepared with the best-balanced and most powerful array of guns. But she, like France, Great Britain, Russia, and Austria-Hungary, had counted on a quick war of movement. Apparently no great commander even realized that the cavalry cycle of warfare was a thing of the past, stymied by the hail of bullets from modern small arms of the infantryman—much less that the infantry itself would become dependent upon a wall of artillery shells to shield its advance. Further, few visualized the revolutionary impact on artillery power that was to come from railway and motor transportation, aircraft observation, telephonic and radio communication, improved and varied types of ammunition, and target location by survey and sound ranging.

In keeping with the theory that any war would be sharp and short, the British considered that 500 rounds per field gun in the theater of operations and a reserve of 1,000 rounds in the arsenal were adequate—seven rounds per field gun per day was thought to be reasonable. Von Moltke, chief of the German General Staff at the outset, fixed the war reserve at 1,200 rounds per gun in 1912, but this was not reached except for heavy artillery by 1914. France had on hand more than 1,400 rounds per field gun and 2,000 rounds per heavy gun before mobilization, but her artillery was inferior in number and variety.

Only after the war had bogged down in the trenches did the actual role of artillery start unfolding. With proper "preparation" by a heavy artillery bombardment, it was discovered, an advance of a mile or so

The excellent French 37mm gun was the smallest used fieldpiece. U.S. soldiers work way toward entrenched Germans, using weapon as a machine gun sniper.

through the trench defenses could be almost guaranteed. Nations doubled, and in some cases more than tripled, their artillery pieces and strained their industrial resources to feed them ammunition. The number of guns and their meager daily ration of seven or eight rounds in 1914 quickly became an absurdity. Armies that had started with six guns to each 1,000 infantrymen finished with 10 guns per 1,000 rifles. At the zenith of firepower, in the great attacks, literally thousands of guns lined a frontage of many miles almost wheel to wheel, each spewing out 500 or more rounds of high explosives in a day.

From the moment she wheeled out her giant 420mm howitzer—the first of many tactical surprises—to make a shambles of the Liège forts, Germany consistently outgunned the Allies. This dominance continued for three years. On August 1, 1914, Germany had 8,165 artillery pieces ready for the field. They consisted of more than 5,000 77mm guns and 1,260 105mm howitzers—her *Feldartillerie*—and 1,368 150mm heavy howitzers and quantities of other *Fussartillerie,* ranging from the 105mm gun up to the 420mm "Big Bertha." By August 1, 1917, the number of German guns available for use had more than doubled to 17,455, of which nearly 11,000 were fieldpieces, the remainder heavy artillery.

France, much to her surprise, was grossly inferior in artillery at the outset despite her fast-firing 75mm gun. Only 2,800 "75's" were on hand in August, 1914, and that was about all except for 250 heavy pieces, mostly 155mm guns and howitzers. France rose valiantly from the brink of defeat to produce enough munitions to take care of both her own needs and those of the American Expeditionary Forces. Her own artillery in the field at the time of the Armistice had increased to 6,400 field guns and 6,175 heavy guns. French production during the war included 17,300 75mm guns, 6,722 heavy guns and howitzers, and 297 million shells of all calibers. At the peak of production, 226,000 75mm shells and 51,780 155mm shells were turned out in a single day.

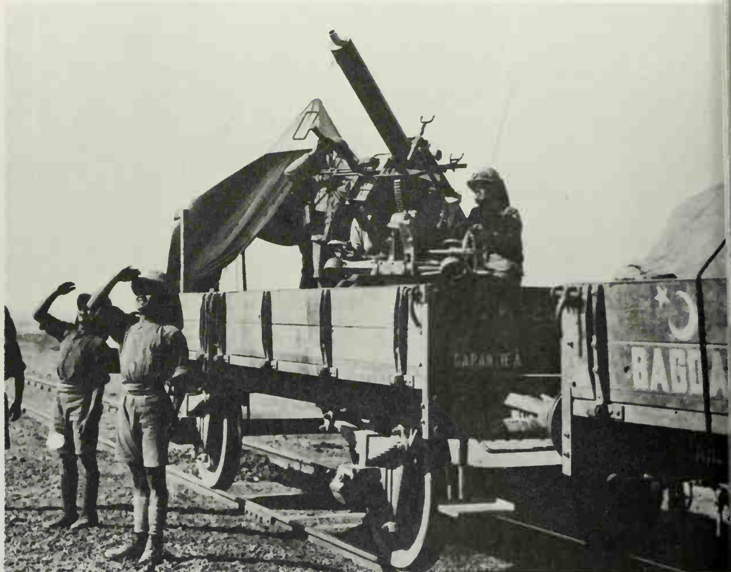
British forces were severely handicapped from lack of both guns and ammunition during 1914 and throughout 1915. Ten months after the war began, only 1,400 British guns were in France and only 71 of these were larger than 5-inch. Shortages of guns and shells—many of them "duds"—caused a national scandal in the spring of 1915. The public outcry resulted in a coalition government and creation of a Ministry of Munitions headed initially by Lloyd George, and ultimately by Winston Churchill. It mobilized the nation's resources in machinery, materials, science, and invention. Production of explosives rose from 400 to 7,000 tons per week, and shipments of ammunition across the English Channel eventually exceeded 53,000 tons per week. Shell production increased from 200,000 weekly in June, 1915, to 2,000,000 a week in March, 1917, and a total of 28,750 guns were delivered to the army during the war.

Russia was pathetically deficient in artillery and all manner of war materials, and her plight steadily worsened until the end. Her divisions had little more than half the guns of a German division, which could attack with almost a guarantee of success. Russia was reported to have begun the war with 850 shells per gun; when she bowed in 1917, she had few guns or shells left. General Sukhomlinov, minister of war, who won his spurs as a cavalry officer against the Turks in 1877, was annoyed with the term "modern war," and dismissed several staff college instructors in 1913 for espousing the vicious innovation of "fire tactics."

Italy entered the war in 1915 with 2,121 artillery pieces of all types and found it necessary to nearly quadruple her supply, to 7,995 guns, by Armistice.

The United States, sitting on the sidelines, was caught napping when forced to plunge into the war in 1917 without appreciable stocks of military supplies on hand. Only 900 pieces of artillery were available, mostly 3-inch guns, and these were allotted to training purposes. The crisis in Europe was too imperative to wait out the lead time for tooling up to production. So American soldiers fought largely with European guns—3,000 of them, nearly all French—and French ammunition.

Only the British 1-pounder antiaircraft gun, shown in action in the Turkish Theater, was smaller than the 37mm cannon.



A British 8-inch howitzer cuts loose at Wagnonlieu, May, 1916.

When production got going, however, U.S. firms had turned out more than 1,600 pieces by Armistice and more than 3,000 by April, 1919, while at the same time filling large orders for the Allies. Above all, America became the arsenal for the stuff that hurled the shells and exploded the projectiles on the German war machine. In the Allied effort, World War I was in large measure fought with American smokeless powder and high explosives.

British 52nd Siege Battery called its 12-inch railroad howitzer "Alpha No. 1."

Many mistakes were made by most of the commanders in the field in trying to master this Gargantuan form of warfare that was spawned and fed by the big factories of the twentieth century. No-man's-land was chewed into crater fields or churned into mud over which tanks and sometimes even the infantry could not move. The advance of entire armies, initially victorious, was blocked by vast wastelands of their own making when supplies could not be brought up. But a number of successful tactics also were established for the emerging artillery cycle, such as the rolling barrage and the quick "hurricane bombardment." Earlier bombardments were characterized by an enormous wastage of shells as well as lives.

"To the spectator," wrote Gerald A. Campbell, war correspondent of the *London Times*, "the noise is so tremendous that it seems that it must be beyond the limits of human endurance to face the storm of steel and fire. At the hottest moments it keeps changing curiously and horribly in character, volume, and tempo, rising and falling with alternating diminuendo and crescendo and hurrying and slackening pace. It is all extraordinarily relentless. Sometimes the deafening volley of reports sound like a clattering of a clumsy, lumbering wagon, jolting heavily over the frozen ruts of a rough country lane; sometimes like the brisk hammering of thousands of carpenters and riveters at work on thousands of wooden joists and steel plates; sometimes like the rumbling of hundreds of heavy goods on trains thundering and bumping over uneven points and meeting every now and then in hideous collision." (6) Yet, Campbell noted, against the cacophony of confusion, the different kinds of sound were always distinguishable—"the heavy slow boom of the big guns, the vicious sharp bang of the field pieces, with their lightning-like velocity and shattering irresistible force, the shriek of the shells . . . and most awful of all, I think, the sudden unexpected silences, which make you hold your breath and wait—like a condemned murderer with the noose round his neck must wait on the scaffold—for the dreadful moment which you know will come when the storm will all begin over again."(6)

The plethora of types of artillery pieces used in World War I was such that all could not be described within the confines of this book, which is intended to illustrate the principal weapons. The Germans alone, for example, started the war with 110 different models of gun carriages that were acceptable. During the four years and three months of fighting, German artillery hurled at the Allies some 300 million assorted projectiles of steel, explosives, and gas with a total weight of about 6 million tons. The Allies fired even more.

(above) An unusual view of a German antiaircraft truck-mounted gun in action in Flanders, August, 1917. This unidentified gun, approximately 3-inch, probably was adapted to field use from a naval vessel.

(below) American soldiers examine a 1917 model 150mm German howitzer at a display of captured equipment on the Place de la Concorde, Paris. This model was 15 calibers long, could fire a 93-pound projectile about 10,000 yards. A 170mm *Minenwerfer* is shown at right.

French "75" of the American 6th Field Artillery, 1st Division, in action amid bursting shells, Ardennes, France, in October, 1918. Other guns are barely visible at extreme left.

THE FABULOUS "75"

THE MAGNIFICENT FRENCH 75MM GUN, designed in 1897, was undeniably the finest fieldpiece in the world. Germany tried for years to equal or surpass it; others copied it. A weapon of unique mobility and accuracy, it could spit out 15 to 20 rounds a minute. (In a postwar demonstration at Aberdeen Proving Ground, Maryland, a crack American crew achieved a firing rate of 25 rounds a minute.)

The "75" played a far more significant role in World War I than its function as a field gun. It was too good; it helped mislead the French to unwarranted confidence in a short war of movement. Obsessed with its merits, the French expected all things of the "75" and failed to balance their artillery with the howitzers and heavy pieces needed for the kind of war that actually ensued. In 1914 each French divisional artillery consisted of thirty-six 75mm guns in three *groupes* (brigades) of three four-gun batteries, and the corps artillery was preponderantly "75's" with a sprinkling of heavy pieces and foot regiments. In contrast, the German division had fifty-four 77mm field guns and eighteen 105mm howitzers, and each corps and army was equipped with additional heavier howitzers.

There was a certain grace to the taper of the 1897 model "75" and an overall balance that distinguished it from other field guns of the day. It was perfected by Captains Sainte-Claire Deville and Emile Rimailho. The steel tube with rifled bore was 33 calibers long (calibers times diameter of the bore equals length) and was reinforced near the breech by a breech hoop. The midsection had a characteristic bronze envelope or jacket, and the hoop and jacket were joined by inner and outer locking hoops to prevent sliding of the tube. A single movement of the eccentric breech block sufficed to open or close the breech. Firing was by spring hammer operated with a lanyard. The firing pin was seated in the breech block, and only when the breech was locked did the pin come in line with the primer at the center of the cartridge base. One of the most unusual, and important, features of the French "75" was its hydropneumatic recoil system and recuperator. Normally two separate systems, they were combined successfully in one cylinder.

The gun developed an initial muzzle velocity of 1,805 foot-seconds, and its projectile could slam into a target 10,000 feet away at nearly 1,000 feet a second. It fired either a 16-pound shrapnel shell or a 12.3-pound high-explosive shell to ranges of 9,100 yards and 9,846 yards, respectively. The shrapnel shell (invented, incidentally, in 1784 by Lieutenant Henry Shrapnel of the British army) was used almost exclusively by the French and British in the early days of the war. For the "75" each 16-pound casing held 300 lead balls weighing 12 grams each, hardened with antimony and mixed with compressed black powder. The French called the drumfire of their massed "75's" *rafale,* in which a squall of shrapnel shells was sent exploding to release the balls that shattered the opposing infantry in agony and death.

The "75's" performed this duty cruelly in the Grand Couronné battle that opened on September 5, 1914, as the Kaiser himself stood vainly by with his white-horsed *cuirassiers,* waiting to march triumphantly into Nancy. This rare French victory over Crown Prince Rupprecht's army, in the early days before they learned not to attack in massed formation, was described by Gerald F. Campbell, war correspondent of the London *Times*:

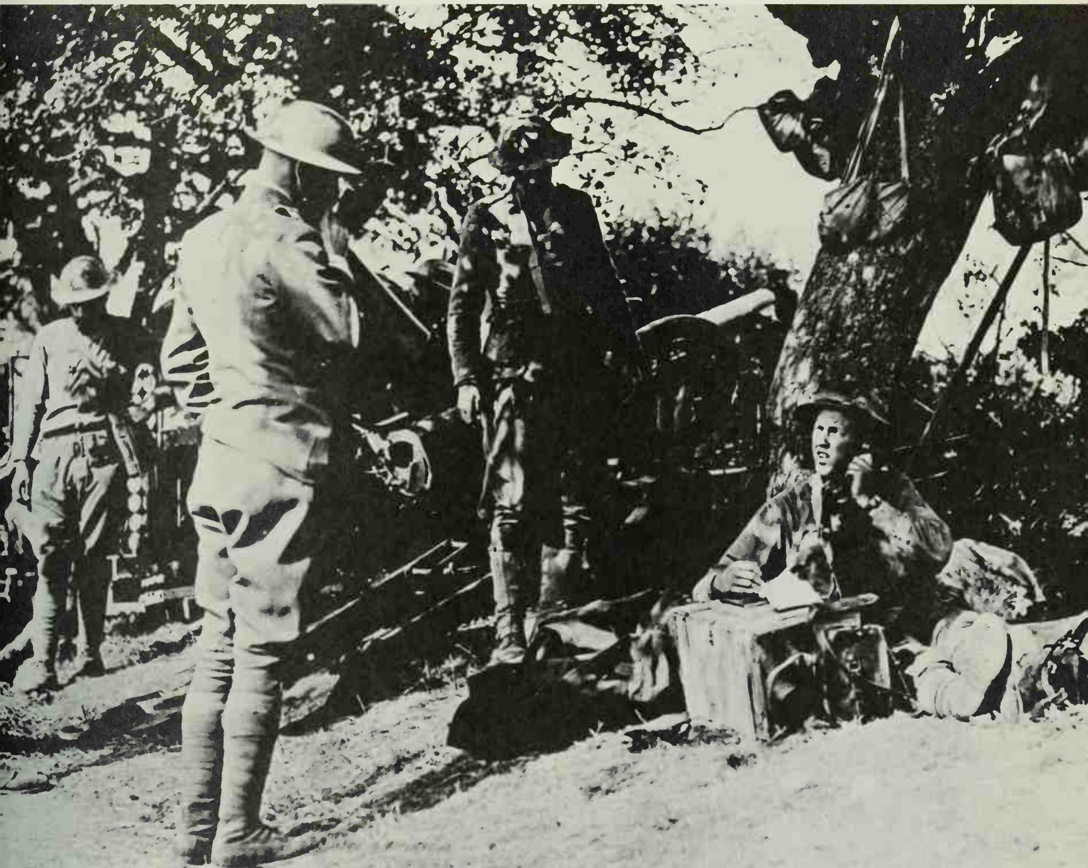
"From the woods a mile away, headed by their fifes and drums, wave upon wave of Germans advanced as steadily and as pompously as if they were on parade, to the attack of the French infantry positions on the side of the hill." After a violent hand-to-hand struggle, the German ranks broke, and as they fled to the shelter of the forest the French "75's" mowed them down rank by rank at short range. The Germans advanced six times towards the deadly hill, and were driven back each time to the sheltering woods. "At some places at its base," wrote Campbell, "the bodies were piled up five or six feet high, and when the survivors took cover behind the heaps of dead and wounded the 75's still raked them through and through, smothering dead and living in a horrible mire of flesh and blood, while the 75's, firing over the heads of the front ranks, finished off the work further back. The losses were enormous. Thousands of German dead were left lying on the plain, and in the evening they asked and were granted a few hours' truce to bury them." (6)

French-developed 75mm antiaircraft gun mounted on a truck in action at Montreuil, France, June, 1918. Note outriggers to stabilize the carriage.

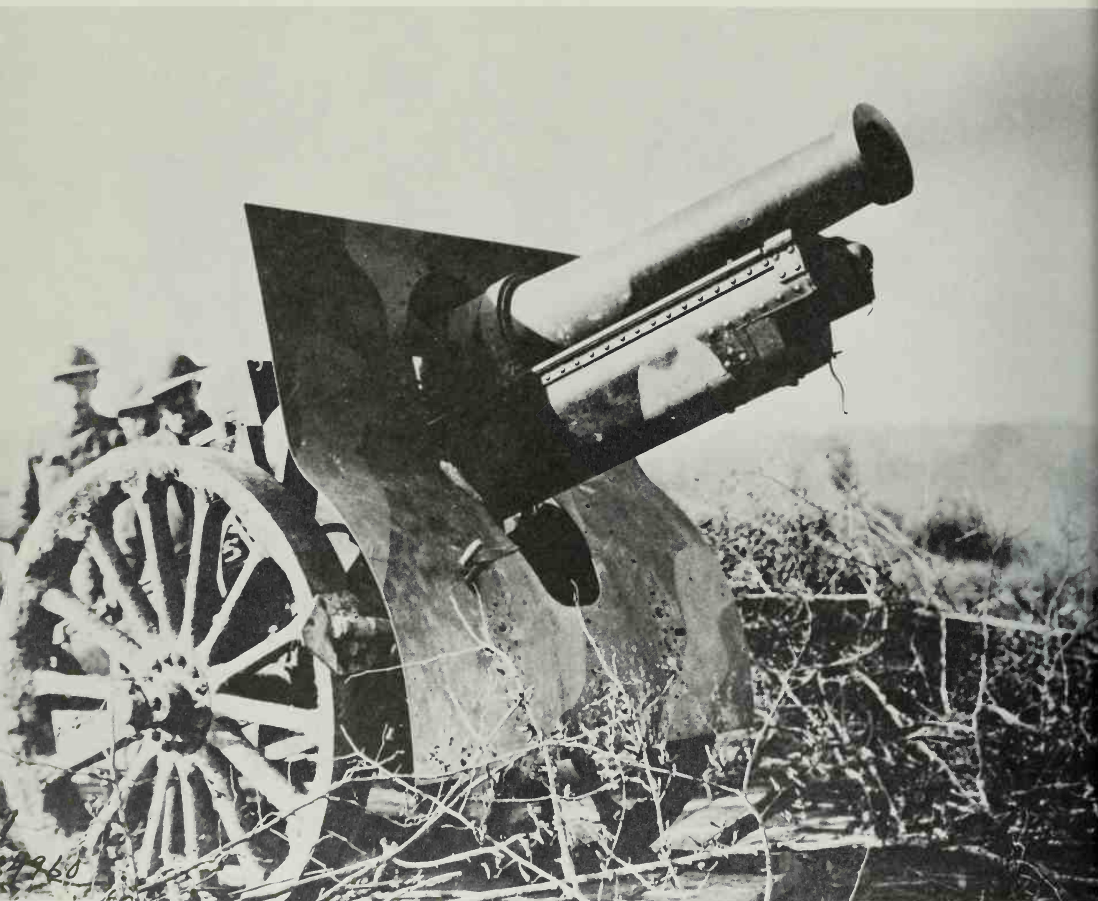
French "75's" in winter action.

Camouflaged French "75's" being used by the American 6th Field Artillery, 1st Division, near Einville, Meurthe-et-Moselle, France.

An emplaced French "75" in action in France, June, 1918, with American crew. Battery captain with megaphone receives reports from observation posts via field telephone before relaying instructions to crew.



"Calamity Jane," a 155mm howitzer (serial no. 3125) and crew of the 11th Field Artillery, said to have fired the last shot of the war for the Allies in the Bois de la Haie, Meuse area, France.



FRENCH MEDIUM AND HEAVY ARTILLERY

DEALING WITH THE FRENCH ARTILLERY of World War I is synonymous with talking about American matériel, especially the "75's" and the 155mm guns and howitzers. These, plus a variety of other French makes, were used almost exclusively by the doughboys in France. Many a veteran of the American artillery of fifty years ago will swear, with ample justification, that the "155" was the best counterbattery of the war.

The long German 150mm gun consistently hammered Allied positions from safe ranges more than 10 miles away. The French 105mm Schneider gun had a similar range but its projectile was too light. The answer was provided in the Saint-Chamond 155mm G.P.F. (*Grande portée Filloux**), models 1917 and 1918. This powerful and extremely accurate weapon undoubtedly was the best Allied medium gun. Its length was 232.87 inches, and its weight, on wheeled mount, was 20,100 pounds. The G.P.F. hurled projectiles of 95 to 99 pounds to ranges of more than 21,000 yards, compared with 17,500 yards for the Schneider model, which appeared in 1917. The French "155" of World War I was so good that the same gun was used in quantity following the Normandy invasion more than twenty-five years later as the U.S. M12 Gun Motor Carriage, mounted on a Sherman tank chassis. It was the predecessor of the famous American "Long Tom" 155mm gun, even more powerful, that appeared in World War II.

The need for a gun like the "155" early in the war was so critical that stop-gap measures were taken while tooling up went on. Thus came

* Literally, "Great range" Filloux, named after the designer, as designated by the Saint-Chamond Company. Some refer to G.P.F. as *"Grande puissance Filloux,"* meaning "Great power" Filloux. In either case, the description is accurate.

into being 200 hybrid field guns of 145mm caliber. Taken from French war vessels and mounted on mobile carriages by Saint-Chamond, these hastily improvised guns, after being worn out by firing several thousand rounds, were successfully rebored to take 155mm ammunition. A few French 120mm and 220mm guns also were used, but they were not outstanding.

Disaster after disaster slowly impressed upon the French the need for the high-angle, plunging fire of the howitzer. They had the opportunity of learning its value in the first few days of the war in the wooded hills of the Ardennes. The "75's," superior as they were in the open, could not search out the nooks and slopes of "dead ground" where the machine gunners lurked. Again, at Loos in September, 1915, a French general, confident in the results of a three-day bombardment, predicted his men would be able to advance through the destroyed German defenses with rifles at the slope. The trouble was, the German second position was practically intact on the reverse slope, safe from direct observation and

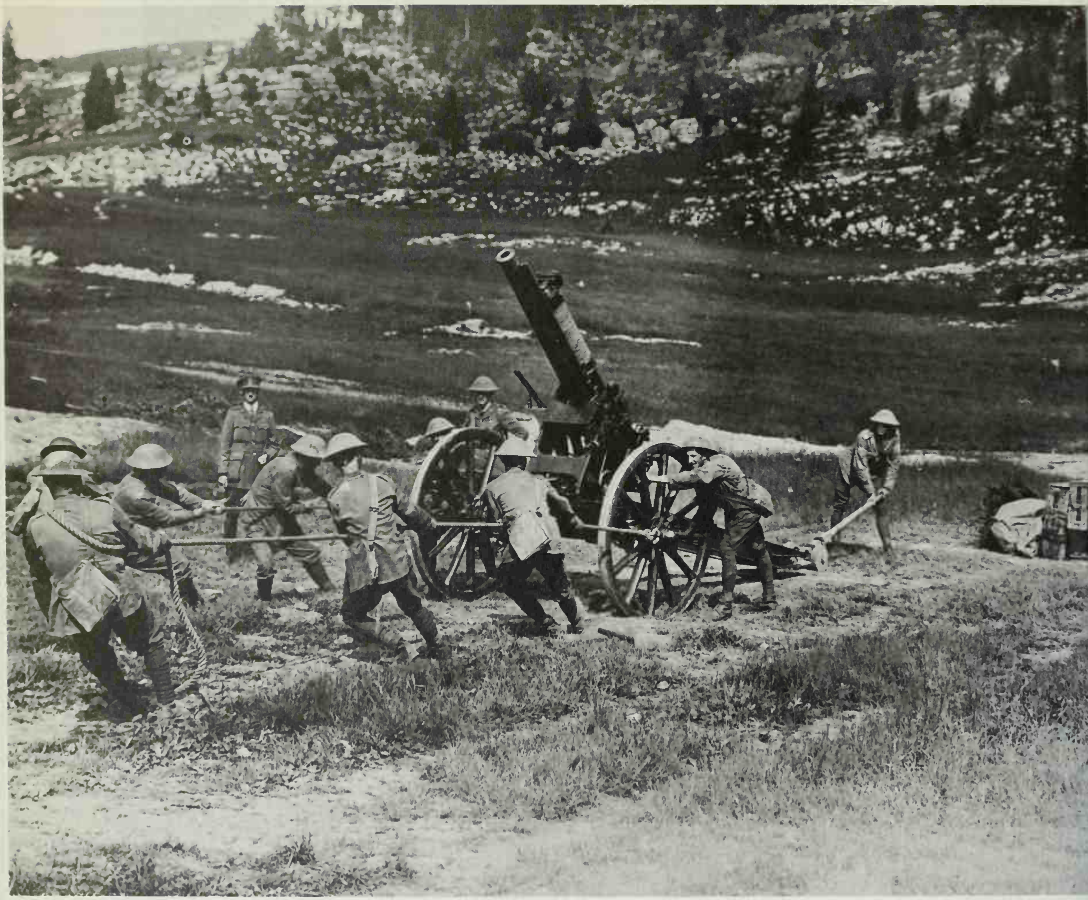
The *"Grande portée Filloux"* Saint-Chamond 155mm (6.1-inch) gun being manned by crew of U.S. 146th Field Artillery Regiment. A counterbattery gun par excellence, it was developed to answer the long-ranging German 150mm gun. The "155" was used as a self-propelled gun in World War II, and was the predecessor of the American "Long Tom."

anything but the steep, plunging fire from howitzers. French military thinking, it appears, was paralyzed in the vein of tactics developed by Napoleon, one of history's great military geniuses who himself had stumbled on the lack of howitzers. (The tale of Waterloo, it has been pointed out, might well have been different if one-fourth to one-third of Napoleon's artillery had consisted of howitzers to rout Wellington's army from its positions which grapeshot and cannonballs failed to penetrate.)

Thus the French never had a light field howitzer to compete with the German "105's" but, concentrating on heavier matériel, came up belatedly with their heavy 155mm field howitzer. When the hurry call came, Saint-Chamond dusted off plans of the model it had built for foreign governments. This was superseded by a heavier Schneider model of greater range.

American artillery crew in Lorraine man Model 1917 155mm howitzer.

An 18-pounder on an improvised antiaircraft mount is manhandled to new position on the Italian Front. The 18-pounder, firing an 18.5-pound shell to a range of 10,500 yards, proved superior to the 13-pounder as an antiaircraft weapon and was used as such in great numbers. Bore diameter was about 3.3 inches, and weight with carriage 2,821 pounds. Muzzle velocity was 1,640 feet per second.



BRITISH AND U.S. FIELD AND HEAVY ARTILLERY

GREAT BRITAIN, LIKE FRANCE, had sacrificed firepower for mobility. Accustomed to fighting small "brush wars" as part of policing her empire around the globe, Britain did have well-balanced equipment for her fine little army, but in the beginning her artillery suffered particularly from lack of range.

British divisional artillery was disposed in three brigades of three batteries each of 18-pounders, totaling fifty-four; eighteen 4.5-inch howitzers in one brigade of three batteries; four 60-pounders, and a siege train of six 8-inch howitzer batteries.

The 18-pounder (3.3-inch) was a hard-hitting gun 29 calibers long (96.96 inches). Though slower in fire than the French "75," it ranged to 10,500 yards. The 18-pounder eventually replaced the 13-pounder (3-inch) gun as an antiaircraft weapon. The 13-pounder, Britain's "horse artillery," which did not see much use with the cavalry, was 24 calibers long and had a range of 8,600 yards.

The 4.5-inch howitzer was a handy piece that endured on into World War II to see service on a modern mount with General Wavell's forces in Libya. It was 70 inches long, weighed 3,010 pounds with carriage, and fired a 35-pound projectile 6,800 yards. The standard breech-loading 8-inch howitzer, built by Vickers, was 127.6 inches long and fired a 200-pound shell 10,500 yards. The 60-pounder (5-inch bore) gun weighed nearly 10,000 pounds with carriage and had a range of 15,100 yards.

As the war progressed, British artillery was beefed up in the medium and heavy categories. Six-inch guns were adopted, as well as a 6-inch howitzer and the 9.2-inch heavy howitzer, which saw use in World War II. It is noteworthy that British ammunition was exclusively shrapnel at the start of the war. High-explosive shells were added in time for the

(above) British horse artillery at the gallop with the quick-firing 13-pounder (approximately 3-inch). The gun was 24 calibers long (73.26 inches), weighed 2,200 pounds with carriage, and fired a 12.5-pound projectile 8,600 yards. Muzzle velocity was 1,700 feet per second.

Battle of Loos in the fall of 1915 and eventually replaced shrapnel foı the 4.5-inch howitzers and heavier pieces.

When the United States declared war in April, 1917, she had on hand just enough light artillery to equip the army of 500,000 men that advocates of preparedness had thought might have to take the field in the event of an emergency. Quick expansion of plans to a force of 5 million pointed up the vacuum in artillery, which was the most critical U.S. deficiency in the war.

Among the 900 pieces of field artillery on hand were 544 3-inch guns of 1902 vintage; sixty-four M1906 4.7-inch field guns, a few of which got overseas; and some 1908 model 4.7-inch and 6-inch howitzers. Most of these pieces were allotted to training purposes.

The U.S. Army in 1916 had ordered an improved 3-inch gun. To speed things along, the caliber was changed to accommodate standard French ammunition, and this became known as the U.S. M1916 75mm gun. It had a range of 9,700 yards, elevation of 53 degrees, traverse of 45 degrees, and was equipped with a block-type breech mechanism and hydrospring recuperation. Similarly, the U.S. redesigned the British 18-pounder being produced in American factories and designated it the M1917 75mm gun. Its range was considerably less.

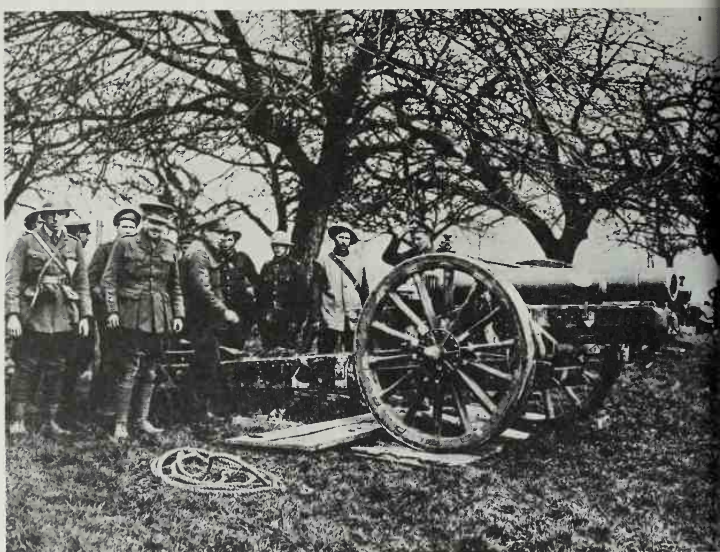
Tooling up to produce the enormous quantities of artillery needed for 5 million men, starting almost from scratch, proved too great a task in the few months' time available to provide U.S. arms in quantity for the fighting that remained to be done in Europe. The upshot was that U.S. soldiers fought almost exclusively with Allied artillery, mostly French, with the understanding that it would be replaced later with equivalent materials or guns. American factories, once production got rolling, turned out 3,077 units of artillery by April, 1919, but only 1,642 had been produced by Armistice. Of these, 477 reached France and only 130 got to the front. More than 3,000 pieces were bought from the French and British.

Nearly all artillery ammunition used by Americans at the front was manufactured by the French; however, the approaching great supply forecast by the rate of U.S. production, which reached 3 million rounds a month, took the pressure off French and British ammunition reserves.

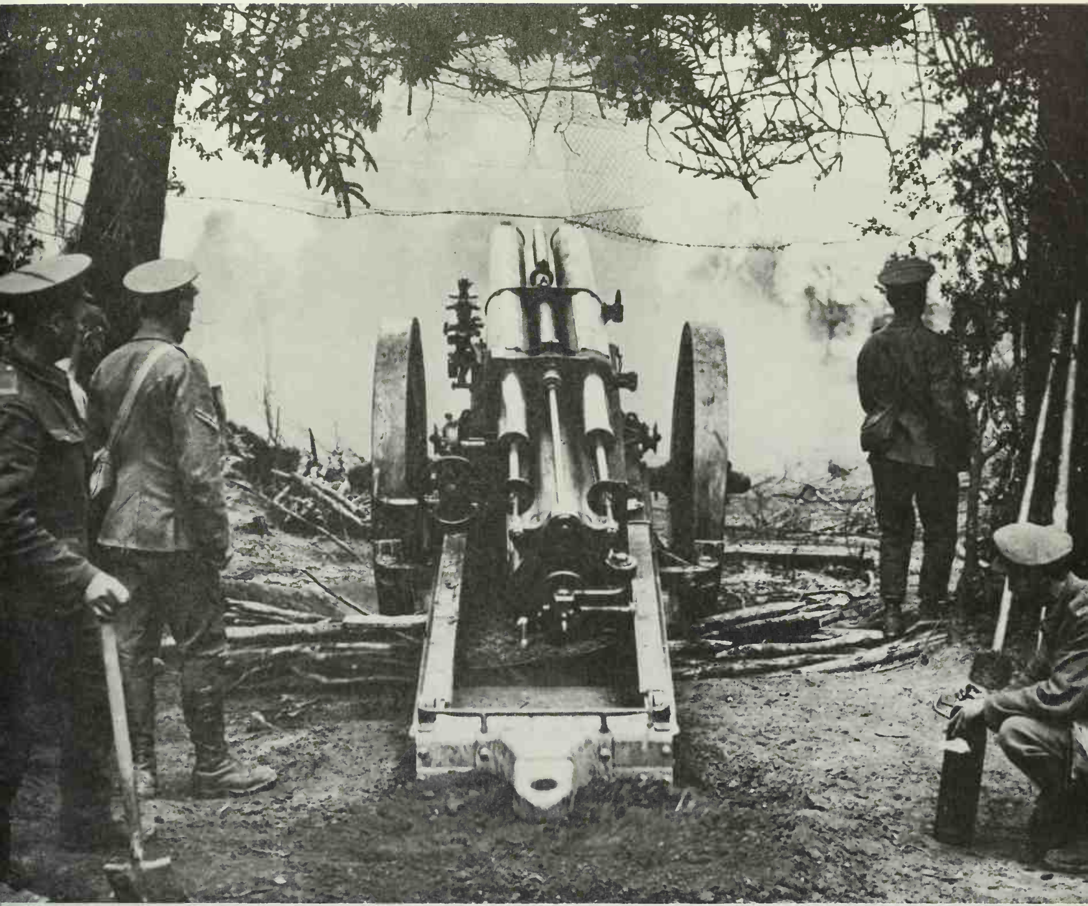
From April 1, 1917, to November 11, 1918, the U.S. produced 632 million pounds of smokeless powder, equaling the combined production of France and Great Britain, and by Armistice, U.S. production was 45 percent higher than the combined French and British rate. American production of high explosives by the war's end was 40 percent larger than Great Britain's and double that of France. For the production of toxic gases and gas shell filling, a project requiring new equipment that attracted little private interest, the government built the Edgewood Arsenal complex of plants at Aberdeen Proving Ground, Maryland, which turned out 10,000 tons during 1918.

(below) Britain's standard light 4.5-inch howitzer was a dependable, handy piece that also saw service with Wavell's forces in Libya during World War II. This Mark I model is shown in the dug-in advanced position it occupied during the Battle of Flers-Courcelette in September, 1916. It weighed 3,010 pounds, fired a 35-pound projectile 6,800 yards.

A variant from the standard British gun of the 5-inch class was this 4.7-inch piece shown at Becourt Wood in September, 1916. Horses were employed for ammunition supply.

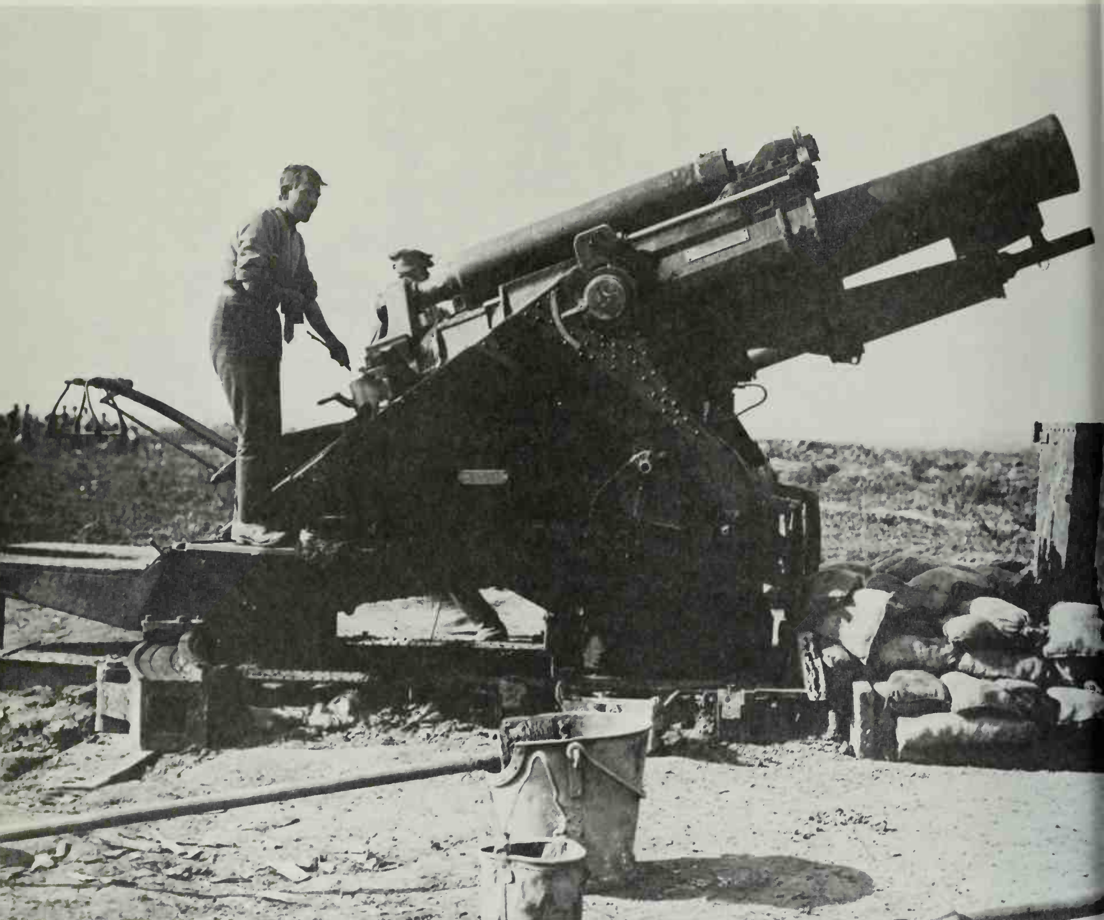


British 6-inch howitzers appeared in quantity during the war. A siege battery is shown at Merville during the German offensive in April, 1918. This breech-loading Mark I Vickers piece was 14.6 calibers long and weighed 9,318 pounds with carriage. It could fire a 100-pound projectile 9,500 yards or an 86-pound projectile 11,400 yards, and developed about 1,300 feet-per-second muzzle velocity. Muzzle energy with the 100-pound shell was 1,310 foot-tons.

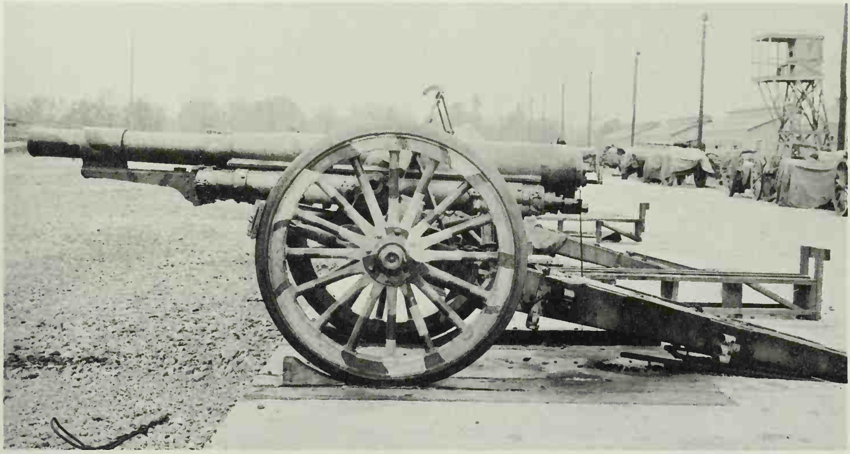


Standard British heavy field gun was this 60-pounder, firing a 5-inch shell, shown in recoil during action at Dainville in May, 1916. Length was 33.6 calibers (168 inches) and weight 9,859 pounds with Mark I carriage. The 60-pounder developed a muzzle velocity of 2,095 feet per second, muzzle energy of 2,045 foot-tons, and had a range of 15,100 yards.

British Vickers Mark I 9.2-inch heavy howitzer was only 14.5 calibers long, threw a 290-pound projectile 10,225 yards, and weighed 29,100 pounds. It developed a muzzle velocity of 1,200 feet per second and muzzle energy of 3,250 foot-tons. The Mark II of 1918 had significantly improved statistics: range, 13,080 yards; muzzle velocity, 1,500 feet per second; and muzzle energy, 5,080 foot-tons. It weighed 35,500 pounds with carriage and was 18.5 calibers long. Both howitzers were used in World War II.

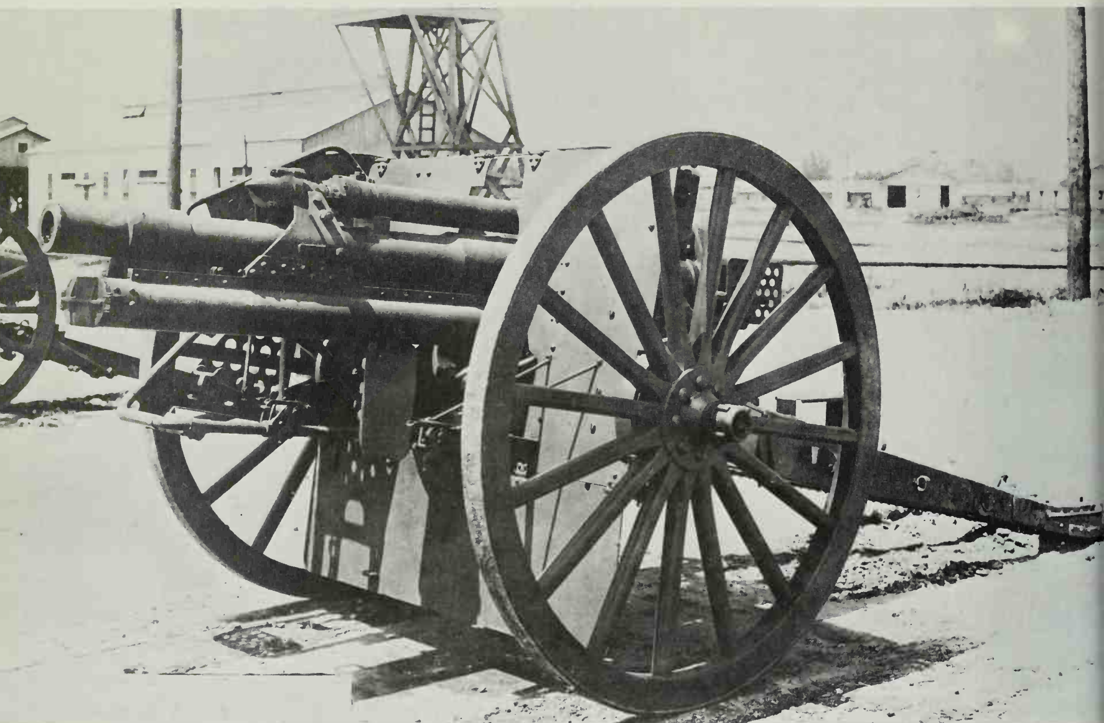


U.S. 4.7-inch field gun, Model 1906. Only sixty-four of these guns were on hand at the outbreak of war, and a few got overseas. This gun had a very long recoil of 70 inches, could fire a 60-pound shrapnel shell or a 45-pound high-explosive projectile to ranges of 8,311 and 9,022 yards, respectively, at an elevation of 15 degrees. Ranges increased significantly at higher elevations, the longest about 13,000 yards at 41 degrees. The gun was pulled by a five-ton tractor.



Like the French and Germans, Britain threw every available piece into the field. This is a 6-inch naval gun on a field mount during the Battle of Albert in July, 1916.

The United States also had a split trail in the Model 1916 75mm gun, which originally was an improved 3-inch gun ordered by the U.S. Army, but modified, in the interest of time, to use standard French ammunition. It had an elevation of 53 degrees, traverse of 45 degrees, and hydrospring recuperation. The Saint-Chamond Company developed a hydropneumatic brake for the gun that was so successful that the French adopted it for their famous "75."



ITALIAN AND RUSSIAN ARTILLERY

THE ITALIANS FIELDED a 75mm cannon and several howitzers, notably a 13-caliber 75mm piece and 1914 and 1916 models of a 17-caliber 100mm howitzer.

The standard field gun, the 1911 model 75mm gun, 27 calibers long, was the first split trail to be used in World War I. The split trail was invented by the French Colonel Deport, and permitted much greater elevations (and, thereby, greater ranges) than the usual box trail by accommodating recoil between the flasks of the trail.

(The United States had a split trail that gave a field of fire of about 45 degrees and an elevation of about 60 degrees, for which Colonel Rimailho of the Saint-Chamond Company was asked to develop a hydropneumatic brake. Tests at Bourges, in which 6,000 rounds were fired, were so impressive that the new brake for the American gun was also adopted by the French for their "75." While the original "75" brake operated with constant recoil at all elevations, the new brake varied recoil with the elevation—the higher the angle of elevation, the shorter the recoil—which permitted firing at high angles without digging a pit. It was being put into production by Saint-Chamond when the Armistice was signed.)

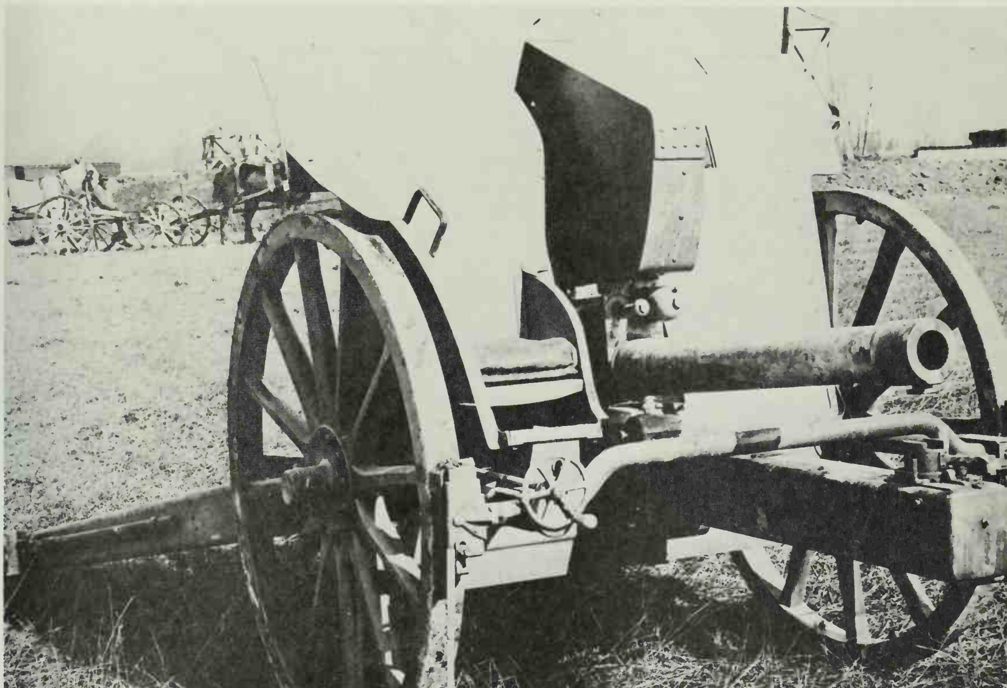
Russia's standard field gun was a 1902 model 76.2mm piece, 30 calibers long, that was produced by the Putilov plant of the French Schneider works. It fired a 14-pound shell 7,002 yards, and was hard-hitting with a muzzle velocity of 1,933 feet per second. A 1910 model 122mm howitzer produced by Schneider had a range of 8,752 yards, slightly more than a 1909 model manufactured by a Russian firm.

The 106.7mm "42-line" gun, model 1910–1912, manufactured by Schneider, was 28 calibers long and had a range of 12,581 yards with a 36.2-pound projectile.

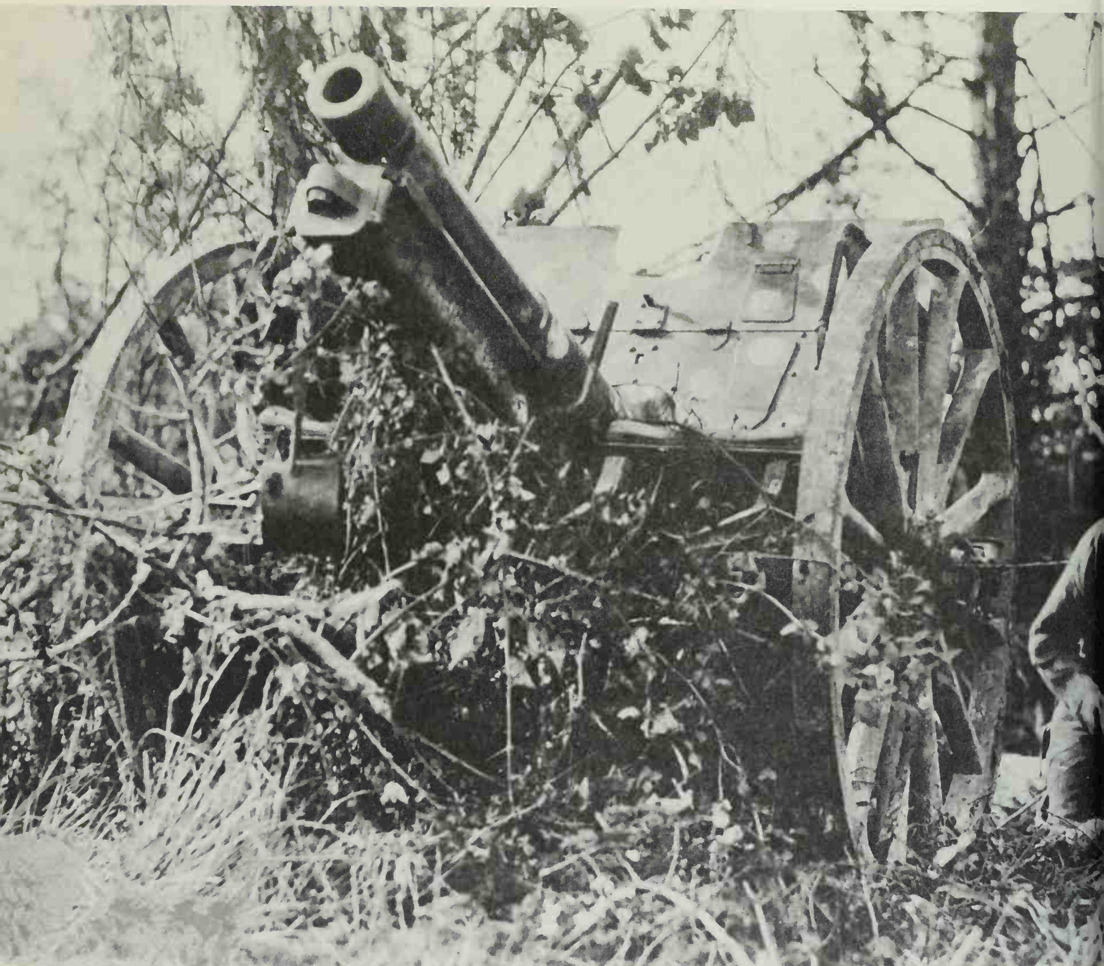
The Russian firm of Obuchov produced a 152mm gun, 1904 model, which had a muzzle velocity of 1,968 feet per second and a range of 13,123 yards. With a new type projectile developed during the war, range was increased to 20,779 yards. Another 152mm "60-line" gun, 30 calibers long, had a similar range.

A Russian 152mm howitzer, 1910 model, had a range of 9,518 yards.

Italian 75mm gun, Model 1911, was the first split trail to be used in the war. This standard field gun was 27 calibers long.



A German 77mm light field gun, Model 1896, still partly camouflaged just after capture by U.S. troops near Mont Saint-Père (Hill No. 130) in France, July, 1918. Germany had more than 5,000 of these guns at the outbreak of the war. It was 27.3 calibers long, had a range of 9,260 yards with a 15-pound shell. While it never equaled the French "75," it was effective. Early in the war many were mounted on small-diameter wheels to lower the muzzle and placed in forward positions to blast Allied tanks.



GERMAN AND AUSTRIAN FIELD ARTILLERY

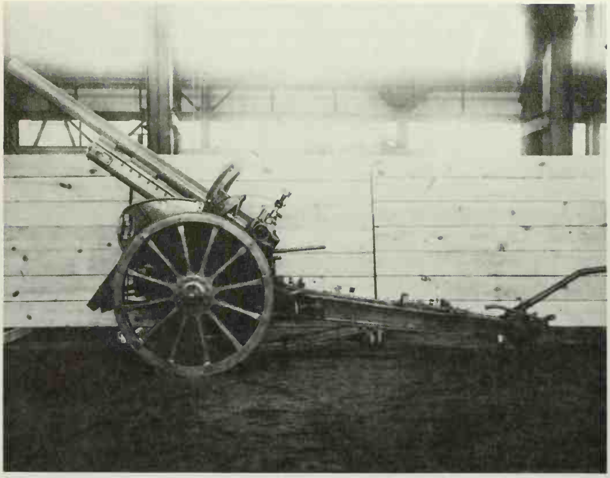
AT THE BEGINNING OF THE WAR Germany's field artillery consisted of the 77mm gun, for the most part gun carriage model 1896, and a light 105mm howitzer, model 1898–1909. A longer, improved "77" was brought out in 1916, as well as two new 105mm howitzers.

The 77mm model of 1896 resulted from collaboration between Krupp and Erhardt to develop a fieldpiece to compete with the French "75" while at the same time utilizing some parts of older matériel. Thicker than the "75," its breech mechanism was of the familiar Krupp design with a wedge operated by a crank. It had a box trail carriage with spring-return recoil mechanism, a dependent line of sight, and a maximum elevation of only 16 degrees. Although 500 pounds lighter than the French gun (with carriage), it was inferior in most vital statistics: length, 27.3 calibers; muzzle velocity, 1,526 feet per second; and range, 9,260 yards with a 15-pound shell.

The 1916 model 77mm gun was vastly improved by adding 7.7 calibers (23.6 inches) to the length and increasing the size of the powder chamber. Using a 13.4-pound shell, the Germans claimed a muzzle velocity of 1,968 feet per second and a range of 11,264 yards. The range increase was obtained in part by using a carriage similar to that of the 105mm howitzer, giving a maximum elevation of 40 degrees. By early 1918, nearly 60 percent of the "77's" in use were of the new model.

Germany's 1898–1909 light howitzer was a box trail carriage with trunnions at the breech and equilibrator between the cradle and trail, which allowed constant recoil at all elevations. It was only 12 calibers long and threw 28- and 35-pound shells to a range of 7,655 yards. Two much more powerful light howitzers reached the front during the war. The 1916 model, with a much longer tube (22 calibers), had more than twice the muzzle energy of the older version and a range of 10,930

This 1916 model of the German "77" was a vast improvement over the 1896 original. Length was increased to 35 calibers, the powder chamber was increased, and it was mounted on a carriage similar to that of the 105mm howitzer. The range was increased to 11,264 yards and it could reach an elevation of 40 degrees.



yards. A Krupp model, 20 calibers long, also appeared, with a range of 11,700 yards.

* * *

Austria-Hungary's light field gun was a 1914 80mm Skoda that fired a 14.7-pound shell 9,514 yards. Similar in many respects to the German "77," it had a maximum elevation of 80 degrees, depression of 10 degrees, and traverse of 7 degrees. The traverse was increased in 1917 by leaving off the top carriage and having the trail pivot about the spade. This model obtained 10,717 yards with a 17.6-pound shell.

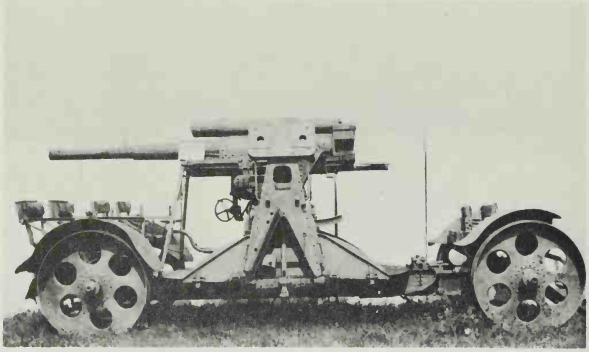
Austria's light howitzer was a 100mm Skoda similar to the Italian howitzer. The 1914 model was constructed of bronze to reduce the danger to crews from prematures, this malleable metal being less apt to splinter than steel. Its length was 67 inches, projectile 35 pounds, and range 8,748 yards. A steel model was produced in 1916 that was similar in all respects to the bronze piece except in elevation, which was increased from 50 to 70 degrees.

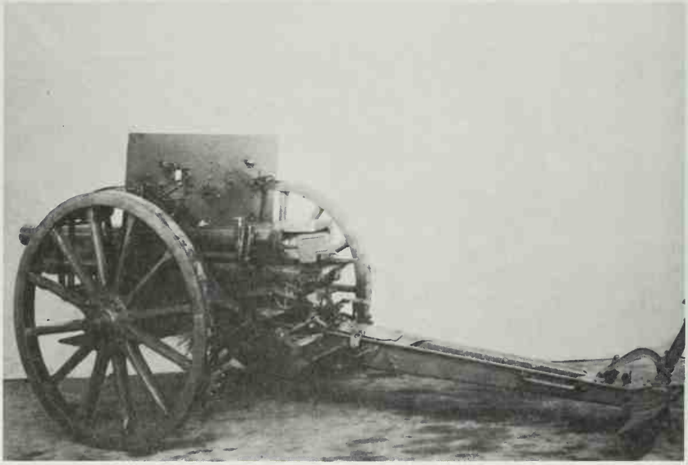
Skoda produced a 150mm howitzer in 1916 that had a range of 12,029 yards with a 96-pound projectile. It reached a 65-degree elevation.

Austrian artillery, like most German pieces, had the cradle trunnions well to the rear, with the muzzle preponderance being overcome by two counterrecoil spring assemblies attached to arms on the cradle on either side, and to the top carriage.

Model 1898–1909 German light 105mm field howitzer was only 12 calibers long, had a range of 7,655 yards. Projectiles were 28 and 35 pounds.

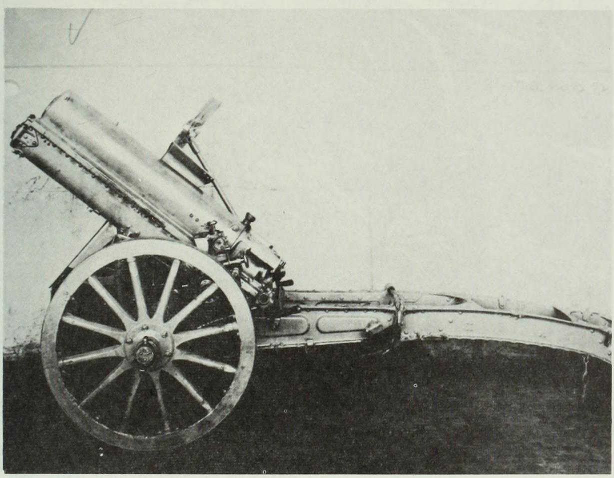
The Flak 102 80mm gun, a special antiaircraft weapon brought out in 1917. It was the forerunner of the Flak 18, basic design for the famous German 88mm gun of World War II.





Austria-Hungary's standard light field gun, the Skoda 80mm Model 1914. Similar to the German "77," it had a horizontal sliding-wedge type breech block and hydrospring recoil mechanism. The trail had a large opening to permit recoil at high angles of fire. The "80" could be elevated to 80 degrees.

Light mountain howitzers such as this Austrian 75mm Skoda model were also used by France and Italy.



A short 12-caliber 150mm German howitzer, Model 1902, and remains of a pillbox captured by the British 29th Division at the Battle of Ypres, October, 1918. This is one of four 150mm models dating from 1896.

GERMAN HEAVY ARTILLERY

IN CORPS ARTILLERY and howitzers, the principal German pieces were the 105mm gun and the 150mm heavy howitzer.

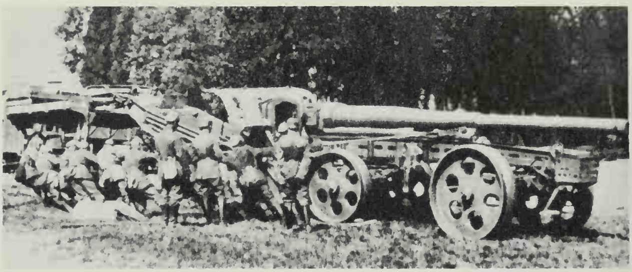
The war was started with 1904 and 1914 models of the 105mm gun, and ended with a new 1917 design. Both the 1914 and 1917 models were mounted on one of the few German carriages to use a hydropneumatic recoil system. They were box trail carriages fitted with both a fixed and a folding spade. The 1917 gun was far superior to its forerunners—45 calibers long, muzzle velocity of 2,156 feet per second, and range of 15,000 to 18,000 yards with a 41-pound or 38-pound projectile.

Four different versions of the 150mm corps heavy howitzer were used by Germany during the war—the 1896, 1902, 1913, and 1917 models. All had box trails, quick-return mechanisms, and hydropneumatic recoil mechanisms. The length of recoil was variable and was regulated by the recoil of the piston during elevation. These models ranged from 12 calibers in length for the oldest to 15 calibers for the 1917 howitzer, which threw a 93-pound projectile about 10,000 yards.

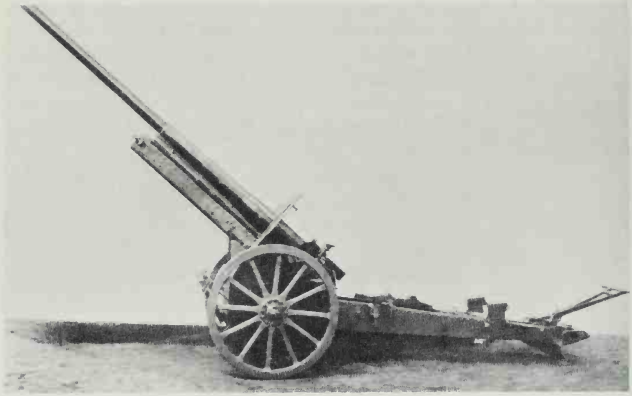
In the German military organization the army artillery consisted mainly of 150mm guns and 210mm howitzers. The prewar 150mm gun had a length of only 30 calibers and a range of 13,100 yards with a 96-pound shell. In 1916, Krupp produced a gun 43 calibers long, which, abetted by improved ammunition, could hurl a 115.8-pound projectile nearly 25,000 yards. The carriage was similar to most prewar carriages, with trunnions near the breech, equilibrators to overcome the muzzle weight, and a constant-recoil, hydrospring recoil mechanism, but an independent line of sight was provided. Its 22,359-pound weight required cast-steel wheels instead of wood.

The tube wagon of the German army heavy gun—150mm 1916 model produced by Krupp—is shown being pulled by a Krupp-Daimler *Artillerie-Kraftzugmaschine*.

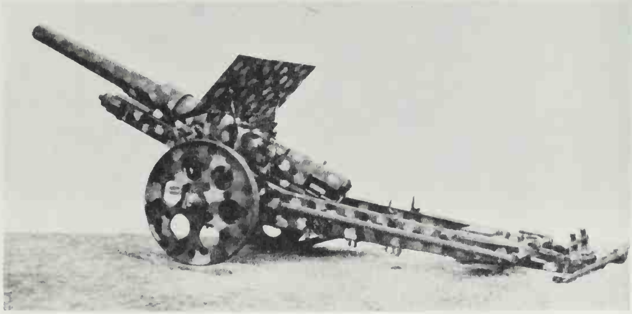
Gun team in act of assembling the 150mm Krupp gun. It was 43 calibers long, weighed more than 11 tons, and could fire a 115.8-pound projectile about 25,000 yards.



In 1917 the Germans came out with a tremendously improved 105mm gun—45 calibers long, muzzle velocity 2,156 feet per second, and range up to 18,000 yards. This was one of the few German guns using a hydropneumatic recoil system.

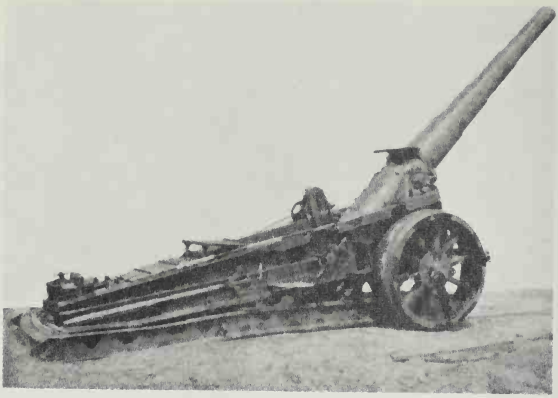


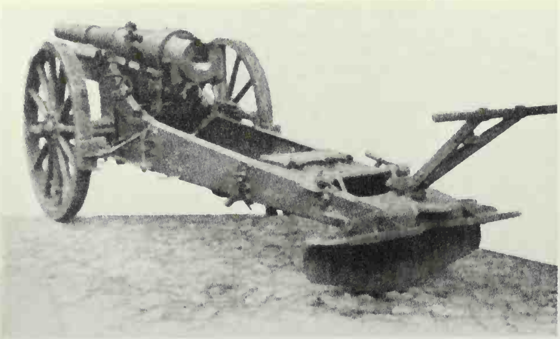
German 130mm gun was 35 calibers long, weighed about 7½ tons, fired a 92.6-pound projectile to a distance of more than 18,000 yards. Only 16 of these Model 1909 guns were on hand at the beginning of the war, reaching the front in 1916. Krupp manufactured 158 more.



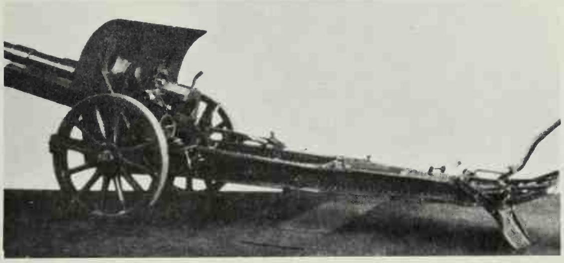
In this unusual view, German crew of a 210mm howitzer takes a break during the great German offensive of March, 1918, in Picardy. The howitzer is the improved long mortar (14.5 calibers) introduced in late 1916, which fired a 265-pound projectile 11,160 yards. Weight with *Radgürtel* on pressed-steel wheels was 16,650 pounds.

German quick-firing 170mm heavy gun on wheeled mount. It was 40 calibers long, weighed more than 24 tons, fired a 138.5-pound projectile to a maximum range of 26,278 yards.





German 1904 model 105mm gun, the standard corps heavy field gun, had a range of almost 14,000 yards with a 41.3-pound projectile.

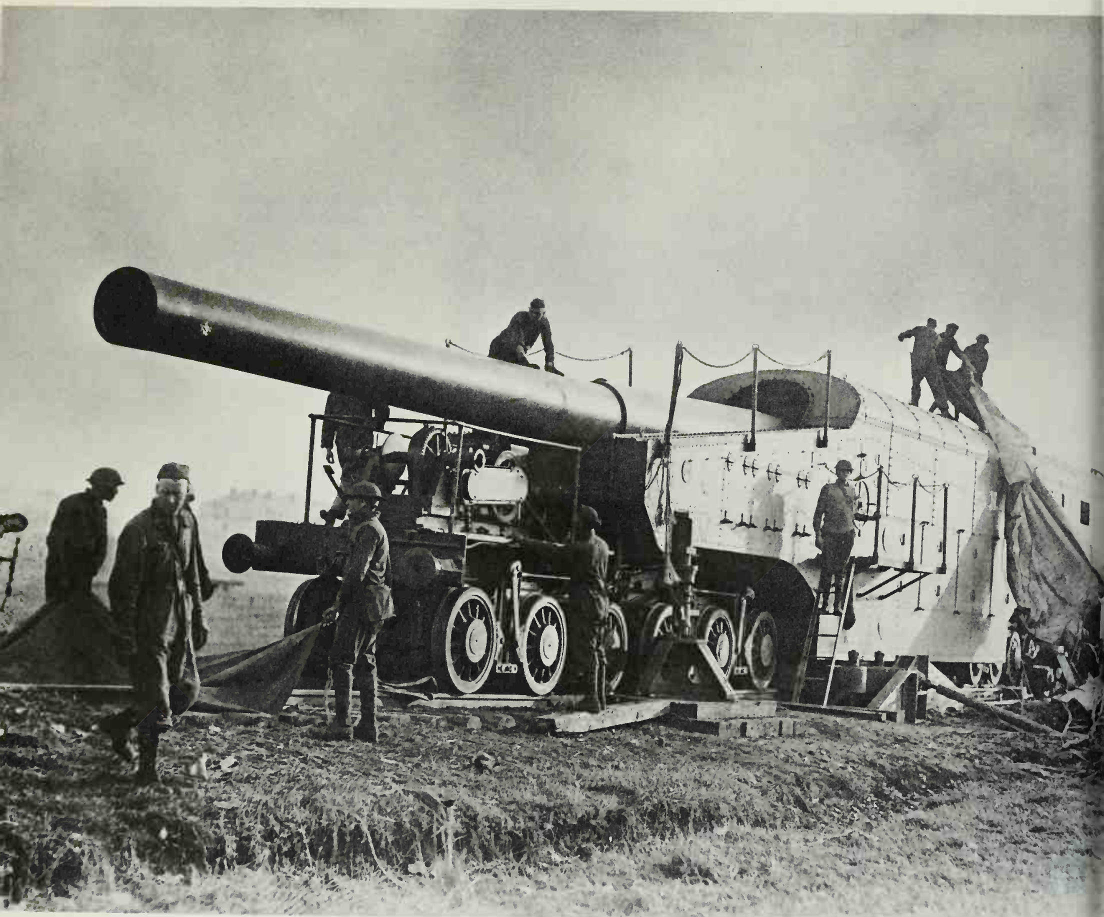


Long 130mm heavy howitzer fired a 92-pound projectile 9,624 yards.

The 210mm howitzer was the workhorse of Germany's heavy howitzers. The 216 pieces of this equipment on hand required more ammunition than was available for field use in 1914, and apparently drew on reserve supplies of the German fortresses in helping to reduce the Belgian and French frontier forts. The 1911 model, at 7,060 yards, was short-ranged compared with the long 14.5-caliber mortar that came out in late 1916. It threw a 265-pound projectile 11,160 yards. Weight with wheel belts (*Radgürtel*) was about 16,650 pounds, and wheels were of pressed-steel construction.

In addition to these standard pieces, Germany had a profusion of other heavy guns and howitzers, notably 130mm, 120mm, and 170mm field cannon. Like all the belligerents, she threw every available gun into the race for firepower, using naval and coast artillery pieces, sometimes jury-rigged to make them mobile.

U.S. Navy in France. One of the famous "Plunkett Guns" at Thierville, Meuse, being covered after a day's work. These were 14-inch battleship guns mounted on railway carriages. Although wearing Army uniforms, the crew members are sailors with U.S.N. insignia on their collars.



VERY HEAVY ARTILLERY

THE LONGER THE WAR PROGRESSED, the more it became a contest of monstrous guns, ever increasing in size, in efforts to blast the enemy from strongly entrenched positions. To a great extent it was a railroad artillery war, the likes of which had never occurred before and probably could never take place again. Both sides had dug in and developed such permanent positions that highly efficient railway systems were employed extensively to shuttle guns and troops up and down the lines for lightning concentrations and attacks.

The dividing lines between light, medium, heavy, and very heavy artillery are never too clear, but for comparison purposes "superheavy" artillery was considered to encompass guns larger than 8-inch and howitzers of 12-inch size and above. Some howitzers under 12 inches are included in this section because they were railway mounts. Also, the distinction between high-velocity, flat-trajectory guns and low-velocity, high-angle howitzers became less than clear. The 1914 standard of 12 calibers in length for howitzers disappeared as superheavy howitzers 25 calibers long (for example, the French 320mm) were developed. Much of this big gun development was due to greatly improved ammunition—high explosives with shattering force and streamlined shells that could be hurled more than 20 miles with startling accuracy. It was the explosive blast that mattered most. A near miss of a single 1,000-pound shell could destroy a bridge or tunnel, or wreck a factory.

The French and British suffered badly from the lack of larger-caliber matériel at the war's start. In November, 1914, the French navy demanded railway gun carriages for its 305mm battleship guns of 1893, 1896, 1906, and 1910 vintage. In thirty days the Saint-Chamond Company began deliveries of railway mounts for these naval guns. Following that, the 340mm 1912 model marine gun was put on the rails, then the giant 400mm gun that was used to level Fort de Vaux, which had been captured by the Germans, and to destroy many important railroad tunnels in enemy territory.

The French 340mm railway gun was an exceptional artillery piece, 45 calibers long and capable of firing a 940-pound projectile to a distance of 20½ miles. It was used effectively in the Saint-Mihiel offensive against the railways out of Metz. One problem besetting these guns was the necessity for preparing a timber firing platform, which had to be removed before departure. The time for removal resulted in serious damage and some losses in battle. During the final German offensive in June, 1918, when a sudden, very rapid advance was made between Soissons and Rheims, a French railway battery of 305mm guns was captured for the first time. The crews were so effectively smothered with shellfire that they could not remove the guns. Half were killed or badly wounded as they attempted to damage them with sledgehammers, as thermite was not then in use for this purpose.

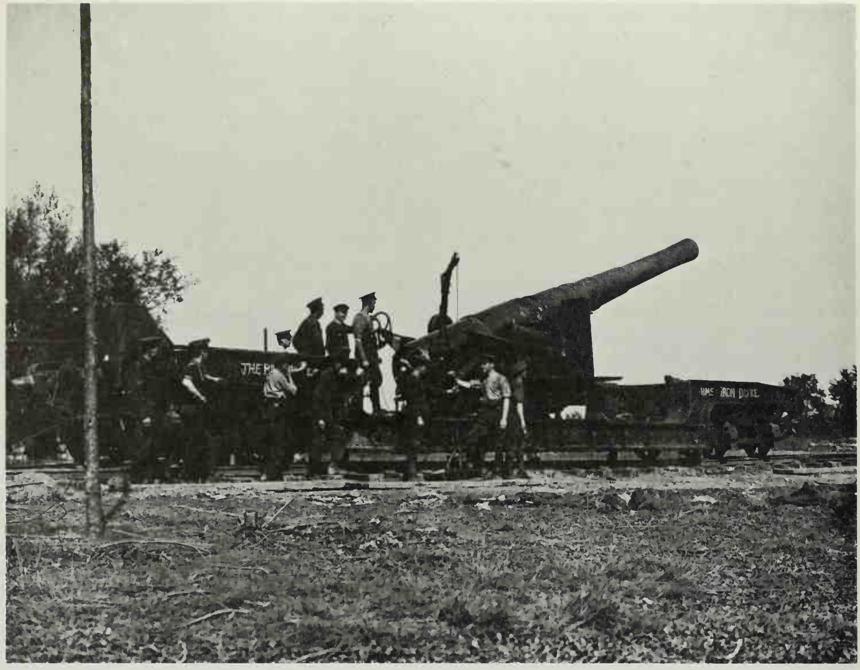
To advance fieldpieces where railways were not available, Saint-Chamond removed the trucks from a number of 240mm railway guns and equipped them with trunnions and wheels. They were drawn by tractors.

U.S. naval guns also got into action on the Western Front in 1918. The famous "Plunkett Guns"—named after Rear Admiral C. P. Plunkett, who supervised the project—were 14-inch battleship rifles. Railway mounts were manufactured at the Baldwin Locomotive works in Philadelphia and shipped to Saint-Nazaire, where guns and mounts were assembled in a huge shop. Assistant Secretary of the Navy Franklin D. Roosevelt took a personal interest in the project and inspected the work in France.

The British concentrated on heavier types of artillery, developing both road and railway models of superheavy pieces. Their 15-inch wheeled howitzer was the closest approach of the Allies to Germany's massive 420mm "Big Bertha." It weighed 24,000 pounds (without carriage) and threw a 1,400-pound projectile 11,487 yards. A wheeled 12-inch howitzer also was developed, as well as a 9.2-inch howitzer on both railway and wheeled mounts. The 9.2-inch howitzer, known as "Mother," fired a 290-pound projectile up to 13,000 yards, and was used in World War II. The longest range of a British gun was 25,000 yards, achieved by a 9.2-inch railway mount firing a 380-pound shell. It was 35 calibers long and weighed 194,274 pounds with carriage.

The Germans achieved fantastic ranges with their big railroad guns. The largest, a quick-firing 380mm naval piece, developed 3,412 foot-seconds of muzzle velocity and fired a 1,654-pound projectile to a distance of 51,967 yards. The longest range (except for the "Paris Gun") was 68,047 yards by a 355mm gun firing a 758.5-pound shell. A 280mm railway gun fired a 771-pound projectile more than 30,000 yards, and a 240mm piece reached 29,000 yards with a 333-pound shell. They even

The British came out early in the war with a giant 15-inch howitzer that, without carriage, weighed almost as much as the Germans' 420mm (16½-inch) road model "Big Bertha"—24,083 *vs* 29,525 pounds. Its projectile weighed 1,400 pounds compared with the "420's" 1,764-pound shell, and range was more than 1,000 yards longer—11,487 yards. It developed a muzzle velocity of 1,116 feet per second and a muzzle energy of 13,540 foot-tons. The howitzer pictured was built by Coventry Ordnance Works, and the stenciling on the side shows it was used at Aubers Ridge, Festubert, and Loos in 1915, and at Ypres in 1916. Its total weight with carriage was about 75,000 pounds, and it was drawn by motor in nine loads.



This British crew called their 9.2-inch railway gun "H. M. S. Iron Duke." The Mark XIII gun could fire a 380-pound projectile 25,000 yards, developing a muzzle velocity of 2,400 feet per second and muzzle energy of 16,994 foot tons. It was 35 calibers long and weighed 194,274 pounds with carriage.

placed on a railway mount a 210mm gun that fired a 253-pound shell nearly 29,000 yards.

When it came to heavy or superheavy howitzers, however, Germany put them all on the road with their *Radgürtel.* The 280mm and 305mm Krupp howitzers were adapted from short naval guns and achieved ranges of 10,612 and 18,482 yards, respectively. It took the chassis of the giant 420mm "Big Bertha" to accommodate the weight and power of the "305."

The 305mm *Motormörser* produced by Austria's Skoda works was a magnificently engineered siege mortar that took part in every fort assault of note.

There were twenty-four Skoda "305's," model 1911, in existence at the beginning of the war, several on loan to the German army. The 23-ton piece was drawn by three motor vehicles with four trailers and could be set up with its portable base in three hours. Improvements were

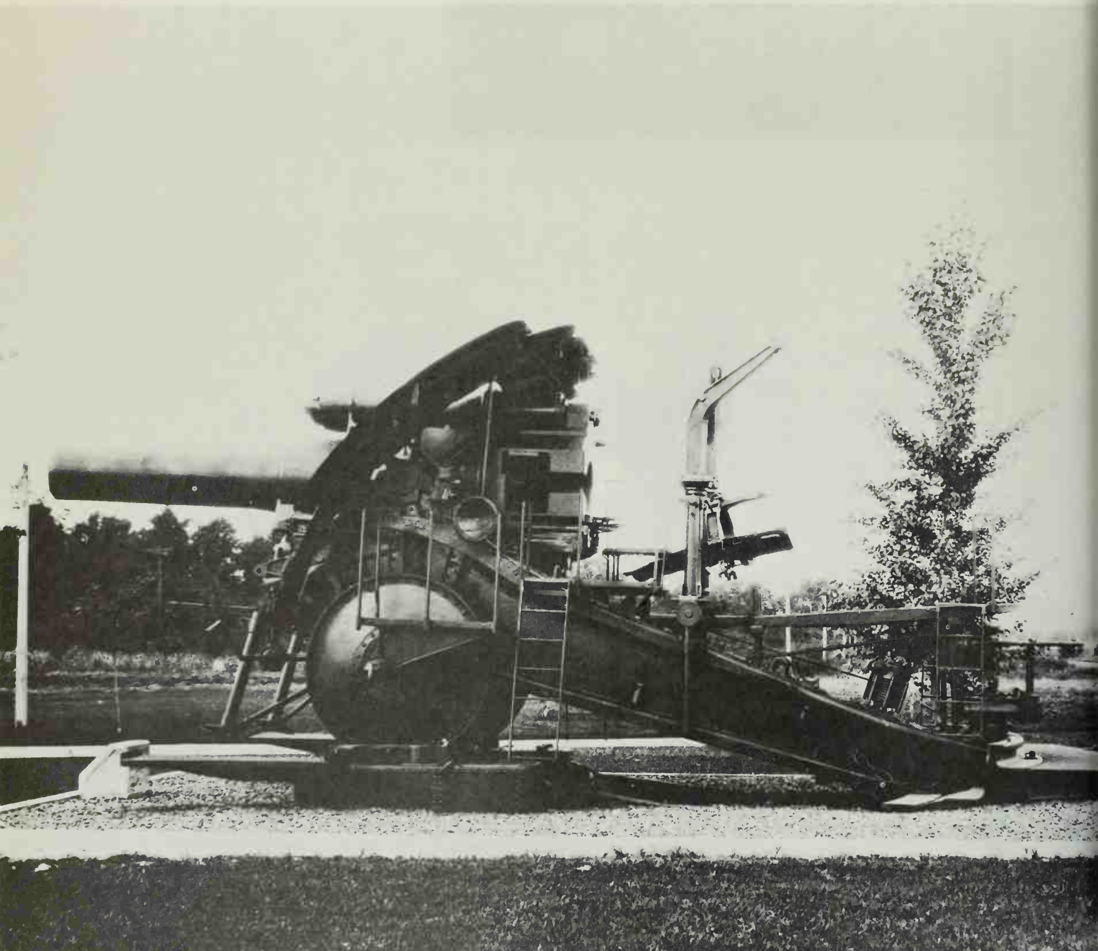
Wrecked German 380mm marine gun, dynamited in its emplacement in the Somme valley to keep it from falling into the hands of the Americans and Australians during their advance on the Cambrai-St. Quentin front. Its barrel is 50 feet long. The long-range Paris Guns were developed from the 380mm naval piece by adding a 50-foot extension, plus another 28 feet, and inserting a 210mm liner.

Close-up comparing the size of shells used by the 380mm gun to a man. They weighed 1,653.8 pounds each and could be hurled more than 25 miles.

German coast artillerymen in position with a 14-caliber, 280mm Krupp howitzer adapted from a short naval gun, with wheeled mount and wheel belts. It weighed 33,571 pounds complete and fired a 628.4-pound shell more than 10,000 yards.

made in 1916, and the M11/16 305, 10 calibers long, had a traverse on its bed of 120 degrees. It fired projectiles weighing 661 and 838 pounds to ranges of 11,930 and 10,498 yards, respectively. The good mobility and great effect were such that more were ordered, resulting in the much more powerful M/16, which reached the front in 1917. This howitzer was 12 calibers long, had a full 360-degree traverse, and a range increased by about 1,600 yards. The Germans claimed that 7 rounds could be fired in 11 minutes with the Skoda "305," but the average was 15 rounds an hour.

The giant "M-*Gerät*" 420mm howitzer—one of the "Big Berthas" that were the largest-caliber artillery pieces ever to be made mobile by road transport—as it was on display until the mid-1940s at the Ordnance Museum, Aberdeen Proving Ground, Maryland. This equipment, plus a large assortment of other World War I weapons collected by the museum and now irreplaceable, were disposed of in a scrap-iron drive at the end of World War II by an unfortunate military decision.



"DIE DICKE BERTA"

AT THE OUTSET OF WORLD WAR I, Germany introduced the monstrous siege howitzer that still ranks as the largest-caliber road model artillery piece ever to be employed in any war.* This 420mm (about 16½-inch) weapon, incredible to other armies of the day, was produced in both railroad and road models, and fired a one-ton shell to ranges from 6 to 9 miles. Nicknamed *"Die Dicke Berta"* after the granddaughter of "Cannon King" Alfred Krupp who inherited the famous Krupp works, the "Big Bertha" should not be confused with the long-range Paris Gun that has been mistakenly tabbed with the name.

The great 420mm howitzer—which also has been wrongly credited in many books to the Austrian Skoda works—was one of the most difficult projects ever entrusted to the Krupp firm. It fitted in with the German plan for the great wheel through Belgium and northern France that actually was attempted. The strong Belgian forts at Liège would have to be dealt with to open the way—then Namur, the French fortress of Maubeuge, and others. Five of the giant railroad howitzers, model 1912, were produced before the war.

The 1912 *kurze Marinekanone* 420mm *Mörser* was called the "Gamma-*Gerät*." It was 16 calibers long and could throw a 2,050-pound shell to a maximum range of 15,529 yards. The rifled tube alone weighed 48,281 pounds, and six railroad cars were required to transport all of the howitzer's massive sections—a total weight of 84 tons. But the

* The largest artillery piece ever used in war was an 820mm railroad gun employed by the Germans in the siege of Sevastopol during World War II, but its size had passed beyond the limits of practical usefulness. The United States developed a 36-inch mortar ("Little David," on display at Aberdeen, Maryland) to be used against the German West Wall defenses during World War II, but it never saw action.

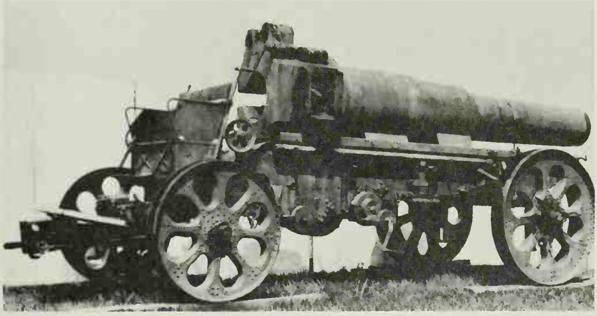
Kaiser needed a road model—the largest possible artillery piece that could be hauled in sections over the bridges of European roads.

Early in 1914 Krupp demonstrated the first road model at the Kummersdorf proving ground before the Kaiser. The tube length of the 420mm "M-*Gerät*" was reduced to 12 calibers, and the total weight of gun and carriage to about 47 tons, which broke down into five tractor loads. This king of all mobile howitzers could throw a high-explosive shell weighing 1,764 pounds to a distance of 10,174 yards. It had a muzzle velocity of 1,093 feet per second and a muzzle energy of 16,400 foot-tons.

Performance of the M model was excellent, but transportation was a troublesome problem throughout the war. Mobilization day found Krupp ready with two road pieces, but still experimenting with steam and gasoline traction engines, and even teams of horses in the search for the best formula for transport. In their frenetic efforts to field a transportation team for the first battery in response to the siege army's urgent call at Liège, the Germans used ten tractors of eight different commercial makes, including several appropriated from the Sarasani Circus. Representatives from Krupp and the Lanz tractor firm finally were called to the front to observe the transportation difficulties, and Lanz designed a special 140-hp tractor for the "M's." It was not until 1918, however, that delivery was made.

Germany used twelve of these elephantine siege mortars during the war—the five existing "Gammas" and seven M types, which were produced from 1914 to early 1916. They were assigned originally to seven batteries, generally two to a battery, serviced by some 200 men.

The travail of the long treks into Russia was recorded in mildly epic proportions in diaries of the first two M-*Gerät* batteries to be put on the road. The worst problem, it was reported unanimously, was the tractors. Five loads were required for each mortar, each load complete weighing about 20 tons. Battery No. 3, the first to be activated, was assigned a special construction platoon in Russia. Its two weapons fired 1,234 rounds within one year. Battery No. 5, which was activated with the third M-*Gerät* to be produced, at the beginning of 1915, recorded that it covered 400 kilometers up to October 25, 1915, for the greater part on bad Russian roads. Wheel belts (*Radgürtel*) were used to traverse the worst terrain, where the battery was troubled with breaking of bolts and loosening of parts.



Highly developed precision in equipment and procedures was required to assemble the M-model 1914 "420," which was transported on five tractor-pulled special wagons. Wagon No. 1 erected a gin (portable hoist) at the emplacement, and its tractor was spotted behind the emplacement to haul up the other loads in order by cable drum. The No. 2 wagon carried the platform, and No. 3 the cradle, which was hoisted clear and held suspended from the gin.

The No. 4 wagon, shown at top, was carriage that was hauled up and centered on the platform and the cradle lowered. The front wheels were removed, leaving the solid steel wheels to support the carriage and howitzer. In actual use and transport, the wheels were equipped with caterpillar belts (*Radgürtel*).

At center is No. 5 wagon with the "Big Bertha" tube, the last to be hauled up.

At bottom, the tube is shown being put in place with assistance of the gin. Wheel belt is clearly visible in this German wartime photo.

An early 1911 model 210mm heavy howitzer, shown in recoil position just after capture by U.S. troops at Vaux in the Ardennes in November, 1918. This was the workhorse of German heavy howitzers before the long 1916 model came out. Its range was only 7,060 yards.

DEATH OF THE FORTS

THE GREAT FORTRESS OF LIÈGE, constructed by the Belgian General Brialmont, had been considered one of the strongest in Europe. It dated from 1890, however, and was growing obsolescent. The fortress around the city consisted of a ring of twelve forts, 9 miles in diameter. Each structure had casemates of 8-foot-thick concrete, and was encircled by a dry moat 30 feet deep. Each mounted two 150mm guns, two 120mm guns, and two 210mm howitzers, all firing outdated black powder. Sunk below ground for the most part, the forts had disappearing turrets for their main armament, protected in steel cupolas. Smaller turrets at the corners mounted rapid-firing guns.

The Germans, attempting a *coup de main* on the night of August 5, 1914, were repulsed with heavy losses. Although eventually able to pierce the intervals between the forts and actually to enter the city of Liège on August 8, they were unable to take a single fort by assault. A new siege army was quickly formed and an urgent call went to the Krupp works for the two new M model "420's."

At Essen, the hastily assembled motor transport and howitzer sections were loaded on a train for a quick trip by rail. Twenty miles east of Liège the battery was forced to the roads by a blocked railway tunnel. Horses, men, and machines struggled a day and a half to wrestle the nearly 200 tons of equipment within firing range of the easternmost forts.

By late afternoon on August 12 the first "420" was assembled and trained on Fort Pontisse. The first 1,764-pound shell arced high in the hot summer sky and screamed down on its target with a thundering detonation. A great plume of debris, dust, and smoke rose hundreds of feet into the air. The steel-nosed shells continued to crash through the concrete casemates, their delayed fuses triggering the high explosives within. Magazines exploded, underground chambers were filled with asphyxiating gases, fire, and noise. Some men in the garrison were blown to bits, others went mad during the twenty-four-hour period it took to reduce the fort to a shambles.

Methodically, the two "420's," several Austrian "305's," and great numbers of 210mm howitzers in the German siege train were brought to bear on the remaining easternmost forts. The Belgian garrisons held out with astonishing tenacity. On August 15 a powder magazine hit by a 420mm shell blew up Fort Loncin, burying 350 men in a huge crater. The last of the Liège forts surrendered on the sixteenth, leaving the way clear—but at the price of valuable time for the Allies—to the invaders.

Next victim of the "420's" was the Belgian fortress of Namur, whose 30,000-man garrison drew the most concentrated siege assault of the war. Three of the nine forts encircling Namur—all of the same vintage as the Liège defenses—were selected as initial targets. They faced no less than six enemy divisions and 500 pieces of artillery including five battalions of 210mm howitzers, two battalions of heavy guns, one battery of "420's," and four batteries of Austrian "305's." The bombardment continued without pause from 10 A.M. on August 21 until midmorning of August 23, followed by a rush of three German divisions on a front of less than three miles upon what remained of nine defending battalions. The six remaining forts held out for two more days.

Next came the northernmost French fortresses. Maubeuge, whose defenses were neglected and outdated, held out for a surprising eleven days. On the other hand, the more modern barrier fort of Manonvillers, on the eastern frontier, fell to the Germans in two days under a hail of 17,000 shells of various calibers.

When the German armies were stalled in the First Battle of the Marne, they turned their attention to the big entrenched camp of Antwerp, final refuge of the Belgian army, which sortied forth on occasion. Antwerp's fortifications were the product of Brialmont's most ambitious venture, but had never been completed. An inner ring of forts 2 to 3 miles out from the city dated to 1870. An advanced line of seventeen forts was constructed after 1906 some 5 to 10 miles out, about 3 miles apart with permanent redoubts built in the intervals. These forts had been designed to withstand only the ordinary siege guns of their day, which were about 8-inch in caliber. The German siege train of more than 350 guns, including the "420's" and "305's," began its bombardment on September 28, 1914, concentrating on only four forts on the southern front. Four days later the garrisons had to be evacuated, and the guns moved forward to crunch through the old inner fortifications. Antwerp capitulated on October 10.

The only prolonged siege of a land fortress occurred at Przemysl in Austrian Poland on the San River. It consisted of a ring of forts 36 miles in circumference, some of them modern. Only a few modern 12-inch howitzers were among their thousand guns, which, for the most part, were outdated and of short range. In addition, there were over 100 machine guns. When forced to retire before the Russians, the Austrians left the garrison of 130,000 men and 21,000 horses with provisions calculated to last three months. Lacking heavy siege guns, the Russians attempted an assault in October, 1914, with disastrous results.

In November the Russians surrounded the fortress and waited out the garrison troops for four and a half months before they surrendered on March 22, 1915. The Russian stay was short-lived. On May 30, General von Mackensen, fresh from his massive breakthrough on the Dunajec River, brought up the German "420's." They made short work of several forts, and the Russians abandoned Przemsyl on June 2.

The German 420mm nutcrackers broke their teeth on the French forts around Verdun.

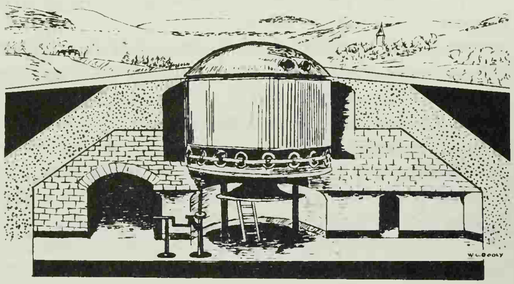
The forts, both old and new, followed the traditional polygonal pattern favored by the Marquis de Vauban, the French genius of siegecraft who reached his prime in the late seventeenth century. The most modern structures, like Douaumont, had huge concrete underground mazes of galleries and corridors protected by masonry arches 3 feet thick. Between this and the main layer of 8-foot-thick concrete was a cushion of sand 3 feet thick. Finally, most of the exterior was covered with several feet of earth. Retractable armored cupolas carried a 155mm short-barreled gun which could fire 3 rounds a minute, twin short "75's," machine guns, and observation towers. The forts were enclosed by moats 30 feet wide and 20 feet deep, covered by flanking guns.

Armament of the forts mattered little during the mighty struggle at Verdun in 1916. There was practically none. The then commander in chief General Joffre, dismayed by the quick demise of the Belgian and French forts to the north, had stripped the Verdun defenses of most of their garrisons and heavy guns for employment elsewhere in 1915. This fact plus a virtual comedy of errors in the French command handed Douaumont over to the Germans in a bloodless fiasco that was to cost France tens of thousands of men before the fort was retaken.

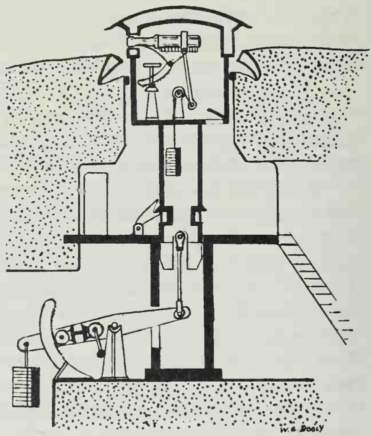
Except for the giveaway of Douaumont, the only fort captured by the Germans was the small Fort de Vaux, whose garrison of 300 men held out heroically for several days in conditions of appalling filth and horror while the enemy swarmed over the structure, spewing flamethrowers and dropping bombs through the crevices. When the defenders surrendered for lack of water, the German Crown Prince congratulated the commandant in person. In their final drive for Douaumont and Vaux in October, the French had to bring up a 400mm (15¾-inch) battleship gun on a special railway mount to destroy Fort de Vaux.

Examination of the most modern forts at Verdun after eight months of bombardment revealed amazingly little permanent damage to the steel cupolas and concrete casemates. Douaumont, for example, suffered permanent damage to only 5 of 18 casemates under the impact of more than 100,000 shells. The most impressive durability was shown by Moulainville, which reportedly took 330 of the nearly one-ton 420mm projectiles. The secret lay in the superior quality of French concrete, its careful placement in monolithic masses, the cushion effect of the sand between layers, and thicker steel construction of the cupolas.

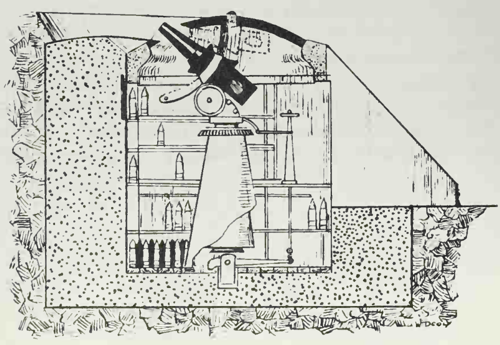
Whether or not the "Big Berthas" could eventually have cracked the tough French defenses must remain an unanswered question since most were put out of action. Five of the eight 420mm howitzers at Verdun suffered premature shell bursts in their tubes during the heavy bombardment. All except one had to be sent back to the Krupp works for repairs in 1916. Mounts of two of the three M-*Geräts* that had their barrels blown to bits were repaired and fitted with 305mm tubes 30 calibers in length. These "Beta-M-*Geräts*" could fire a 728-pound projectile to a range of 18,489 yards. They weighed nearly 51 tons with carriage.



Typical steel turret at Liège showing cross-section of a fortification. This armored cupola, which could be raised or lowered, carried two 15cm (5.9-inch) guns.



Intricate elevation and lowering mechanism shown in this cross-section of a disappearing steel cupola for 3-inch gun. Top of turret is protected by 12-inch nickel steel.



Cross-section of a steel cupola for 4.7-inch howitzer provides strong protection against everything but plunging fire from very heavy ordnance.

The French 400mm (15¾-inch) railway gun, using a naval piece, was the largest land gun (as opposed to howitzer) used in the war. Its specialty was destruction of heavy fortifications and tunnels. Here a "400" is being prepared for firing in the Somme region, France.

The famous "Paris Gun" that bombarded Paris from a distance of 74.6 miles with 210mm projectiles. Each projectile weighed about 275 pounds and was fired with 660 pounds of powder. The shell was fitted with an elongated cone and a special detonator since it would not necessarily fly with the point forward after reaching the maximum ordinate.

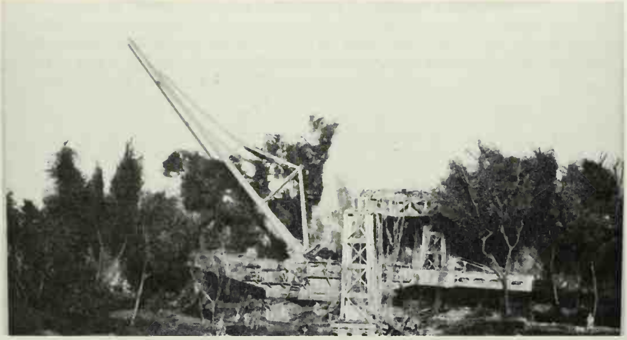
THE PARIS GUNS

ON THE MORNING OF MARCH 23, 1918, two days after the Germans launched the first of their last powerful offensives, heavy, bomblike explosions were heard in Paris. Occurring at frequent and fairly regular intervals, they began at about 8 A.M. and continued until the middle of the afternoon. Ten persons were killed, and some fifteen wounded in different parts of the city. Some tramways stopped operation and many stores were closed.

Many Parisians believed they were being bombed in daylight for the first time by aircraft from a great height, but nothing could be seen in the unusually clear skies. Others felt that the Germans had somehow cunningly hidden guns no more than twenty or twenty-five miles away. Thus began the first bombardment of Paris by the German *Parisgeschütz* from the unbelievable distance of 74.6 miles. People were stupefied at the noiseless approach of the projectiles, like death-dealing meteorites guided from outer space.

For 140 days the "Paris Guns"—often confused with the "Big Bertha" howitzer—bombarded the city intermittently. Usually Parisians could count on being awakened by the tremendous explosions at 6:30 A.M. every third day.

This most unusual feat in the history of artillery was performed by specially built guns ensconced in a quarry in the forest of Coucy. They were not superheavy guns, but "superrange" rifles of a high order of ingenuity. The 232mm *Parisgeschütz* was developed from the 380mm (15 inches plus) naval gun that Germany usually employed as a railway mount. A 50-foot extension was added, plus another 28-foot extension that was not rifled. Overall length of the tube was 128 feet and weight with carriage was 308,000 pounds. Into the tube was inserted a liner 210 millimeters in diameter (about 8 inches). The long range was ob-



tained by achieving a muzzle velocity of 5,407 feet per second and firing at an elevation of about 55 degrees. The projectile varied from 273.4 pounds to 277.8 pounds. It took advantage of the thin atmosphere at great heights, reaching a zenith of 24 miles in its trajectory.

A gun developing such pressure wears rapidly. The Paris Gun was calculated to be able to fire about fifty times before wearing out. Thus shells with varying sizes of rotating bands were laid out carefully in consecutive order for firing. Once worn down, the original tube was first rebored to a 232mm, and, finally, a 260mm diameter. Nine of the guns were constructed—six by Krupp and three by Skoda. Six were used and one blew up in action. The guns were never captured, though often bombarded and observed.* They were said to have shaken like fishing poles when fired, and the great length of tube had to be stabilized by a special truss. The expected target area of these guns when the bore was new was an area about two miles long by three-quarters of a mile wide.

In Paris, a total of 256 persons were killed over the four-month bombardment period, the worst disaster occurring near the outset when 156 persons were killed or wounded in the church of Saint Gervais on Good Friday, March 29. The shock wore off quickly. As described in late May by Lee Meriwether, American diplomat in Paris:

"Last Sunday thousands of people promenaded on the Avenue du Bois de Boulogne. . . . Children rolled hoops on the walks. Automobiles dashed along on their way to the park. The side paths were thronged with men and women on horseback. All the while, at regular intervals of 15 minutes, shells from the 75-mile guns dropped somewhere in Paris. . . . No one spoke of the bombardment, and all that the Parisian papers said the next day was this two-line announcement:

" 'The bombardment of the Paris region by long distance guns was resumed yesterday.' " (26)

* C. R. M. F. Cruttwell in his *History of the Great War* states: "The shell took more than five minutes to arrive, and hooters in Paris sounded the warning, as soon as the telephone announced the firing of the gun."

A model of the *Parisgeschütz* in firing position, as constructed at the Ordnance Museum, Aberdeen Proving Ground, Maryland. A special truss had to support the 128-foot tube, which swayed like a fishing pole when fired. Nine of these guns were built and six were used.

SELF-PROPELLED ARTILLERY—THE FINAL LINK

THOUGH IT IS LITTLE KNOWN, heavy artillery, profiting by the lessons of the tank, progressed all the way to the ultimate goal of self-propulsion during World War I, combining opposing qualities of power and mobility, and of great weight and ease of service.

In 1918 the French Saint-Chamond Company mounted both the 120mm and the 220mm guns on the chassis of track-laying tractors. Finding that the 220mm model negotiated rough ground "with extraordinary facility," the developers tested it on the shell-torn wastes around Verdun. "In the ravine of Vignes, where even '75's' could not be maneuvered," reported Saint-Chamond, "these pieces were put into position and fired against German positions." They negotiated streams and trenches, broke down walls and passed through forests. Following the trials, the French government ordered seventy-five tracked mounts equipped with 194mm Filloux guns and 280mm Schneider howitzers. Delivery was made after the Armistice.

The matériel consisted of two separate units with electric transmission, operating as one unit. The gasoline engine was placed on the limber—itself carrying 8 tons of ammunition—which was connected by electric cable to the second vehicle mounting the gun. Each vehicle carried a driver while en route to the gun position. The gun could be fired as soon as the tractor was stopped, and could be on the move again immediately after the last shot was fired. The limber, having both the heavy load of ammunition and the power plant, could be detached and withdrawn to the rear in the event of heavy enemy fire.

Thus emerged, half a century ago, the first models—only briefly tested on the field of battle—of the big self-propelled guns which dominated the artillery of World War II.

A Tommy with Enfield Mark III rifle stands watch while his buddies try to catch some sleep in a British trench in France, July, 1916.

TRENCH WARFARE

INTRODUCTION

FOLLOWING THE CHAOTIC FIGHTING that historians call the First Battle of the Marne, the Germans fell back from Paris across the Aisne River and dug in. There, from the first primitive trench lines in the Great War was demonstrated to military commanders an agonizing truth: The power of defense, with modern weapons, had transcended the power of attack.

Frantically, each side tried to outflank the other in a series of leap-frogging movements that was called the "race to the sea." The specter of a prolonged siege-war of attrition finally materialized following the first battle of Ypres near the Belgian coast. When the last German attack was repulsed on November 11, 1914, the British regulars had been decimated as an army; Ypres was their supreme memorial. If Ypres was their tombstone, it also wrote *finis* to the stereotyped theories of warfare embraced by all belligerents. Cavalry divisions had delivered their last big charges on the decisive Western Front. The war of movement was dead. What was to have been a whirlwind operation of a few weeks was now in its hundredth day and the conflict was just getting started. The machine gun ruled supreme.

The first trench lines stretched across France and part of Belgium for some 460 miles, from Switzerland to the sea. They were not to be dented as much as 10 miles at any point during the next three years of savage bloodletting. The centers of the Allied and German fronts were, in the words of Winston Churchill, "leaning up against each other in complete equipoise." Like two invincible gladiators with feet rooted to the earth toe to toe, they alternately mauled and maimed in berserk fury until each collapsed in misery and exhaustion, only to rise again, emaciated and unrecognizable, to renew the fight.

Many crude and improvised weapons were used in the early days of trench fighting before the higher commands had recognized the siege

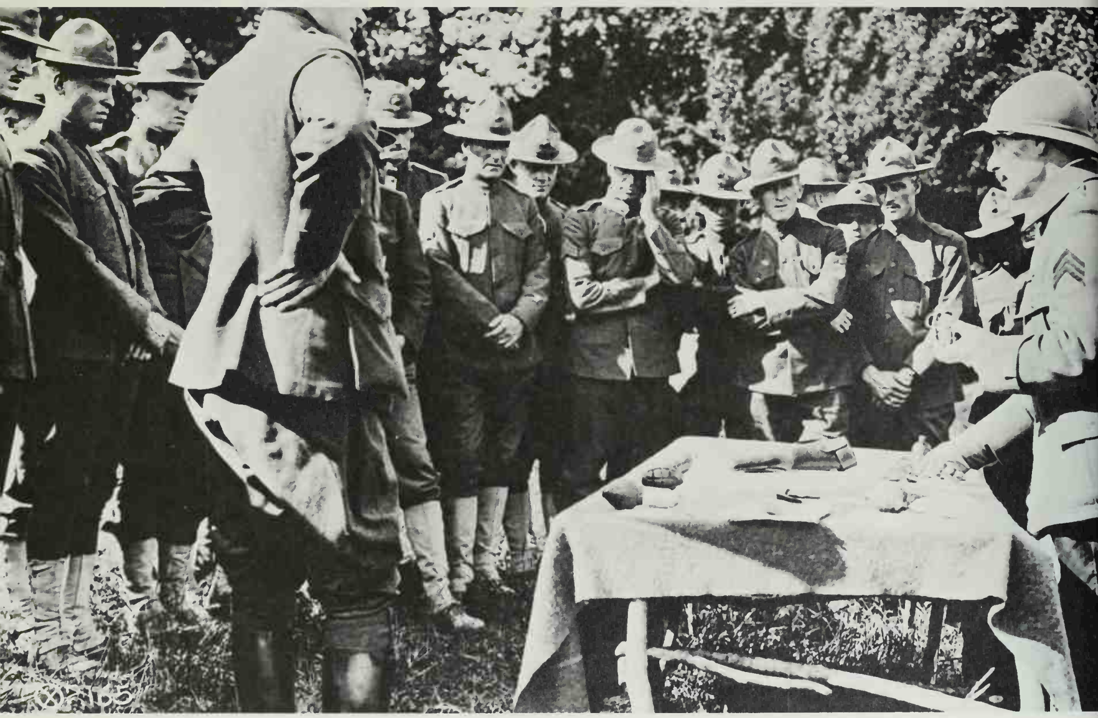
nature of the war. Artillery ammunition was practically exhausted, and between suicidal assaults in the face of the machine gun, bickering warfare continued where opposing trenches were sometimes less than 100 yards apart.

Before grenades, the hand bombs of the day were lighted by match, the fuses often rendered useless by weather. Crude bombs were fashioned from jam tins, wooden boxes, and anything else handy. Patrols roamed no-man's-land by night. Here the Bowie knife was the favorite German weapon; it was silent. The "cosh," a weighted stick, was often used by the British.

Trenches were so stabilized in some sectors that siege warfare was conducted along classic lines. Mining and countermining "duels" were fought in which one side bored under the enemy's tunnel before it reached the line and blew up his work. The most elaborate operation was carried out by the British in Belgium, where thousands of "sappers" spent nearly two years tunneling through blue clay at depths of 80 to 125 feet toward strong German defenses at Messines Ridge. It involved some 5 miles of gallery and 20 land mines containing a total of 1,000,000 pounds of ammonal, on a 9-mile front. At 3:10 A.M. on June 7, 1917, the giant explosions were set off within an interval of 30 seconds, the fortifications were wrecked, and the demoralized defenders overrun by tanks and infantry. The detonations, greater than any in previous history, were heard in London.

Trench siegecraft took on a little Yankee ingenuity when the Americans pinched out the Saint-Mihiel salient in 1918. Teams of pioneers and engineers used "Bangalore torpedoes"—long metal tubes of TNT—which were thrust under barbed-wire barricades and exploded. Leading troops threw long rolls of chicken wire across entanglements to make bridges. General John J. Pershing related that one of the large number of French officers sent to see how it was done "remarked in all seriousness that the Americans had the advantage over Frenchmen because of their long legs and large feet. . . ."

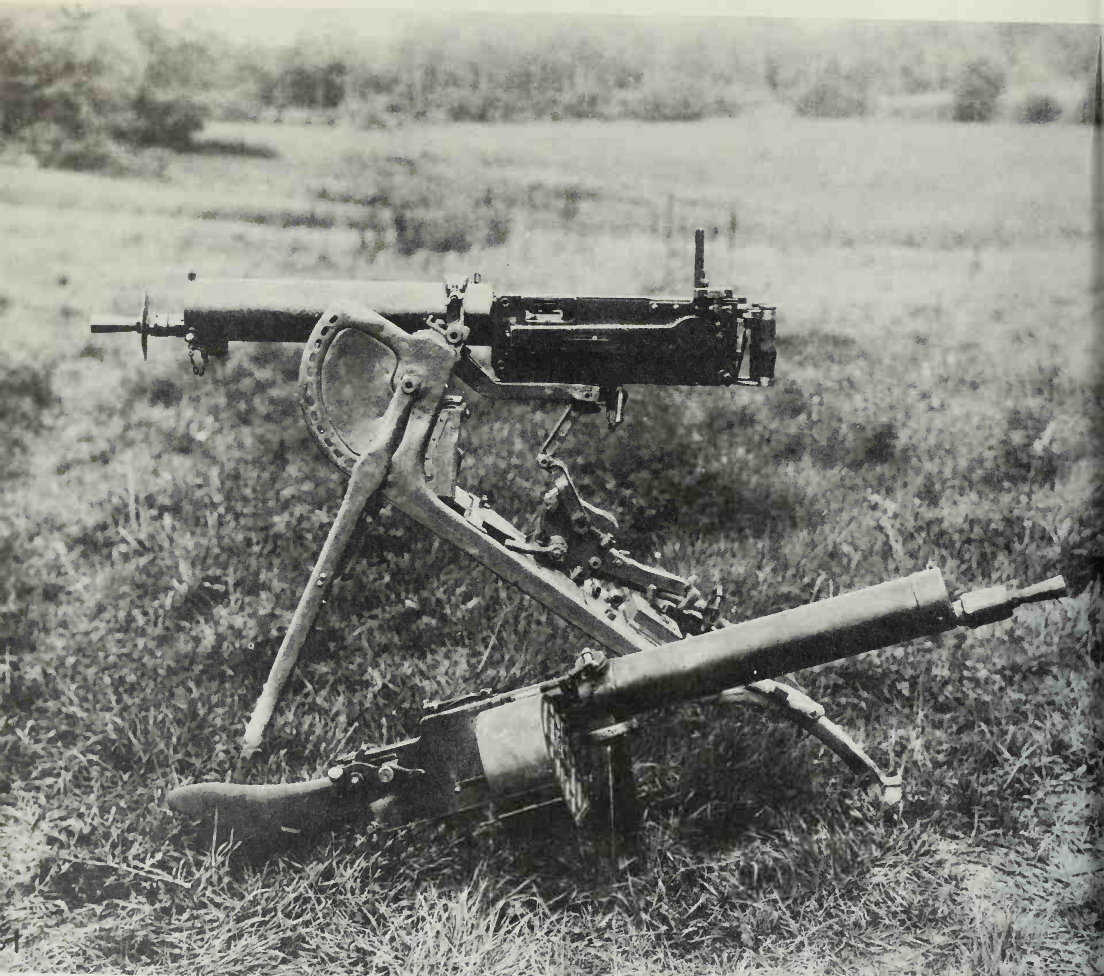
American engineers fabricate rolling barbed-wire entanglements in front of trenches. Boards serve as racks to hold hoops in place while wire is being strung.



Trench fighting in winter. U.S. soldier is sighting a Springfield .30-'06 rifle.

U.S. Marines learn about grenades from French instructor. On the table, in addition to the usual "pineapple" types, is a cup (in case) that can be attached to a rifle muzzle to fire grenades.

Captured German machine guns. The large gun is a heavy 7.92mm (.311-caliber) Maxim, Model 1908, marked *"Deutsche Waffen und Munitions Fabriken, Berlin, 1917."* The smaller gun is the light Maxim of the same caliber, which appeared in 1915. Since the light Maxims were stamped with the place of manufacture—Spandau—they often were called "Spandaus" by Allied soldiers.



THE MAXIM MACHINE GUN

"THE MACHINE GUN," asserted a British commander as late as April, 1915, "is a much overrated weapon and two per battalion is more than sufficient." This observation by Sir Douglas Haig—a cavalry general, like nearly all the British commanders—typified military resistance to innovations. Shortsightedness had, indeed, rendered England and France almost helpless in meeting the threat of this ubiquitous weapon. But failure in the field even to recognize its *de facto* supremacy through battle after battle in 1915 and 1916 remains one of the astonishing absurdities of the war. No-man's-land was its kingdom; the hundreds of thousands who fell there its subjects. By war's end estimates of its toll ran as high as 90 out of every 100 casualties.*

When Hiram Stevens Maxim, an American, lost a patent lawsuit to Thomas Edison, he moved to England and set up the Maxim Gun Company, later to be merged with Vickers. He introduced the master killer to the world in 1889. The first model performed perfectly, spitting out an astounding 600 to 700 rounds a minute. Instead of multiple barrels, which burdened such prototypes as the French *Mitrailleuse,* the American Gatling, the Gardner, and the Palmcratz-Nordenfelt, the Maxim was reduced to one barrel. It was enveloped by a water jacket for cooling. The recoil force of the barrel was used to perform all loading, firing, and ejecting operations, which formerly had to be done by operating a crank or lever. A fabric belt of 250 rounds supplanted the older gravity-feeding magazines.

The German, Russian, and British armies adopted the Maxim in the

* This is disputed by Cyril Falls in his excellent book *The Great War,* which states: "Artillery was the biggest killer, but at the start of a great offensive, when a high proportion of the defending artillery had generally been knocked out, the machine gun, being harder to knock out, was the best defensive weapon." (14)

This heavy Maxim took a large toll of American soldiers from Citadel Hill, near Grandpré in the Ardennes. This was the most important position on a hill dotted with machine gun pits, with brush screen removed to show the gunner's command of the entire valley. Doughboys made three unsuccessful assaults before taking the hill.

same year it was demonstrated. It was the principal gun of the Germans and the Russians throughout the war. Thus, Sir Hiram's name "is more deeply engraved on the real history of the World War than that of any other man," wrote military historian Liddell Hart. "Emperors, statesmen, and generals had the power to make war, but not to end it. Having created it, they found themselves helpless puppets in the grip of Hiram Maxim, who, by his machine gun, had paralyzed the power of attack." (25)

In the manner of scouts for football teams, observers had been dispatched by most of the great powers to watch the Japanese whip the Russians in 1904–1905. Those who were discerning saw a miniature preview of World War I. Trenches crisscrossed every battlefield. The futility of frontal attacks and cavalry charges against the firepower of the

German infantry at bay in shell holes amid bursting shells near the Somme during the last retreat in 1918. Men in foreground are operating a light 1908–1915 Maxim machine gun.

modern rifle and machine gun was shown, as was the reality of what Napoleon had announced prematurely a hundred years before: "It is with artillery that war is made." The Japanese wisely thinned out their men and made rapid, short advances.

This inoculation in revolutionary tactics made necessary by twentieth-century weapons seemed to take only on the Germans. Their observer was Max Hoffmann, a bright young officer and future general who reported to the High Command on the defensive power of entrenched machine guns. Thus the German army was the first to recognize the true value of the weapons. By grouping them under regimental control instead of distributing them among battalions, it exploited the machine gun's firepower at the outset.

Men of U.S. 107th Regiment Infantry, 27th Division, advance through barbed-wire entanglements where a tank has made a path, Somme, September, 1918. One man has either tripped over the wire or been hit.

MARCHING INTO FIREPOWER

AT THE BEGINNING OF 1915, the German High Command became preoccupied with the Eastern Front and milked away many divisions from France to deal with the overrated "Russian steamroller"—a fortunate circumstance that may well have saved the Western Allies. With an accurate assessment of defensive power, General Erich von Falkenhayn, the new German chief of staff, left the long line of the Western Front thinly manned. But it was backed by overwhelming superiority in artillery, machine guns, and a new weapon—gas. It was nearly always the Allies who attacked, and they almost consistently developed a local five-to-three superiority in manpower. But their incessant punches made only temporary dents in an elasticlike defense. The Germans, continually improving their trenches with dugouts, firing steps, and parapets, were content to mow them down as they came.

The hardening of the front had left a huge German salient in Champagne, its apex near Compiègne pointing bluntly toward Paris. It was at this threatening spearhead that the French commander in chief, General Joseph Joffre, noted principally for his imperturbable sangfroid in a welter of defeats, masterminded a series of bull-like rushes during 1915. British Field Marshal Sir John French, pathetically deficient in artillery, shells, specialized trench warfare weapons, and reserves, cooperated with attacks centered around Loos, in Artois. Results of the bloody 1915 campaign were negligible gains at unacceptable cost. By the end of 1915, it was estimated, Allied casualties in the West had mounted to some 1,570,000, compared to more than 600,000 for the Germans.

In the Battle of Souchez, May 9 through June 19, the French attacked after a five-day artillery preparation of 700,000 shells from 1,200 guns, with each square yard of the front calculated to receive 18 shells. In the center, the *poilus* broke through for 3 miles—almost to the crest of

Doughboys training in "going over the top" with U.S. 1917 model Enfield rifles.

the coveted Vimy Ridge—and looked upon green farmlands untouched by war. "They picked flowers and put them in their caps as a symbol of the open warfare which they believed was beginning," wrote historian C. R. M. F. Cruttwell. But the advance was short-lived. Two thirds of the attack had been foiled; the hole was quickly plugged by the Germans; and the French suffered an attrition estimated variously from 100,000 to 400,000 men, far above enemy losses. The twin effort of the British at Aubers Ridge on May 9 broke down in one hour. Handicapped by a lack of guns (only 71 British guns in France were larger than 5-inch) and ammunition, much of it faulty, the British could afford a bombardment of only 45 minutes. The undamaged machine guns, intact in their emplacements, "mowed down without difficulty the heavily loaded waves of brave men lumbering towards them," Cruttwell recorded. (11)

The pattern was repeated in September in Champagne and at Loos.

Joffre had mustered about 500,000 men for his second Champagne assault on September 25, outnumbering the enemy by three to one at the outset. Prefaced by a three-day bombardment greater than had been seen before, the French advanced in pouring rain to the tune of the "Marseillaise" and the beat of drum and fife. Results of the ten-day struggle were the same: an uncoordinated series of local skirmishes and a trifling gain of ground. The rounding up of 25,000 German prisoners and 150 guns partially masked the real defeat. The Allied loss has been estimated at 145,000 men.

In Artois, a phase of the Battle of Loos, in effect, was dedicated to the murderous power of the Maxim machine gun. Abetted by an ill-advised cloud gas release by the British which poisoned some of their own troops, it was one of the most tragic Allied fiascos of the war. Although the British enjoyed a seven-to-one superiority at the moment of attack on September 25, gains were limited and costly, one division losing 60 percent of its infantry. During the night of the twenty-fifth the Germans reinforced their positions and erected a new wire barricade.

With mistaken optimism, the British commander ordered a renewal of the frontal assault on September 26 by two raw divisions that had received their rifles only in July, and had been in France two weeks. Without sleep for 48 hours, hungry, and exhausted after 18 hours on the move to the front through heavy rain, the doomed "civilian army" was deployed for a daylight attack across a valley in full view of a well-prepared enemy. This reenactment of the Charge of the Light Brigade—"in slow time, under conditions of infinite squalor and magnified in scale a hundredfold," was described in Alan Clark's poignant book *The Donkeys:*

"For fully ten minutes the Germans held their fire . . . at a range of 1,000 yards, the order to fire was given. The diary of the 15th [German] Reserve Regiment records that:

" 'Ten columns of extended line could clearly be distinguished, each one estimated at more than a thousand men, and offering such a target as had never been seen before, or even thought possible. Never had the machine-gunners such straightforward work to do nor done it so effectively. They traversed to and fro along the enemy's ranks unceasingly. The men stood on the fire-steps, some even on the parapets,

A Franco-American raiding party going over the top with sacks of hand grenades at Badonviller, March, 1918.

and fired triumphantly (*jauchsend*) into the mass of men advancing across the open grassland. As the entire field of fire was covered with the enemy's infantry the effect was devastating and they could be seen falling literally in hundreds.' " (8)

The barrier before the German lines, relates Clark, consisted of "hard steel barbed wire, too thick to be cut with the hand-clippers that had been issued to some sections, braced and criss-crossed among pine stakes and pit-props driven 35 centimeters into the earth. Its height was over four feet and its depth across five metres, or nearly 19 feet. Desperate, the men hurled themselves at it in frenzy; some tried to scramble over it as one might a thick yew hedge, others pulled at it with their bare hands; still more ran up and down along its edge in the hopes of finding a gap that might have been cut by shellfire, until they were cut down." (8)

Some 10,000 had participated in the assault, and casualties totaled 385 officers and 7,861 men during the three and a half hours of action. The Germans reportedly suffered no casualties at all. A bitter quarrel arose between Haig and his superior, Sir John French, as to the blame for this debacle. Haig succeeded French in December.

But it was not to be the end of such "bloody meaninglessness," as Lloyd George put it, in the face of the machine gun. Nine months later, on July 1, 1916, the German Maxims reached their zenith of slaughter during Great Britain's blackest day of the war. Haig massed over 500,000 men for his ambitious Somme offensive, of which about 100,000 were to advance on an 18-mile front against a successive series of trenches. The Germans had excavated deep dugouts in their elaborate chalk trenches which could resist anything but a direct hit by an 8-inch shell. The wire barricades were 20 to 30 yards deep, staked with iron posts, the barbs as thick as a man's thumb.

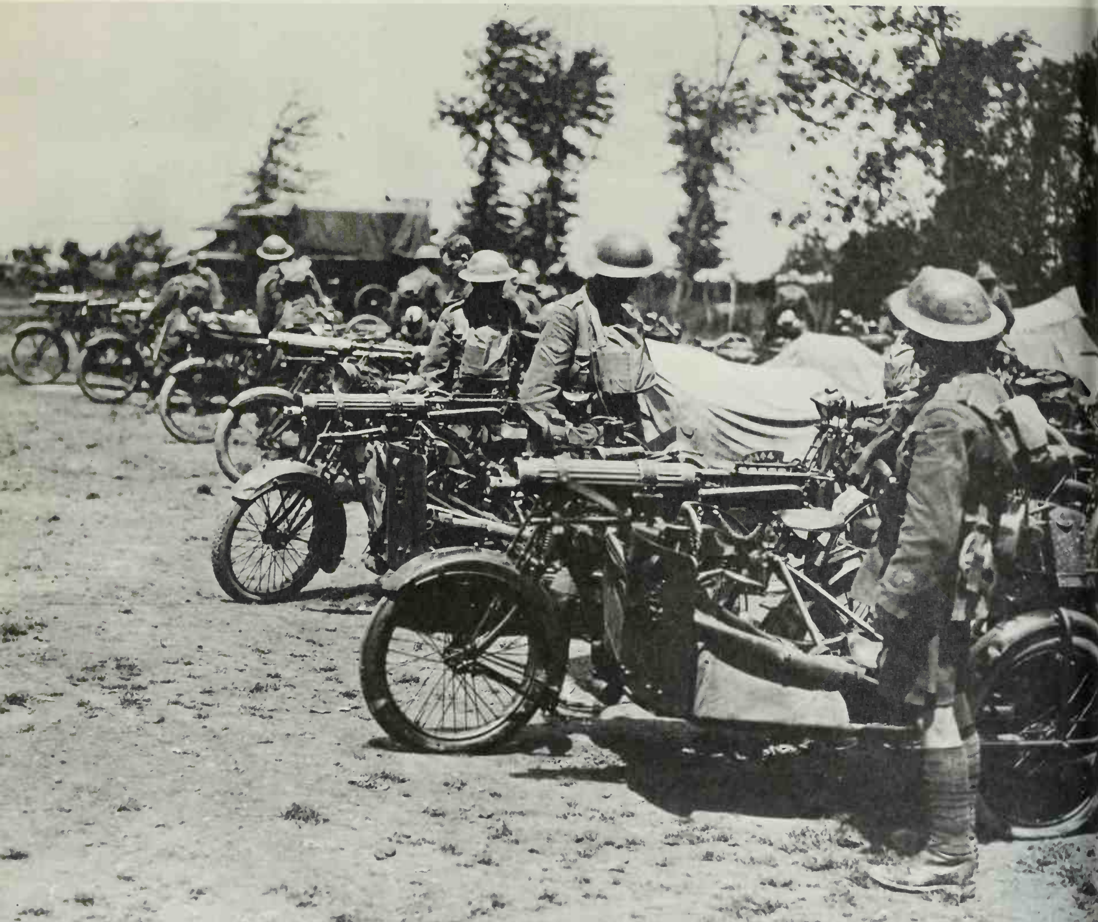
Following a seven-day bombardment, 100,000 men went "over the top" in waves at 7:30 A.M., rifles held aslant under a blazing sun. They were dense waves, sometimes five or more of them 100 yards apart, men shoulder to shoulder in eighteenth-century formation. They walked as upright as they could under their burdens. "Each staggered under a weight of 66 pounds, more than was borne in full marching order," wrote Cruttwell. "They carried 220 rounds of ammunition, two bombs, and two sand bags; a proportion were further encumbered with picks and shovels, boxes containing carrier pigeons and telephone apparatus." (11)

The German artillery had indeed been crippled by the bombardment. But the machine gunners who had persevered through the week's pounding in their dugouts, often without food, came leaping to their weapons the moment the barrage was lifted. It was the machine guns, estimated at about 100 teams and guns, that held the German front together that day. The British losses of nearly 60,000—of which more than 19,000 were killed or died of wounds—figured at about 60 percent of the officers and 40 percent of the men engaged, a proportion said to be unparalleled in great battles recorded in history. The German losses, while heavy, were comparatively much lighter.

U.S. troops attaching the *tromblon*, a discharger cup invented by the French, to the muzzles of their rifles in preparation for firing grenades. The cup was a great improvement over the old percussion-type rifle grenade with steel tail rod that sometimes damaged the rifle.

American privates exhibit captured German body armor and helmets. Soldier at extreme right has damaged German 13mm antitank rifle.

Vickers .303's mounted for transport by British Motor Machine Gun Section at Dieval, June, 1918.



THE ALLIED MACHINE GUN RUSH

THE NEEDS OF THESE EARLY ALLIED ARMIES in the field did not go unheeded. A public outcry inspired by the press in England had already resulted in formation of a Ministry of Munitions to spearhead a crash program of development and production. The ministry, headed by Lloyd George, boldly overruled the shortsighted military's opinion that the prewar allotment of two machine guns to a battalion was "more than sufficient," and multiplied the number by sixteen. (It was also this ministry that saved the Stokes mortar and the tank from being pigeonholed by the War Office.) If recognition of the overwhelming need for more and better weapons of trench warfare came late, the problem was attacked with energy and resourcefulness.

France, though in a desperate condition with many of her factories and raw material sources in the hands of the Germans since the early days of the war, quickly turned out an astounding flow of both light and heavy weapons.

The lessons of the first two years of the war were not lost on the United States, though not yet a belligerent. In 1916, Congress appropriated $12 million for machine guns and a board was created "to free the air of the various controversies and to set at rest in as final a fashion as possible the conflicting claims of makers and inventors." Secretary of War Newton D. Baker stated in his annual report: "Perhaps no invention has more profoundly modified the art of war than the machine gun." In 1912, Congress had sanctioned the allowance of four machine guns per regiment, but the U.S. Army's plans of 1919 called for 336 machine guns per regiment as a result of its experience in the war.

British Army officers instruct members of a company of the U.S. 306th Machine Gun Battalion, 77th Division, in the use of the Vickers machine gun.

The British Vickers .303

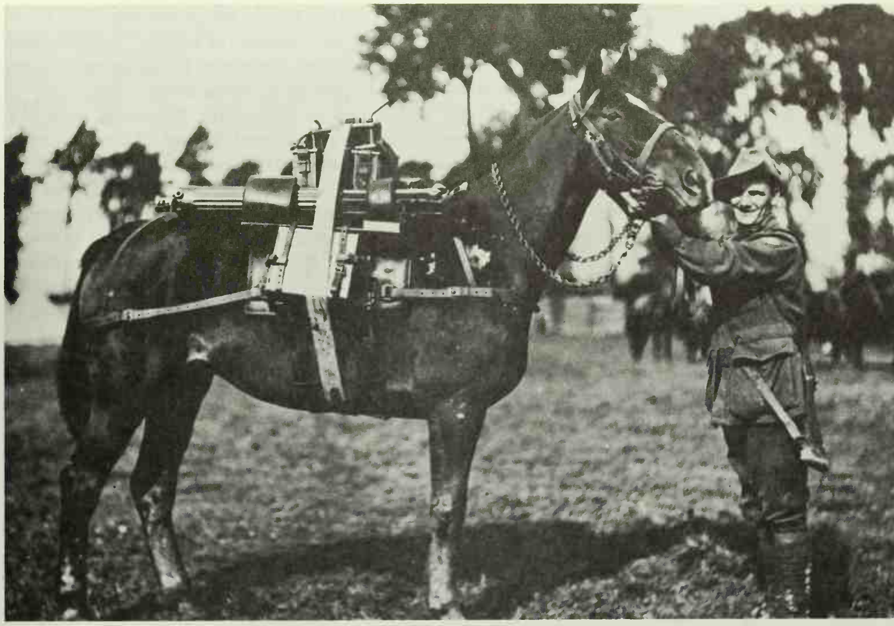
In 1912 the British cavalry had adopted the great Vickers .303-caliber machine gun, based on a Maxim design. The infantry still was equipped with the old Maxim in 1914, but received the Vickers during the middle war years.

Liquid-cooled, the trim Vickers .303, like the Maxim, was operated by a combination of gas and recoil power. The gas generated by the explosion of the charge was trapped at the muzzle and rebounded to a cup screwed to the barrel, thus transmitting more power to the recoil. Considerably lighter than the Maxim, the Vickers weighed 40 pounds with water jacket filled, 10 pounds less when empty. It was belt-fed and cycled at about 500 rounds per minute. It was sighted up to 2,900 yards and had an accurate range of 600 yards.

This reliable weapon was the standard British infantry and aircraft machine gun through World War II.

The French Hotchkiss

The famous .315-caliber Hotchkiss was the only air-cooled and gas-operated heavy machine gun in the war, and also was the heaviest, weighing 52 pounds. It was an effective antiaircraft weapon and weighed 70



Vickers .303 machine gun packed for transport, muscle style. 1st Anzac Corps.

pounds with tripod mount. In this type of gun the expanding gases behind the bullet are forced through a hole into a cylinder near the end of the barrel as the bullet emerges, where they strike the head of a piston which operates the gun. Cooling is achieved by radiation rings along the barrel. It was fed by 30-round metal strips.

The Americans used 5,300 heavy machine guns of foreign make during the war—more than the U.S. Browning—and nearly all of them were the French Hotchkiss guns. Japan manufactured an elaborate copy of the Hotchkiss for World War II.

The American Browning .30-Caliber Machine Gun

The U.S. War Department had almost settled on the Vickers in 1916, but encountered technical difficulties in mass-producing it. Tests of all outstanding makes were conducted in May, 1917. It was at these tests that John M. Browning's new gun made its debut in both the heavy- and lightweight versions.

The Browning .30-caliber weapon was adopted as the U.S. Army's ultimate standard heavy machine gun, partly because its design was well adapted to rapid production in quantity. But it was much more than that. Tests in Europe convinced the American commander, John J. Pershing, that both the heavy and light Browning were greatly superior to any machine guns in use by any of the armies on either side. The heavy Browning was the lightest of all the "heavies" in the war, weighing only 37 pounds with its water jacket filled. Simplicity in design made it the only heavy machine gun to be operated by recoil alone.

Unfortunately for U.S. troops in France, the Brownings were considered to be too good. Although they started coming off the production line in the first quarter of 1918, none was issued at the front for combat until the Meuse-Argonne battle in late September. Pershing feared that one of the new Brownings might fall into German hands before production reached high gear. "If this should happen it was possible that with their quick recognition of the importance of any military improvement and the demonstrated German industrial capacity for quantity production, they might begin the immediate manufacture of German Brownings," stated a War Department report of 1919. It was a great tribute to the enemy, but by the middle of 1918 the naval blockade had nearly exhausted Germany's industrial resources, and her offensive strength was waning. In fairness it should be noted that this became apparent only gradually on the battlefield, and many Allied commanders were concerned at a late date that Germany might be able to force the war into 1919.

The heavy machine gun equipment of the first U.S. troops in France was the French Hotchkiss; later, the American-manufactured Vickers was added; and, finally, 27,000 heavy Brownings were shipped before November 1, 1918. Only 1,168 of these Brownings were used at the front. A few were modified for aircraft use.

Demand for the Vickers as a synchronized aircraft gun was so acute that the Marlin, a modified version of the old Colt, was adapted to this use to release the Vickers for the ground troops.

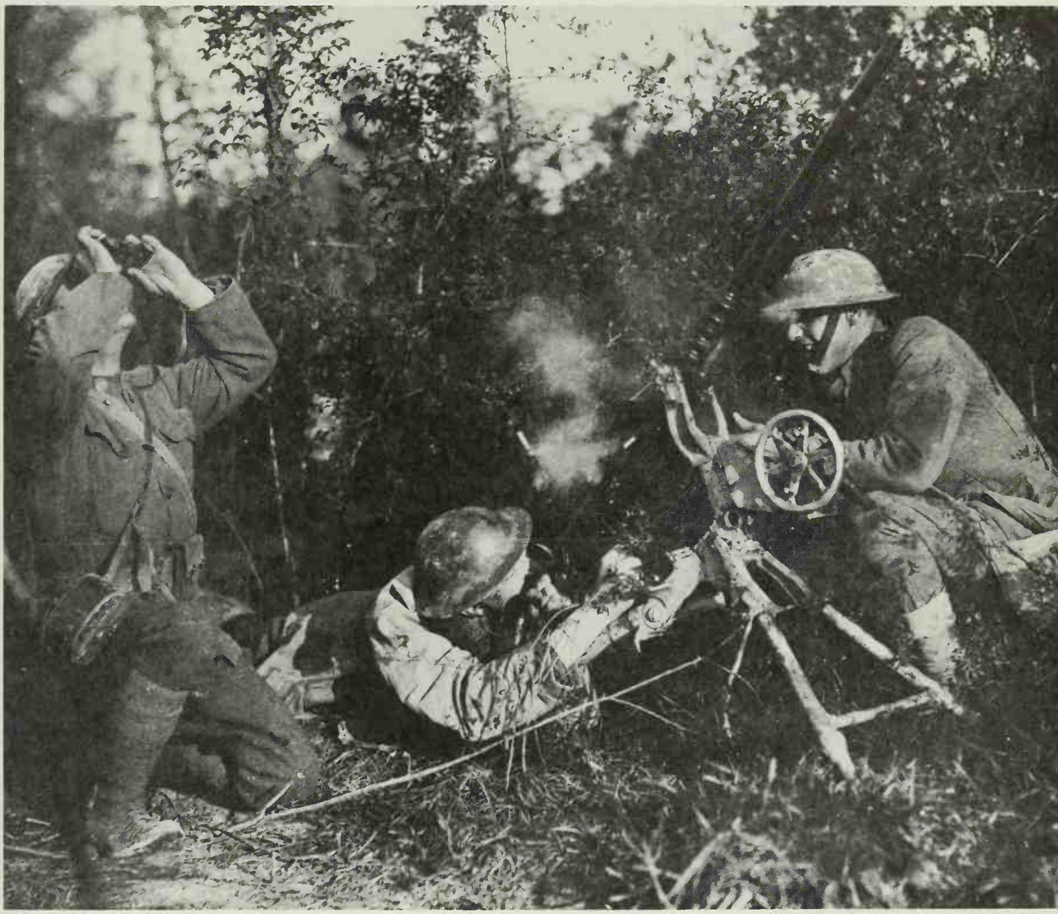
Russian and Italian Machine Guns

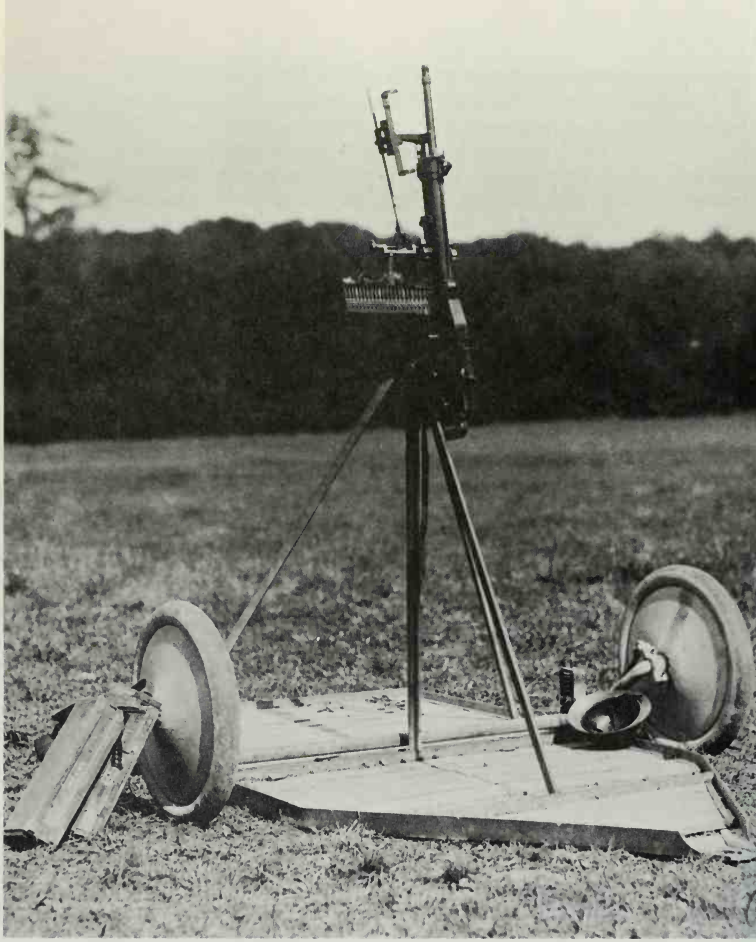
The standard Russian heavy machine gun was a 7.62mm Maxim, typically mounted on a Sokolov wheeled carriage. It survived through World War II and later found its way into Korea.

Early in 1917 the Marlin-Rockwell Corporation, New Haven, Connecticut, completed a large Russian contract for the 1917 Colt machine gun—slightly modified from the old U.S. Army Colt—chambered for the 7.62mm cartridge. Colt's Patent Fire Arms Manufacturing Company, Hartford, Connecticut, then tooled up for production of 7.62mm Vickers guns for Russia; but by the time the 1,000 weapons were ready in 1918, Russia had collapsed in revolution. The Vickers guns were taken over by the United States and modified to take 11mm ammunition.

The only notable water-cooled machine gun to be magazine-fed was the Italian Revelli. It also fired the smallest bullet—.256-caliber—although it weighed nearly 49 pounds with full water jacket. Magazines held 50 rounds in 10 separate spring-loaded compartments. Operation was by a combination of recoil, inertia, and cartridge projection (blowback).

U.S. team in hot action against a German plane with a Hotchkiss machine gun at Villers-Tournelle, May 20, 1918.





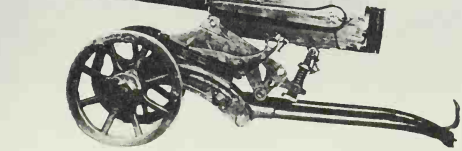
An unusual portable French antiaircraft rig with a St. Etienne machine gun in Alsace. The gun is fed with strips of 8mm Lebel cartridges.

Rounding out the heavy machine guns of World War I, the Austrian .315-caliber Schwarzlose shared honors with the Hotchkiss as the largest-caliber machine gun. It was the only one operated by the "blowback" principle—that is, the rearward thrust of the cartridge drove the breech block against a heavy spring, which pushed it forward again. Cartridges were oiled before insertion to avoid binding. No positive locking device was provided. Sealing of the breech depended on inertia provided by the heavy moving parts and a strong spring. For this reason the barrel was unusually short in order to be sure that the bullet left the gun before the inertia was overcome.

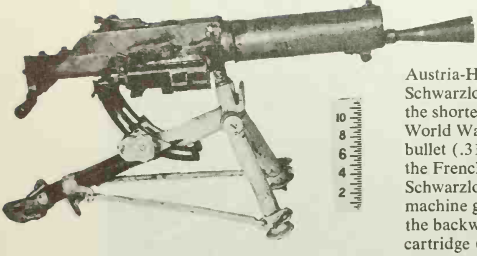
The U.S. heavy .30-caliber Browning machine gun being worked from a shell hole on "Hill 328" in France. Probably the best machine gun in the war, the Browning was not permitted at the front until the last great battle when over 1,100 were thrown into the Meuse-Argonne offensive. Recoil-operated, it had a cyclic rate of 500 shots a minute.

TECHNICAL NOTES: The forerunner of the modern .50-caliber Browning also was developed during World War I. On October 15, 1918, the first water-cooled .50 caliber fired 887 shots in bursts of 100 to 150 rounds. The 5¼-inch cartridge, with 707-grain bullet, developed a velocity of 2,369 feet per second. A large order was placed, but was canceled when the war ended. Also, a Browning tank machine gun was designed in 1918 and large orders placed, only to be cut back at war's end. This basic design was used for the 1919A4, A5, and A6 guns, which established great records in World War II.

Italian M1914 Revelli (Fiat) was smallest-caliber machine gun of the war, using .256 (6.5mm) ammunition. It weighed about 49 pounds with mount and the barrel was 25¾ inches long. Ammunition was fed by a box magazine on the left containing 50 rounds in columns of five. Cyclic rate was 500 rpm. It could be adjusted to fire single shots.



Russia's stolid old Maxim M1910 machine gun was sturdy enough to see service in World War I, World War II, and the Korean conflict. Mounted on a Sokolov wheeled carriage like a junior-sized artillery piece, it used 7.62mm ammunition.



Austria-Hungary's M1907–12 Schwarzlose machine gun had the shortest barrel of any in World War I but fired the biggest bullet (.315-caliber) along with the French Hotchkiss. The Schwarzlose was also the only machine gun operated solely by the backward thrust of the cartridge (blowback).

TECHNICAL NOTE: the Schwarzlose machine gun was fed by 250-round belts, weighed 50 pounds with water jacket, and was sighted up to 2,620 yards.

A Lewis machine gun being operated from a trench firing step by men of the 119th Infantry, 30th Division, in the Watou area of Belgium in July, 1918. The Lewis .303-caliber "light machine gun" was more of a "medium" weight —26½ pounds—and was of British design. The U.S. developed the Model 1917 Lewis (shown) from the British design, chambering it for the U.S. .30-'06 cartridge. It was fed from the top by a 47-round drum, and cycled at 600 shots a minute.

TECHNICAL NOTES: A "Lewis controversy" developed in the U.S. in 1916, when training guns bought from the British unlocked under pressure, resulting in violent extraction. This was corrected jointly by U.S. and British manufacturers, resulting in a very efficient gun.

LIGHT MACHINE GUNS

LIGHT MACHINE GUNS were a by-product of World War I, the result of needs demonstrated early in the seesaw trench fighting for a light automatic weapon adaptable to both defense and offense. They weighed from 16 to 28 pounds and were operated either by gas or recoil. By the end of the war the terms "light machine gun" and "automatic rifle" were being used interchangeably for most makes.

Britain's gas-operated Lewis gun was produced in great quantities. Though its weight (26½ pounds) somewhat handicapped, the Lewis was used by both the British and French, and saw heavy service covering the Tommies as they mopped up German pillboxes with Mills bombs in the mud of Flanders. Its top-loading magazine carried 47 rounds—the largest quantity of any of the light guns carried by ground troops. A lighter version weighing 18½ pounds was produced for aircraft, and was also manufactured in the United States as a "flexible gun" for planes. The British also produced a 28-pound version of the Hotchkiss. It was gas-operated and fed by a 30-round strip for ground use; 50-round belts were used in tanks.

The French Chauchat probably was the most-used light machine gun on the Western Front. It was one of the first weapons thrust into the doughboys' hands at French training camps, and 34 000 of these guns were obtained by U.S. troops before the light Browning was made available near the finish. The Chauchat weighed only 19 pounds and was fed by a 20-round semicircular box magazine underneath the gun. It was the only Allied recoil-operated light machine gun and had an unusually long recoil of 5 inches. France's lightest machine gun was built for aircraft use—the gas-operated Darne, just under 16 pounds, which was belt-fed.

Germany, as would be expected, had a profusion of light machine

Captured light Maxim being operated by infantry of the U.S. 64th Regiment, 7th Division, in Meurthe-et-Moselle, October, 1918.

The Browning automatic rifle, originally termed "light machine gun," shown ready for action. By far the best gun of its type, the BAR weighed slightly over 15 pounds, used 20-cartridge magazines. Although 29,000 light Brownings were shipped to France from March to November 1, 1918, only 4,600 reached the front, starting with the Meuse-Argonne offensive in September.

guns—four principal types, all recoil-operated, weighing from 20 to 25 pounds. These were the Maxim; the Madsen, served by a 40-round box magazine vertically on top; and the belt-fed Bergmann and Parabellum, used mainly as flexible aircraft mounts.

The U.S. Browning was by far the best light machine gun (or automatic rifle) of the war—though by Pershing's dictum it saw little action. Weighing only 15 pounds, it was gas-operated and used a 20-round box magazine. The light Brownings came into production in February, 1918, but embarking divisions were not equipped with them until after July 1. Nearly 70,000 of these guns were produced during 1918, of which 29,000 were shipped to France before November 1, and 4,600 were actually used at the front. The light Browning, with some improvements, survived into another war.

French Chauchat automatic rifle manned behind a barricade in Alsace, by men of the U.S. 137th Infantry Regiment. Loader is about to insert a new crescent-shaped cartridge magazine under the weapon.

French 37mm gun, Model 1916, in firing position on parapet of a second-line trench in Alsace, June, 1918. It had a maximum range of a mile and a half, and some claimed it was more accurate than a rifle at ranges over 1,000 yards. Used as a machine gun sniper, it fired an explosive shell with delayed fuse that would pierce .7-inch armor plate at 2,500 yards. Maximum possible rate of fire was 35 rounds per minute.

TRENCH ARTILLERY

CERTAIN WEAPONS THAT ARE technically artillery are covered in this section, since they were prominently identified with the infantry in the warfare of the trenches.

One of the great weapons in this category was the French 37mm gun, introduced in 1916. It was an answer to the machine gun, whose withering fire mocked the infantryman from distances that effective rifle fire could not reach. The deadly accurate "37" was a true field gun, but light enough to move right along with the infantry for close support. Accuracy was claimed at more than 1,000 yards, and its delayed-fuse shell could penetrate .7-inch armor at 2,500 yards. It was like a junior edition of the French "75," equipped with a similar breech mechanism. Not a one-pounder as some have tagged it, the "37" fired a heavier shell, and under perfect conditions could achieve 28 to 35 rounds a minute. It was cocked by hand for the first round, after which the counterrecoil of the barrel cocked the gun after each firing. It took either a high-explosive shell or a shrapnel canister of 32 lead balls, which formed a cone-shaped pattern that was effective against personnel at 75 yards.

The "37" infantry gun was usually handled by a three-man team, but could be operated by two men—one keeping it aimed and the other loading and firing. The French also produced it in large quantities as the main armament for the light Renault tanks. The tank gun was loaded, sighted, and fired by one man. The "37," which also could be set on two wheels, was adopted by the United States Army as its lightest field gun. It modified the carriage (M1916A1) to provide hinged joints for the trails so they could be folded to form a pack load for pack transportation.

Positions of gun crew for the "37": sergeant in charge of piece, loader, gunner, and officer in charge of platoon. The "37" was adopted by the U.S. Army as its smallest artillery piece. Often erroneously called a "1-pounder," it fired either a high-explosive shell or a low-explosive fixed canister shell that weighed 1.59 pounds and carried 32 lead shrapnel balls. Muzzle velocity was 1,276 feet per second.

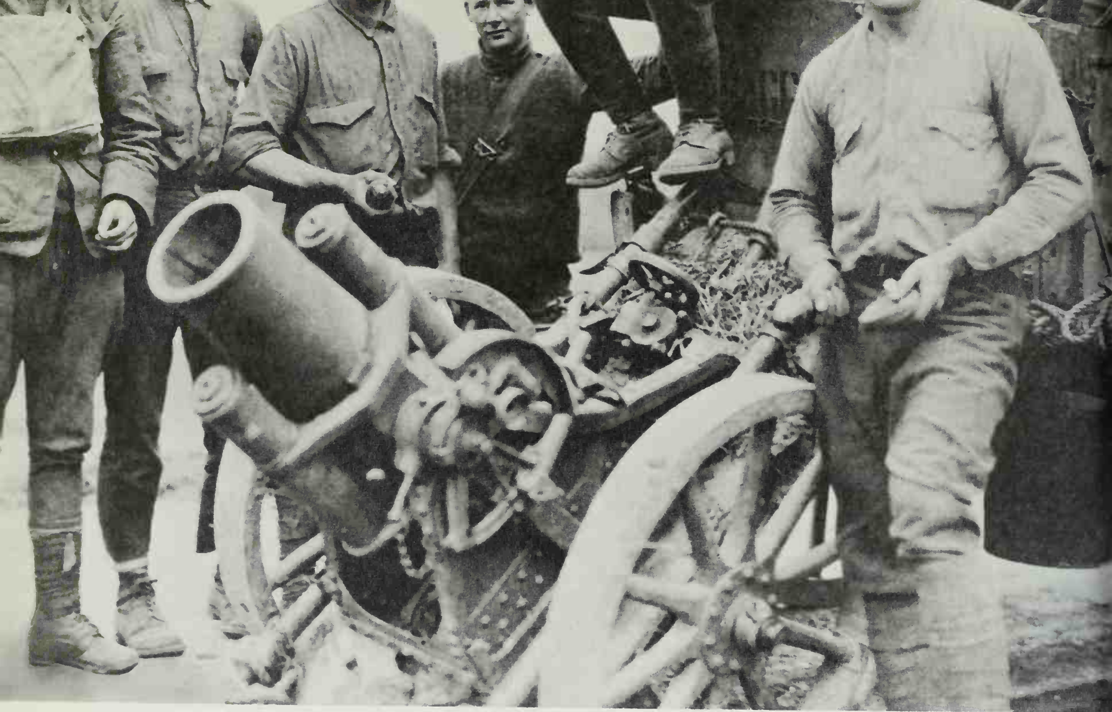
GERMAN TRENCH MORTARS

IT WAS IRONIC that in a war notable for innovations by science, a discarded weapon nearly two and a half centuries old had to be dusted off for the siege war of the trenches. It became one of the most important. The mortar—a short-range artillery piece that was devised to throw huge bombs in the classic sieges of forts—was introduced in 1673 by the Dutch Baron Van Coehoorn. The "coehorn mortars," as they came to be called, fell into disuse after the wars of the eighteenth century.

Germany had about 150 modern trench mortars (*Minenwerfer*) at the outbreak. Of short range but high, curved trajectory, they had been designed to sweep the opposite slopes of ridges around their forts in the Moselle region near Metz. But the forts were not threatened. and since the trench lines had stabilized in France at points only a few hundred yards apart, the Germans installed the mortars in their first-line trenches toward the end of 1914. Each day they destroyed defense works that the French had constructed at night.

The Germans were masters with the trench mortar from beginning to end. The principal pieces were the 76mm light (*leichter*), the 170mm medium (*mittlerer*), and the 250mm heavy (*schwerer*) *Minenwerfer*. All were engineered with precision, rifled, and equipped with recoil mechanisms. With pinpoint accuracy, they could hit enemy positions too close to the line for artillery fire.

Mobility enabled the Germans to make extensive use of trench mortars as attack weapons. For the great offensive opened on March 21, 1918, the 18th Army assembled 835 mortars, two-thirds of them medium and heavy, on a front of 12½ miles. The chief *Minenwerfer* officer and his staff began preparations at the scene more than a month in advance. The mortars were moved stealthily by night into this apparently quiet sector on the Somme. Shelters for crews and ammuni-

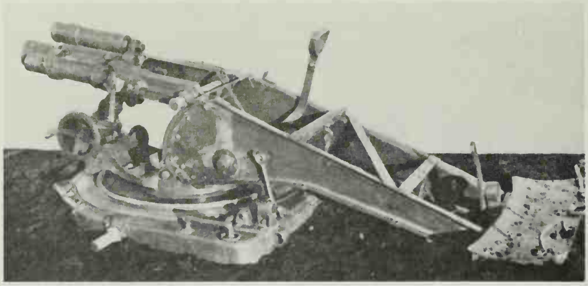


U.S. Marines of the 2nd Battalion, 5th Marines, with a 170mm German trench mortar captured in the Battle of Belleau Woods, June, 1918, which they are taking to salvage pile.

tion were built, followed by placing of the batteries in camouflaged positions. The principal mission was destruction of wire barricades in front of the Allied lines, and for this purpose a heavy or medium mortar was assigned to each 28 to 55 yards of front. Others were trained on the first and second, and parts of the third, Allied lines.

The *Minenwerfer* were a large part of the barrage of disaster that suddenly deluged the British lines with gas and high explosives. Of the three German armies attacking on a 42-mile front, General Oskar von Hutier's 18th made a resounding breakthrough. Horse-drawn medium *Minenwerfer* followed along with the infantry during the advance. A captured German document declared:

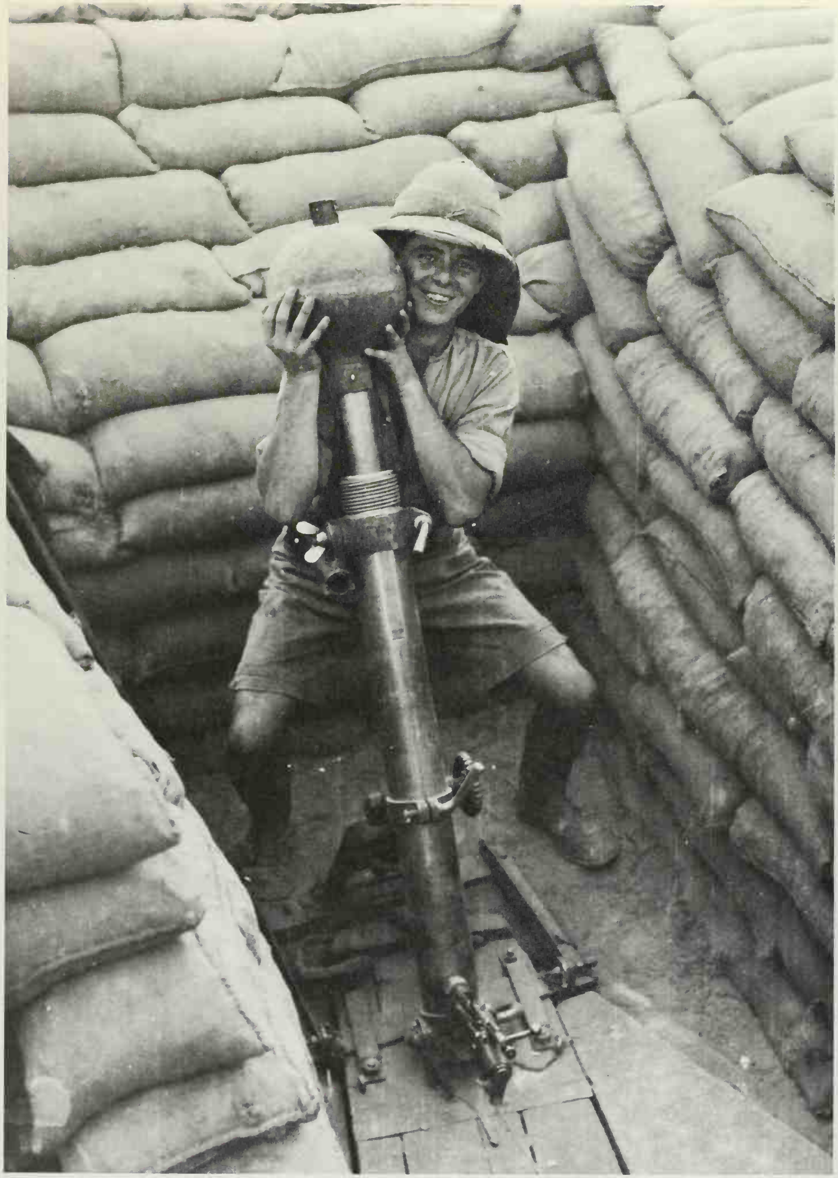
"We are much superior to the English and the French, not only from the point of view of accuracy of *matériel,* but also from the point of view of the possibility of its use in the war of movement. During the period which followed the attack of the 21st of March, the French utilized *Minenwerfer* for the first time for their counterattack on the 6th day of April, for which the preparation lasted several days; as for the English, after the 21st of March they used no *Minenwerfer* on the front of the 18th Army." (29)



Earliest German *leichter Minenwerfer* (light mortar) shown in operation. It was 75.85mm in bore diameter and 5.67 calibers long. The mortar projectile weighed slightly over 10 pounds and could be thrown 1,148 yards. Muzzle velocity was 295 feet per second. Weight with firing platform and wheels was 312 pounds. Elevation was 45 to 78 degrees. All the German *Minenwerfers* were rifled, the *leichter* having six right-hand constant-twist grooves.

At center, the improved 1916 model light *Minenwerfer* shown in flat-trajectory firing position as modified in early 1917. It had a 360-degree traverse and range in normal firing position was increased to 1,422 yards. Maximum range in flat-trajectory position was 995 yards. It also could be fired with wheels on and trail spade sunk in the ground.

The German method of transporting the light *Minenwerfer.*



A British "plum pudding" being loaded in an Ordnance M.L. 2-inch Mark I trench mortar, 1918. Varying sizes of ammunition were used. A crude but effective trench weapon was the "Livens Projector," which threw a 60-pound bomb containing 30 pounds of phosgene gas. These were deployed in large numbers and fired simultaneously at a common target.

ALLIED TRENCH MORTARS

GERMAN MORTAR FIRE WAS so devastating, even in 1914, that the Allies began feverish efforts to find an antidote. The only effective counterbattery against an enemy mortar placed close to the front lines was another mortar. Museums were combed for mortars of bygone wars. The earliest models resembled pieces of pipe. Men in the trenches even devised their own danger-laden mortars from shell cases, kegs of nails, and scoops of powder.

The French 58mm trench mortar No. 1 reached the front in April, 1915, followed later by a somewhat improved 58mm No. 2, which became France's standard light mortar for the war. American trench artillerymen in France, nearly all of whom underwent training with the "58-2" as well as the British Stokes and Newton mortars, recall the dangerous French weapon with little affection. The 58mm size was the diameter of the metal stem of the bomb, which fitted into the bore. The big 77-pound bomb was extended to the rear by a series of fragile fins surrounding the stem. In a word, the "58-2" was a short, smooth-bore gun into which was set a large bomb with fins along the exterior. Range was about 550 yards.

The French heavy trench mortar was a 240mm piece that was produced in both short and long versions. France did not develop a successful medium mortar until the 150mm Fabre appeared in 1918. It was mobile and, except for its smooth bore, resembled the German *Minenwerfer*.

British pieces included 2-inch, 4-inch, and 3-inch Stokes light mortars; the 6-inch Newton medium; and a long 9.45-inch heavy mortar that was copied from the French 240mm weapon. The 3-inch Stokes became a standard infantry weapon of the French, Italian, and American as well as the British armies. British-designed 6-inch and 11-inch Sutton

A 240mm (9.45-inch) trench mortar mounted for pony cart transport at Saint-Pol Trench Mortar School, July, 1917. The original of this mortar was designed by the Société Batignolles and weighed more than 3 tons. Later versions were manufactured in England and the U.S. Ranges varied from 1,200 to more than 2,000 yards with shells weighing from 150 to about 200 pounds.

mortars were developed by the U.S. government, but did not get into the war. The United States manufactured nearly 2,500 mortars of the Stokes, Sutton, and the 9.45-inch models. The heavily used 6-inch cast-iron mortar shells, weighing 40 pounds each without charge, were produced principally by American stove manufacturers.

Italy had a 58mm trench mortar that was lighter in weight and longer in range than the French weapon of similar size; a 70mm light mortar that threw a 42-pound bomb 1,100 yards; a 240mm piece with a range of 4,120 yards; a 320mm Samia mortar ranging 1,500 yards with a 130-pound bomb; and a 400mm heavy, which hurled a 580-pound bomb 4,470 yards. The Italian "400," largest of the war, weighed 25,700 pounds, and while it had roller wheels, it usually was transported by rail.

As a class, Allied mortars, in contrast to the *Minenwerfer*, posed great difficulties in transport and setting up. Though mobility was a prime need for these weapons, they were not mobile, nor were they designed for mobility. Timber platforms generally had to be constructed for the base. They had smooth bores and rigid carriages without recoil or brake mechanisms. Clinometers, goniometers, quadrants, and graduated plates were used to lay the piece.

Inventive American trench mortarmen were rapidly solving the mobility problem at the Trench Artillery Center in France as the war came to an end. A portable steel platform—half the weight of the conventional timber base—was developed for the heavy 240mm mortar. Two portable metal beds were devised for the 6-inch Newton, mounted on rubber-tired gun carts. The French finally introduced their mobile 150mm Fabre mortar in 1918.

A 3-inch Stokes mortar in action. It was produced in both England and the United States, and threw a 10-pound bomb about 1,200 yards. Both the light Stokes and the 6-inch Newton, which could toss a 50-pound bomb up to 1,800 yards, became the standard American "infantry howitzers."

Doughboy of the 2nd Battalion, 6th Regiment Infantry, has just fired a rifle grenade at Domèvre, Meurthe-et-Moselle. The grenade is propelled from the cup by gases from a blank cartridge. The rifle is a Springfield Model 1903.

RIFLES, CARBINES, AND PISTOLS

SINCE MUSKETRY BECAME AN ART of warfare, the rifle has been the soldier's best friend—his personal piece of artillery. It has often been said, with some justification, that the rifle has not been accorded proper credit for its part in World War I due to the spectacular upswing in artillery and machine guns and the advent of new weapons.

Yet some of the greatest organized and individual feats were performed with the rifle in both the opening and closing phases, when there was a war of movement. During the first days in August, 1914, dismounted Belgian cavalrymen decimated one of Germany's finest cavalry squadrons, which attacked repeatedly at Haelen, and British riflemen at Mons convinced the Germans that they were facing machine gun companies. In 1918, American Sergeant Alvin York turned in the most outstanding individual performance with an Enfield. And in between, during the long trench siege when machine guns overpowered the fire of the soldier's weapon, the rifle carried the bayonets of millions of men who advanced through the hell of no-man's-land.

The fastest, sharpest-shooting infantry of the war were the lost host of "Old Contemptibles"—the small, select army of British regulars who were largely sacrificed to the German mincing machine in the first few months of fighting. They were professionals with their Enfields, trained to fire with reasonable accuracy at 15 rounds per minute (some say 18) on targets 1,000 yards away. In the direct path of Von Kluck's invading army at Mons, the seasoned riflemen mowed down the Germans in thousands before they adopted more open formations to face what they believed were machine guns.

The most concentrated slaughter probably took place at the Anzac beachhead at Gallipoli when the Turks made suicidal charges starting at 3 A.M. on May 19, 1916. As described by Alan Moorehead in *Gallipoli:*

"Everywhere along the line the Turks jumped up from their hiding places and in a dark cloud swept forward over the broken ground. At most places the oncoming enemy had to cross two or three hundred yards before they reached the Anzac entrenchments, and so there was half a minute or more when they were exposed in the open and quite defenseless. Very few of them survived even that amount of time." After an hour of indiscriminate killing, Moorehead wrote, the Australians and New Zealanders began to withhold their fire until a Turkish officer had assembled the full company of his men in the open. Then all were destroyed together. "Here and there some few of the Turks did manage to get into the Anzac trenches, but they survived only for a few minutes; there was a quick and awful bayoneting and then the tide receded again.

"As daylight broke the battle assumed the character of a hunt, with the Turkish officers serving in the role of beaters driving the game on to the guns. A wild, almost berserk excitement filled the Australian and New Zealand ranks. In order to get a better view many of the soldiers jumped up and sat astride the parapets and from there they blazed away at the screaming mass of Turks before them. The Anzac soldiers who had been held in reserve could not bear to be left out of the fight; they came pressing forward offering to pay for a place on the fighting line. In one trench two soldiers actually fought one another with their fists for a vacant position on the parapet . . ."(27)

When action was broken off at midday, some 10,000 Turks had fallen.

In general, cavalrymen carried the shorter carbines, which usually had an effective range of about 800 yards. An exception was the rifle-firing British cavalryman. By war's end, with the cavalry largely useless, dismounted squadrons were being used in many instances.

Most rifles weighed about 9 pounds and bayonets averaged slightly under a pound. Nearly all had magazines carrying 5 rounds, with the British Lee-Enfield being the notable exception, carrying 10 rounds. All had bolt actions. The barrel lengths ran anywhere from 24 to 32 inches, and calibers varied between .256 and .315 inches.

Britain's Short Magazine Lee-Enfield Marks I to III caliber .303 and the U.S. 1903 Model caliber .30 ran a close race for honors as the outstanding rifle of the war. The U.S. War Department in 1919 stated flatly that the Springfield "is probably the best infantry rifle in use in any army." Speaking of both the Springfield and the modified Enfield produced for U.S. soldiers, it added: "The American troops were armed with rifles that were superior in accuracy and rapidity of fire to those used by either their enemies or the Allies." The case seems to have been overstated slightly in view of the fact that the American Enfield was simply a modification of the British rifle, chambered to take the U.S. .30-caliber ammunition.

As an all-round soldier's weapon the Short Enfield probably had a slight edge. It was dependable, ruggedly constructed, easily maintained —the answer to the muddy abuse of trench warfare, 1914–1918. It cocked on the closing of the bolt. Despite the fact that its rear-locking bolt was weak in theory, and old-type rim cartridges were used, its ease of action accounted largely for the extremely rapid rate of fire obtained. The Enfield was the only rifle in the war sporting a 10-cartridge magazine—another factor in the rate of fire. It was sighted from 200 to 2,000 yards' range. Its pistol-grip handle mated perfectly with the hand for an efficient job of bayoneting. The bayonet was 1 foot 4.2 inches long and weighed 1 pound 4 ounces. Weight of the rifle was 8 pounds 10½ ounces. The British had been disappointed in a short-barreled carbine used by their cavalry in the Boer War. They wisely shortened their fine Lee-Enfield rifle to 3 feet 8½ inches to accommodate both the infantry and cavalry. This is the rifle that supermarksman Alvin C. York used to kill at least 20 German soldiers and capture 132 others.

The American Springfield .30-caliber Model 1903, like the rifles of many nations, was based on the Mauser design. While the bullet was slightly smaller than the Enfield's, the U.S. standard rifle was superior in accuracy and range, being sighted from 200 to 2,850 yards. Like the Enfield, it proved its sturdiness on through World War II, and was a favorite sniping rifle of the Marines on Guadalcanal. The rimless cartridge, developed in 1906, held a 150-grain sharp-nosed bullet with a muzzle velocity of 2,700 feet per second (hence, the Springfield is often called the ".30-06"). Charged with a 5-round clip, the M1903 was among the lightest of the war's principal rifles, weighing 8½ pounds, and its length was the shortest—3 feet 7¼ inches. The bayonet was 1 foot 4 inches long and weighed a pound.

When America declared war, some 600,000 Springfields were on hand—enough to equip an army of one million. Also in stock were 200,000 heavy old .30-caliber rimmed Krag-Jorgensens (.30-40 "Krags") which were used for training. The United States needed a production of more than the 1,000 Springfields per day that could be expected, and again fell into some good luck. As with the 18-pounder field gun, several U.S. plants were completing large British orders for the .303-caliber Enfield rifle. The design was easily converted to take Springfield .30-caliber ammunition and 2,300,000 U.S. Enfield Model 1917 rifles were produced by Armistice.

Germany's famous old Model 1898 Mauser fired a heavy 7.92mm (.311-caliber) bullet and was sighted from 400 to 2,400 meters. But it was half a pound heavier and an unwieldy 6 inches longer than the British and U.S. rifles—4 feet 1½ inches. The rapierlike bayonet weighed only 14 ounces but was 1 foot 8.35 inches long, topping any on the Western Front. The Germans prudently shortened the '98 Mauser for World War II. Generally they had only a battle sight on the Mauser, but they had fine telescopic sights in quantity for their snipers, even in the earliest days. They picked off many a Tommy and *poilu* who moved at the wrong time in the trenches.

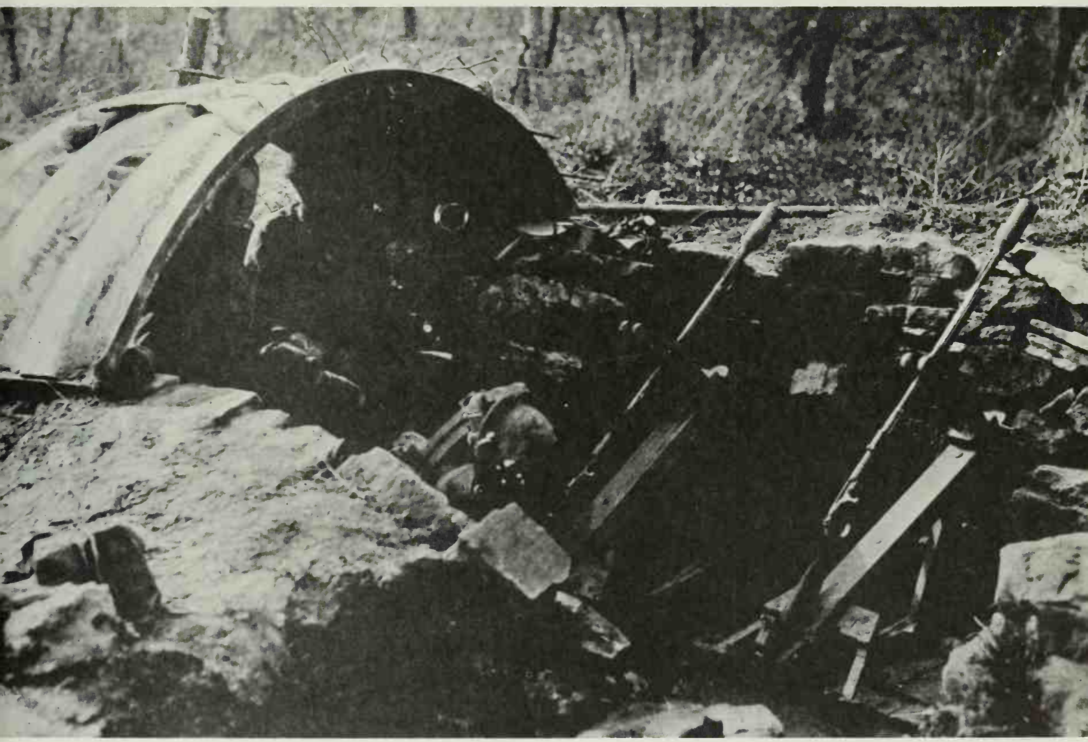
Except for the Turkish Mauser, the French Lebel was the heaviest of the rifles, weighing 9 pounds 3 ounces. Along with the Austrian Mannlicher, it also fired the heaviest bullet—8mm or .315-caliber, to match their machine gun ammunition. The Lebel was a troublesome

Crack French Alpine Corps troops with Lebel rifles.

weapon, especially in the earlier models—1886–1893. They carried 8 cartridges in a spring-loaded tube under the barrel until converted in 1916 to take a 5-round clip. The Lebel had no safety catch. Its range was comparable to that of the Mauser, but it was even longer—4 feet 3½ inches.

The Austrian Model 1895 Mannlicher was a beautiful rifle of substantial range. It was sighted for ranges from 328 to 2,843 yards and fired an 8mm cartridge from a 5-round clip. Weight was 8 pounds 5½ ounces, and length, 4 feet 2 inches. Italy's Mannlicher-Carcano used

Special racks devised to mount French Lebel rifles for grenade launching.



a 6-round clip of 6.5mm (.256-caliber) rounds, and featured a progressive twist in the rifling. It weighed 9 pounds and was about the same length as the Austrian rifle.

Russia had the dependable old Mosin-Nagant Model 1891 7.62mm (.30-caliber) rifle (also known as the "Nagant Three Line"), which lasted on into the early years of World War II. The Nagant weighed nearly 9 pounds, measured 4 feet 3.8 inches—longest in the war—and was sighted for ranges from 400 to 2,700 "paces."

The shortage of rifles as well as artillery and ammunition contributed heavily to the collapse of Russian armies. In the spring and summer of 1915, following Mackensen's Dunajec breakthrough with Austro-German forces, Russia lost all of Poland and Lithuania and a million men. German soldiers told of capturing Russian infantrymen armed only with clubs, waiting for comrades to fall and yield their rifles. In Moscow, the Russian foreign minister pleaded with French Ambassador Maurice Paléologue to ask Paris for 1,500,000 rifles merely to arm the regiments at the front. Russian production was only 50 000 a month. General Bielaiev, the Russian chief of staff, told the French ambassador:

"In several infantry regiments which have taken part in the recent battles at least one-third of the men had no rifle. These poor devils had to wait patiently under a shower of shrapnel until their comrades fell before their eyes and they could pick up their arms. . . . It is quite true that our *moujiks* have an amazing capacity for endurance and resignation, but that doesn't make it any less ghastly. . . . Today, with its artillery and infantry dumb, our army is drowning in its own blood." (30)

U.S. Springfield M1903 ".30-'06" rifle.

Except for the United States and Great Britain, most belligerents modified their rifles into short carbines for cavalry use. The Italian M91 had a folding bayonet, but a different model for special troops was issued at the end of the war. The French Lebel was not cut down to carbine size, but the Berthier carbine was chambered to use 8mm Lebel ammunition. It took a knife bayonet. The 1892 Berthier used a 3-round clip and was modified in 1916 to use a 5-round clip.

A standout among the hand guns was the world-famous German Parabellum (Luger) 9mm automatic pistol, Model 1908, highly prized as a souvenir by Allied soldiers. The British issued their reliable .455-caliber Webley revolver, a man-stopper, but short in range, and, of course, there was the powerful American Browning-Colt Model 1911 .45-caliber automatic, the most effective in the war. Because of production problems the United States was never able to meet demand for pistols to equip the doughboys. A .45-caliber Smith & Wesson revolver and a similar Colt revolver were put in production in the fall of 1917.

These Northamptonshire Infantrymen are making the best of a soldier's life in a quiet sector in France. Rifles are 1916 Mark III Enfields.

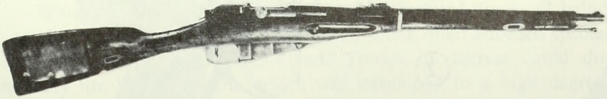
The granddaddy of all World War I shoulder rifles was this German antitank rifle, confiscated by New Zealand gunners in the capture of Grevillers in August, 1918. A Mauser, it fired a 13mm (.53-caliber) armor-piercing bullet and its 35-pound weight was difficult to handle. At the end of the war the Germans were desperately trying to get into production the "Tuf" 13mm machine gun for antitank use.

TECHNICAL NOTES: At the end of the war the U.S. was moving toward greater firepower, particularly for aircraft armament, and the .50-caliber Browning machine gun was developed. Tests of captured German 13mm antitank rifles in 1919 showed the German cartridge to be superior in ballistics to the U.S. .50 caliber. The U.S. cartridge was redesigned, requiring modifications in the Browning to handle the more powerful load. (24)

German cavalrymen experienced the first setback for this outmoded arm of war when one of their finest squadrons, making repeated charges with lance and saber at Haelen, was slaughtered by Belgian rifle fire. Despite repeated failures, the cavalry grew abnormally in most armies until an estimated 1,000,000 horsemen were assembled on all fronts by the middle of 1916. Cavalry in most armies carried short carbines.

The principal shoulder weapons of World War I, from top to bottom: German 7.92mm Mauser, Model 1898; Austrian 8mm Mannlicher, Model 1895; Russian 7.62mm Moisin-Nagant (or "Three Line Nagant"), Model 1891; and Italian 6.5mm Mannlicher-Carcano, Model 1891 (three-quarter right view, with rear sight leaf up and bolt open).

Carbines of the principal belligerents: (1) Russian Moisin-Nagant 7.62mm carbine, Model 1910; (2) Italian 6.5mm Mannlicher-Carcano, Model 1891, with folding bayonet; (3) later Italian *Truppe Special* M91 Mannlicher-Carcano with bayonet; (4) German 7.92mm *Karabiner* 98 Mauser, with bayonet; (5) Austrian 8mm Mannlicher, Model 1895; and (6) French Model 1916 Berthier, converted to take a five-round clip. Great Britain and the United States issued their short rifles to the cavalry.



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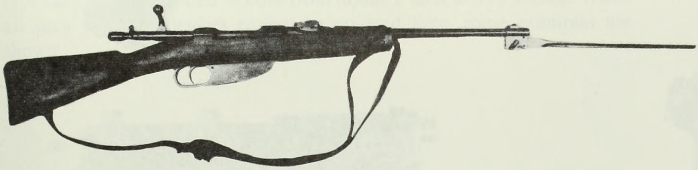

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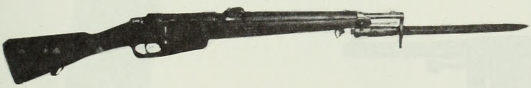

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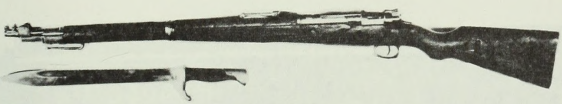

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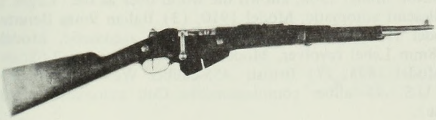

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A few of the world's best pistols date from World War I. Some representative side arms for close in-fighting are shown here: (1) German 9mm Parabellum, automatic loading pistol, Model 1908, known the world over as the "Luger"; (2) Italian 9mm Glesenti automatic, Model 1910; (3) Italian 9mm Beretta semiautomatic, Model 1915; (4) Austrian 9mm Steyr automatic, Model 1912; (5) French 8mm Lebel revolver, Model 1892; (6) Russian 7.62mm Nagant revolver, Model 1898; (7) British .455-caliber Webley Mark VI revolver; and (8) U.S. .45-caliber commemorative Colt automatic (note Belleau wood plaque).

With normal communications blasted in forward areas, all belligerents developed codes of fireworks signals, which often afforded spectacular color displays in no-man's-land. Troops in distress could direct artillery fire by this means, which was developed to a high degree of efficiency. The first "Very" pistols were issued to the B.E.F. shortly after the First Battle of Ypres, early in the war, and most signaling pistols thereafter were characterized "Very." They generally used a shotgun-type cartridge and varied in bore from about 1 inch to 1½ inches. While all such signaling devices cannot be covered here, some examples are shown.

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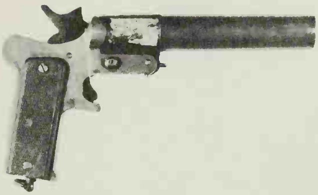
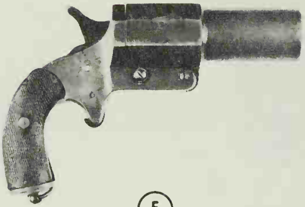

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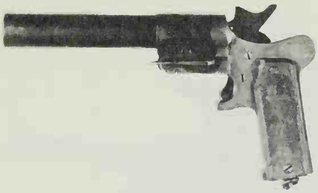
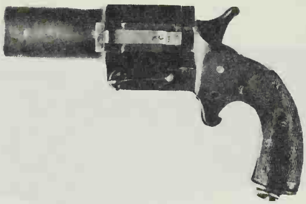

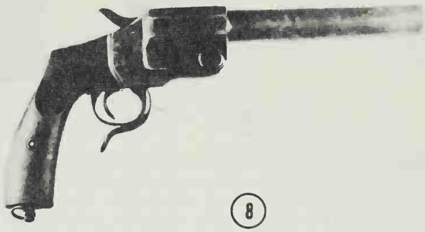

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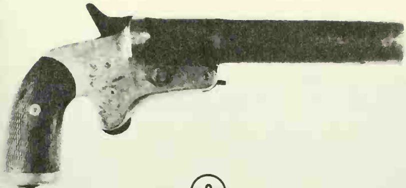

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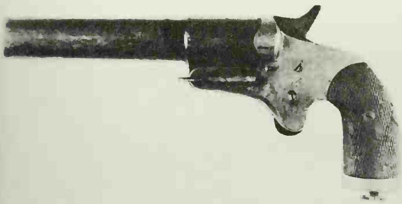
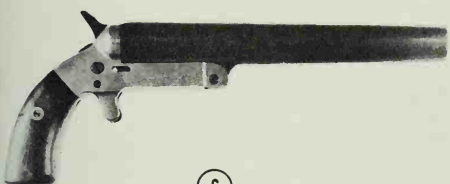
Spectacular displays of green, red, white, or multicolored fireworks often lit up the skies of no-man's-land when an attack was launched, or when infantry in trouble signaled artillery to lift their barrage or to open up. Although star shells and flares often were fired by artillery, much of the signaling, worked out with codes, was done with special pistols. Shown here are (1) British Mark III 1-inch Webley & Scott pistol; (2) short British No. 2 Mark I (1918) Webley & Scott 1½-inch pistol; (3) French 25mm 1917 model; (4) French 25mm Chobert St. Etienne 1918 model; (5) French 35mm model; (6) U.S. 10-gauge Mark III pistol; (7) U.S. 25mm Mark IV, copied from a French model; (8) German 27mm signal pistol; and (9) a British signal gun—No. 1, Mark I, Webley & Scott, 1½-inch caliber—used to fire long shells containing parachute flares.





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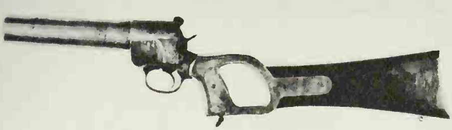


Aerial view of a cloud-gas attack on the Western Front, 1915. Some have identified this scene as the first gas attack, but it is doubtful, since the Ypres attack began just before dusk.

CHEMICAL WARFARE

The Green Cloud of Death at Ypres

April 22, 1915, was a brilliant spring day around the Belgian town of Ypres. The flood tide of the previous November's great battles had ebbed, and the trench fighting could be heard only intermittently from the rim of the Allied salient six miles away. Some neighboring villages had not yet been touched by war. This was now a "quiet sector," and in the town itself, still recovering from what was to be named the First Battle of Ypres, a band still played in the marketplace that was maintained for the troops.

At 5 P.M. a lone German airplane droned over the lines and dropped flares in the twilight, signaling the opening of a Pandora's box in the arsenal of war weapons. French Territorials and African troops holding a section of the Allied line saw a yellowish-green cloud suddenly form in front of the German trenches. As a gentle breeze wafted the strange vapor slowly forward, the Germans mounted a tremendous bombardment, showering the Allied lines with shrapnel and demolishing Ypres and all villages in the salient. When the chlorine mist released from cylinders in the German trenches enveloped the French infantry, they became a surging mass of agonized fugitives. A French army doctor on the fringe of the gas cloud reported: "I had the impression that I was looking through green glasses. At the same time, I felt the action of the gas upon my respiratory system; it burned in my throat, caused pains in my chest, and made breathing all but impossible. I spat blood and suffered from dizziness. We all thought we were lost. . . ."(28)

As described by an officer in the nearby British trenches: "It was a new and devilish engine of warfare, one for which white troops were wholly unprepared, and which held for these brave Africans a sheer terror of the supernatural—one cannot blame them that they broke and fled. In the gathering dark of that awful night they fought with terror, running blindly in the gas cloud, and dropping with breasts heaving in agony and the slow poison of suffocation mantling their dark faces. Hundreds of them fell and died; others lay helpless, froth upon their agonized lips and their racked bodies powerfully sick, with tearing nausea at short intervals. They too would die later—a slow and lingering death of agony unspeakable. . . ."(32)

A four-mile gap several miles deep was left in the Allied line without a living defender, and the British left flank adjoining the French sector was exposed completely. The German troops, however, advanced slowly behind the cloud in their crude respirators, fearful of their infernal creation. A Belgian soldier reported seeing German officers hitting their men with the blades of their sabers in order to make them advance faster. Nightfall prevented them from discovering the astonishing success of the gas attack and fully exploiting the Allied breach.

Thus was demonstrated the first effective use of poisonous gas in "modern" chemical warfare—misused and distrusted by the German authorities themselves. In an earlier experiment the effect of tear-gas shells in a local attack against the Russians in Poland (January 31, 1915) had been nullified by the intense cold.* The German command's distrust in the value of this innovation resulted in no preparations to pour in large reserve forces in the event of a break in the Allied lines. This failure to exploit their surprise key to breaking out of the trench deadlock, like the initial misuse of the tank by the British in 1916, ranks as one of the more serious military blunders of World War I.

The Germans launched their second gas attack with limited success two days later against the Canadians in the Ypres salient. The Canadians gave ground slowly, using makeshift means of protection such as handkerchiefs and linen bandoliers dipped in water. Within a few days the Allied troops were equipped with a crude form of respirator. Thenceforth, the use of gas by both the Germans and the Allies progressed throughout the war, along with improved protection devices.

Developments in Gas Warfare

The only major German success with the cloud-gas attack was in the breakthrough on the Dunajec River on the Eastern Front. On May 2, 1915, with 14 divisions and 1,500 guns against only six Russian divisions with no rear trenches, Mackensen advanced behind a cloud of gas after a four-hour bombardment. The technique also backfired on several occasions. A Russian account tells of a gas attack near Warsaw in which the Germans, apparently wearing inadequate respirators, advanced too quickly and were poisoned with their own gas along with the defenders in the Russian trenches.

On the Western Front the technique boomeranged because the prevailing winds were more often favorable to the Allies, who quickly took

* After the war, the Germans revealed that they had experimented with an irritant gas in shrapnel shells at Neuve-Chapelle on October 27, 1914. Its effect was so feeble as to go unnoticed. The French also were reported to have experimented with irritants at about the same time.

advantage of it. The first British gas attack, however, was a tragic blunder. On September 25, 1915, in the Battle of Loos, 150 tons of chlorine gas was released from more than 5,000 cylinders, much of which wafted back to poison the British in their own trenches or drifted aimlessly about in no-man's-land.

The Germans developed new gases in 1916 and 1917 and perfected the gas shell, followed closely by the Allies. Both sides employed forms of gas in two general classes: lethal agents, which could kill, or permanently damage the lungs; and gases that could put a man out of action immediately, though temporarily. The first class included acute lung irritants such as chlorine, phosgene, and chloropicrin, and paralysants (prussic acid, used by the French and British), which could be immediately fatal by their effects on the nervous system. The second class included tear gas and sensory irritants to the eyes, nose, and upper respiratory passages.

The Livens Projector made its first appearance in the Allied attack at Arras in March, 1917. Resembling a piece of cast-iron pipe, it was one of the crudest mortars in trench warfare, but it fired a deadly 60-pound bomb containing 30 pounds of phosgene. In surprise attacks large numbers installed together and fired simultaneously at a common target produced very high casualties before respirators could be adjusted.

Mustard gas was responsible for the majority of gas casualties in the war. It was introduced by the Germans in July, 1917. Less easily detected than other gases because of its slight smell, mustard gas had a delayed effect, blistering the skin, eyes, and respiratory tract some hours after exposure. Its high persistency rendered large areas untenable except at cost of heavy casualties. Contaminated soil continued to produce dangerous concentrations with rising temperatures for days or even weeks. Mustard gas was used successfully by the Germans at Bourlon Wood in 1917, at Armentières in April, 1918, and in substantial quantities in the big 1918 offensive. By war's end, it was being used by the Allies.

Protection Against Gas

Caught totally unprepared in the first attacks, the Allies were reduced to the use of pads of cotton dipped in a chemical solution and tied over the mouth and nose. This was followed by flannel helmets saturated with neutralizing solutions that protected both eyes and lungs. As new gases appeared, additional neutralizers had to be developed. All combatants finally adopted respirators, which filtered air through activated charcoal and various chemicals to neutralize specific gases.

The most common British and American gas masks were characterized by the lack of airtight fit. The consequent dependence on noseclips and mouth inhalation through the hosepipe gave rise to serious problems of "gas mask fatigue" during prolonged German attacks.

The advent of gas greatly complicated wars to come, creating the need for special equipment, training, alarms, gasproof shelters, and elaborate systems of clearing gas and decontaminating ground after an attack.

Protection against gas was at first very crude, progressing from a gauze pad of chemically treated cotton tied across the mouth and nose, to a gray felt helmet with a talc window but no mouthpiece, and, finally, to true respirators with activated charcoal filters and chemicals to neutralize specific gases. These British machine gunners with their Vickers weapon in the Battle of the Somme, July, 1916, are wearing flannel gas helmets saturated with neutralizing solutions.

Gas as a Weapon: An Appraisal

The effectiveness of gas in World War I is indicated by the fact that it accounted for an estimated 800,000 casualties: Russia, 275,000; France, 190 000; Great Britain, 181,000; Germany, 78,763; United States, 70,552; and Italy, 13,300. Though a late arrival in the conflict, U.S. troops suffered a higher percentage (27 percent) of casualties from gassing than any other combatant. The first attack on American troops took place on the night of February 25, 1918, near Seicheprey, when about 175 German projectiles containing phosgene and chloropicrin inflicted heavy punishment. During the next eight months the Americans were subjected to many such attacks, resulting in a gas casualty total approaching that suffered by the Germans over the entire war.

The art of chemical warfare became rapidly sophisticated with the perfection of gas and smoke shells. The French surprised the Germans with a toxic gas shell at Verdun, and the Germans countered with the deadly "greencross" shell, filled with phosgene, which silenced many French batteries. As the war progressed, it was recognized that mere infliction of permanent casualties was secondary to the objective of temporary demoralization and paralysis of the enemy during attack. Along with tear gas, an irritant that caused sneezing and nausea and was dispersed as a fine dust was introduced. In 1918 a typical German attack—with artillery using 75 to 80 percent gas shells—would direct mustard gas at the flanks of the enemy and a low-persistence gas on the front just prior to attack. The initial successes of the final German offensives were attributed in large part to fearful gas bombardments, which forced continuous wearing of masks with accompanying fatigue, hunger, demoralization, and loss of efficiency.

Germany invited world odium by introducing gas in violation of international understandings. In the intervening years since that worldwide cry of outrage, the merits of this form of warfare have been the subject

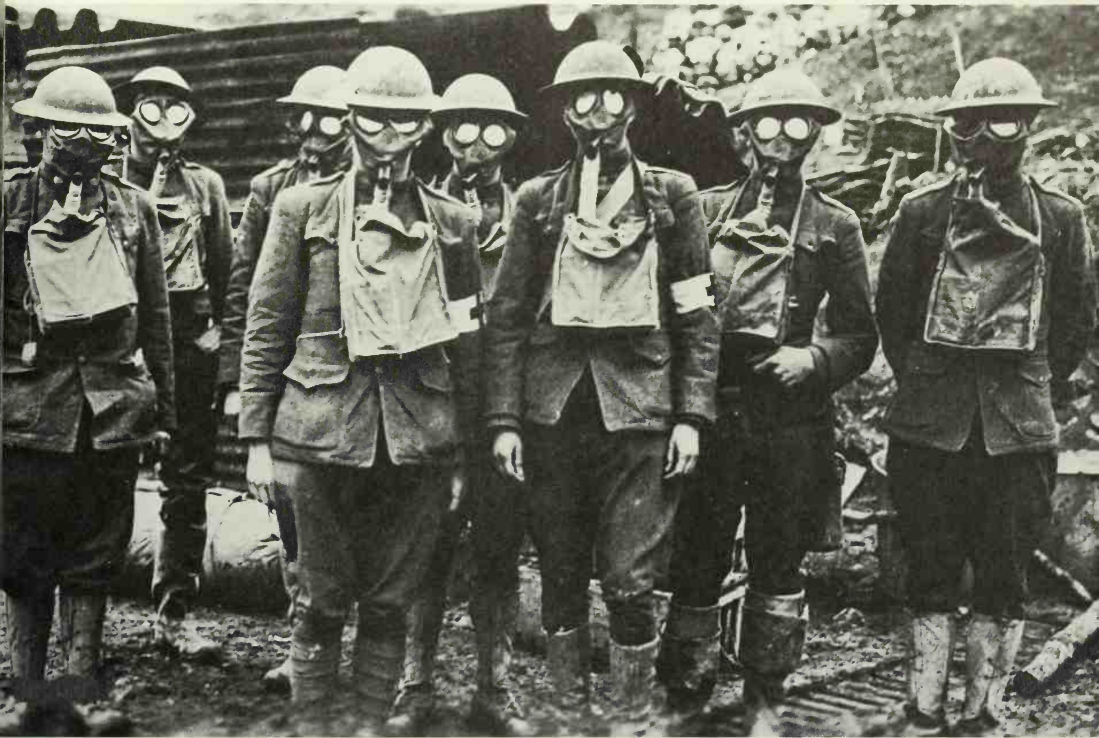
of continuing controversy. Of the 181,000 British gas casualties in World War I, less than 4 percent resulted in death as opposed to 25 percent mortality among other battle casualties. Only 2 percent of American gas casualties resulted in death, and permanent damage from gassing was surprisingly low.

The anger of the unprotected Allied soldier of 1915 was vented on the battlefield of Ypres, described by Cyril Falls (14) as "one of the most murderous battles of the war" for its size—a "soldiers' battle" in which the higher commands could exercise little influence in the days after the

Instructor demonstrates the cleaning of eyepieces in a gas mask drill for men.

gas attack. To the frustrated man in the trench, this sinister new weapon symbolized more than torture and death. These he lived with in many forms. But science now had produced a formless creature that crept up silently and embraced him with insidious suffocation against which he was powerless to fight. It symbolized the death of individual bravery, initiative, and skill.

Germany had invented the surprise key to routing the enemy from his earthworks and the return to mobile warfare, but threw it away at the Second Battle of Ypres. As it turned out, the world's chemical resources were marshaled against her, and gas, like the atomic bomb and the missile, simply joined the long list of terrible weapons devised by man to maim and kill.



American soldiers equipped with a late-type box respirator gas mask. Neither the American nor British masks were airtight, and design hindered freedom of movement.

Artillerymen at Mont St. Eloi conduct a gas mask drill for their horses. Although their eyes were not affected as acutely by gas as those of humans, unequipped horses were poisoned by the hundreds.

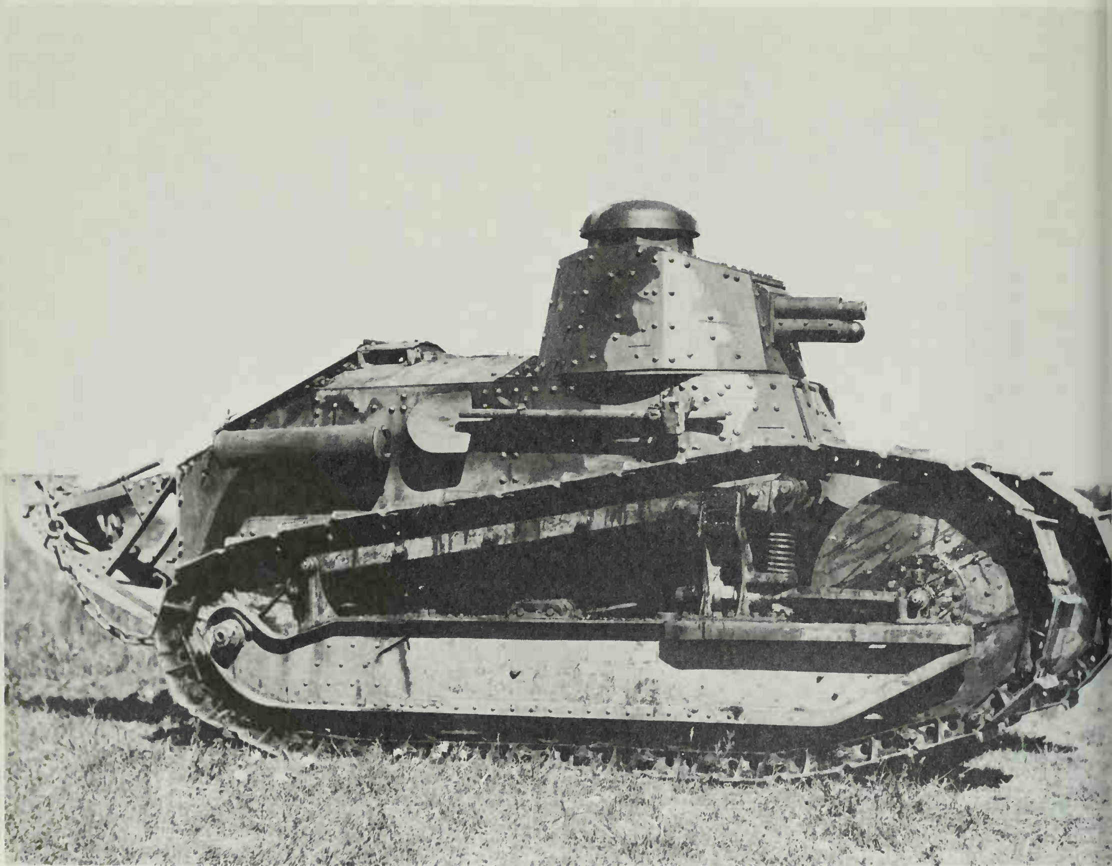
American battery of French 155mm howitzer under gas shell attack while firing toward Châtel Chehery in the Ardennes, October, 1918. Gunner pulling lanyard in foreground is wearing a French Tissot gas mask, the best in the war, permitting maximum freedom of movement. This crew of the 108th Regiment Field Artillery, formerly of the Pennsylvania National Guard cavalry, named their gun "Quaker Maid."

A corporal of the U.S. Army Chemical Warfare Service, 78th Division, holds a gas grenade in his right hand; in his left are a signal pistol and a signal flare.

German searchlight in action, operators wearing gas masks.

Smoke pots being set off by an American soldier in the Argonne Forest in October, 1918. Smoke shells also were used extensively in the later stages of the war to shield movements from enemy troops.

The American version of the light Renault can be distinguished by the steel wheels (the French were wooden) and octagonal-shaped turret, instead of round. This is the 37mm gun model. Note tail that assisted in trench crossing, and was used for carrying drums of fuel and other equipment when not in combat.



THE TANK

Plowshares Beaten into Swords

Introduction of the tank by the British radically altered the course of the war and hastened its end. It knifed through the hidebound military thinking of rusty old wars, changed the organization of all great armies, and rewrote the tactical doctrines to be employed in future conflicts.

Primitive "vehicles" were used as early as 1200 B.C. In 281 B.C., Pyrrhus trampled the Romans at Heraclea in a tanklike attack with his battle elephants. In A.D. 1599, Simon Stevinus, the inventive Dutchman who devised the sluice-system defense for the Netherlands, built two wheeled landships designed to sail along the seashore. Even Leonardo da Vinci designed a circular fighting vehicle, which never got beyond the drawing board. When the bullet forced the addition of heavy protective armor, the evolution of a mobile fighting machine had to await the displacement of muscle power by the industrial revolution. The internal-combustion engine plus the caterpillar track eventually provided the solution.

In an ironic twist of Isaiah's prophecy, the British literally beat plowshares into swords, forging an American agricultural tractor into the military "tank." The project was marked by obstacles and frustration—not from enemy action or lack of know-how, but from an incredible official resistance within, for the military intellect of World War I was too often slow in imagination, quick in skepticism. Between 1907 and 1914 several inventors had proposed varying schemes for converting tractors into armored vehicles, all of which were duly pigeonholed in the British War Office. (One design, dating to 1912, was said to be superior to the 1916 tank.)

The issue finally was forced by the persistence of an engineer officer, Lieutenant Colonel Ernest D. Swinton, who was sent to France as official observer for the British government shortly after the outbreak of war.

Swinton had already formed an opinion on the potential defensive power of the machine gun from his studies of the Russo-Japanese War, a factor that had been given little weight in the war councils of the combatants. This potential became reality with the conflict barely two months old. By early October, 1914, the grim lines of a long siege of stalemate and attrition were etched from Switzerland to the sea.

On October 20, 1914, Swinton, who had taken a keen interest in experiments with the Holt tractor, proposed development of the tractor into a mobile armored "machine gun destroyer," capable of smashing through wire entanglements and crossing wide trenches. Although his proposal fell on deaf ears at the War Office, the scheme attracted Winston Churchill, who, as First Lord of the Admiralty, was experimenting with armored cars to enable naval detachments to cross broken ground and trenches on the Belgian coast. A Landships Committee was formed under the navy's wing, and Churchill became a driving force behind the experiments. The committee floundered for several months in trials of machines with giant wheels, coupled steamrollers, and other contraptions before settling on the caterpillar track. By July, 1915, the news from France was increasingly ominous, and a joint army and navy committee was formed to begin work in earnest on Swinton's specifications.

"Big Willie"

Swinton required a machine that could climb a vertical face 5 feet high and cross a trench 8 feet wide. It was not until February 2, 1916, that a model was produced that could pass these tests successfully. It was designed by Lieutenant W. G. Wilson and Sir William Tritton. General Headquarters in France, reeling from the slaughter at Loos, cautiously ordered 40 machines, but this was raised to 150 by the War Office.

The ungainly Mark I, prototype of all British tanks in the war, was produced in "male" and "female" types, which were promptly dubbed "Big Willie" and "Mother." The term "tank" has an interesting origin. It could easily have come into being as "cistern" or "reservoir," for these terms were also considered in the search for a name as a cover for the secret project. The name, derived from its rhomboidal shape, was intended to mislead the inquisitive, who might see it in transit under canvas, or the enemy, who might intercept messages. That total secrecy from the enemy was maintained during the nearly two years from conception to battlefield was, in fact, remarkable. It even survived a demonstration for members of Parliament. The French, who coincidentally were developing their own *char d'assaut,* never learned about the project until advised by GHQ in June, 1916.

The Mark I was 26 feet long, weighed 28 tons, and carried a crew of eight. Its maximum speed was only 4 mph on level ground, and it averaged about 3 mph on the battlefield. Range of this gasoline-powered monster of its day was about 15 miles. It could cross a trench 10 feet wide, and a "tail" of spring-loaded wheels was hinged to the rear of this first model to improve balance and increase its trench-crossing capacity.

Guns were mounted in curved sponsons projecting from either side of the hull. Intended to work in pairs, the "male" tank was armed with 6-pounders to deal with heavy defenses, and the "female" was the man-killer with its four Vickers machine guns.

The all-round tracks were powered through a two-speed gearbox controlled by the driver, then through a differential with a second gearbox at each outer end of the half shafts. The drive then was carried by chain to driving sprockets in the rear. The requirement for a gearsman to operate the secondary gear levers on each side of the tank was the weakest point in the basic design. It was to prove the undoing of many of these early models in battle.

First Tank Attacks

The creators of the tank had painstakingly laid out its tactical plans. Ground suitable for its operations was to be selected with care; machines should be used en masse to break through a large sector of the front in the van of powerful concentrations of infantry and cavalry. Surprise was the key element. Thus the skin of this first tank was armored only enough to protect against common rifle and machine gun ammunition. Hopefully, a mighty, swift, war-ending stroke would be accomplished before the Germans could develop suitable countermeasures. Hence the secrecy, so well guarded by so many for so long.

In one of the notable follies that characterized leadership in the field, the entire plan for Great Britain's ingenious contribution to the art of warfare was sacrificed for a pittance.

The war had been going badly. The Franco-British offensive on the Somme was bogged down. Public criticism was mounting in the wake of appalling British losses. Sixty tanks had been delivered by August, and General Sir Douglas Haig promptly demanded their use in the Somme deadlock. Pleadings of Lloyd George, the War Minister, and Cabinet members to forego premature use of the machines failed to overcome Haig's obstinacy.

In the mist of dawn on September 15, 1916, the first tank attack in history took place in the shell-torn lowlands between the Somme and Ancre rivers in France. Of the 49 tanks made available, 32 were able to reach the assembly point. Before them lay a stretch of valley that had been chewed into a crater field by one of the heaviest artillery "preparations" to date. Advancing over this treacherous ground in detachments of two or three, the land battlewagons rumbled into history with a great clanking and white cloud of exhaust. Nine tanks steered successfully through the mangled earth ahead of the infantry; nine were unable to keep up with the infantry through the soft ground; nine broke down; and the remaining five foundered in yawning shell holes.

The nine machines that forged ahead achieved spectacular success, which was duly broadcast to the world by the war correspondents. (One tank was credited with forcing the surrender of 300 awed Germans in their trenches; another, followed by a crowd of cheering soldiers, helped capture the village of Flers.)

The net gain in the series of clashes that is called the Battle of the Somme was minuscule in the vast arena of the Western Front. The German line had merely been dented, not broken. For the Allies it was a grave misuse and premature disclosure of a promising new weapon.

Overall, the Germans were not impressed. As it had approached them as a wolf in sheep's clothing, they did not recognize "*Deutschlands Tod*" (Germany's Death).

The Mark II and III

Not many lessons had been learned in the poorly conducted Somme "shakedown." The obvious defects in the first model tank were corrected in the next order for 100 machines. The "tail" was found to be useless and was removed. Stronger rollers were substituted. More important, thicker armor was provided to withstand the armor-piercing bullets that surely would be forthcoming in the next tank attack. This occurred in April, 1917, in the Battle of Arras, where a number of tanks were heavily damaged by armor-piercing bullets.

Thereafter, the Marks I, II, and III were assigned the task of supplying gasoline and ammunition to the Mark IV, which was to be the mainstay of the Tank Corps for the ensuing year.

The Mark IV Heavy Tank

Although generals continued to relegate the tank to minor roles, it had proved its value in infantry support to the extent that GHQ in France ordered 1,000 machines. They had to be of a new model that could negotiate shell-torn ground, and the dissension over specifications wasted five months before work began.

The Mark IV used the same engine, transmission, and hull configuration as the original Mark I, and combined the improvements of the Mark II and III. The principal new feature was sponsons that swung into the body, avoiding the necessity for dismantling and remounting for railroad transportation. The tank also carried an "unditching beam" atop its back which could be hitched to the tracks as an aid to escaping from shell holes and wide trenches.

The first two appearances of the new model in the 1917 Ypres offensive were inauspicious. Seventy-six Mark IV's and 12 supply tanks played a minor role at Messines in June. In the ensuing attacks northward, where the Flanders lowlands were "prepared" by a ten-day bombardment, heavy rains turned the battlefield into a morass that could not be traversed by machine, man, or beast. To the Germans—and to many of the British—the Mark IV, lying helpless in the Flemish mud, illustrated its homely name—it looked like a tank. Could this be a weapon that the

French were to call "*L'Enfant Terrible*" or "*char d'assaut*," and the Germans, the "*Sturmpanzerkraftwagen*"?

Cambrai provided the answer.

Cambrai: The Vindication

Through sheer grit the British Tank Corps at Cambrai saved its new weapon from disrepute and oblivion. There, by dint of persuasion, the tankmen were permitted, finally, to carry out the first mechanized attack in the textbook style envisioned by Swinton.

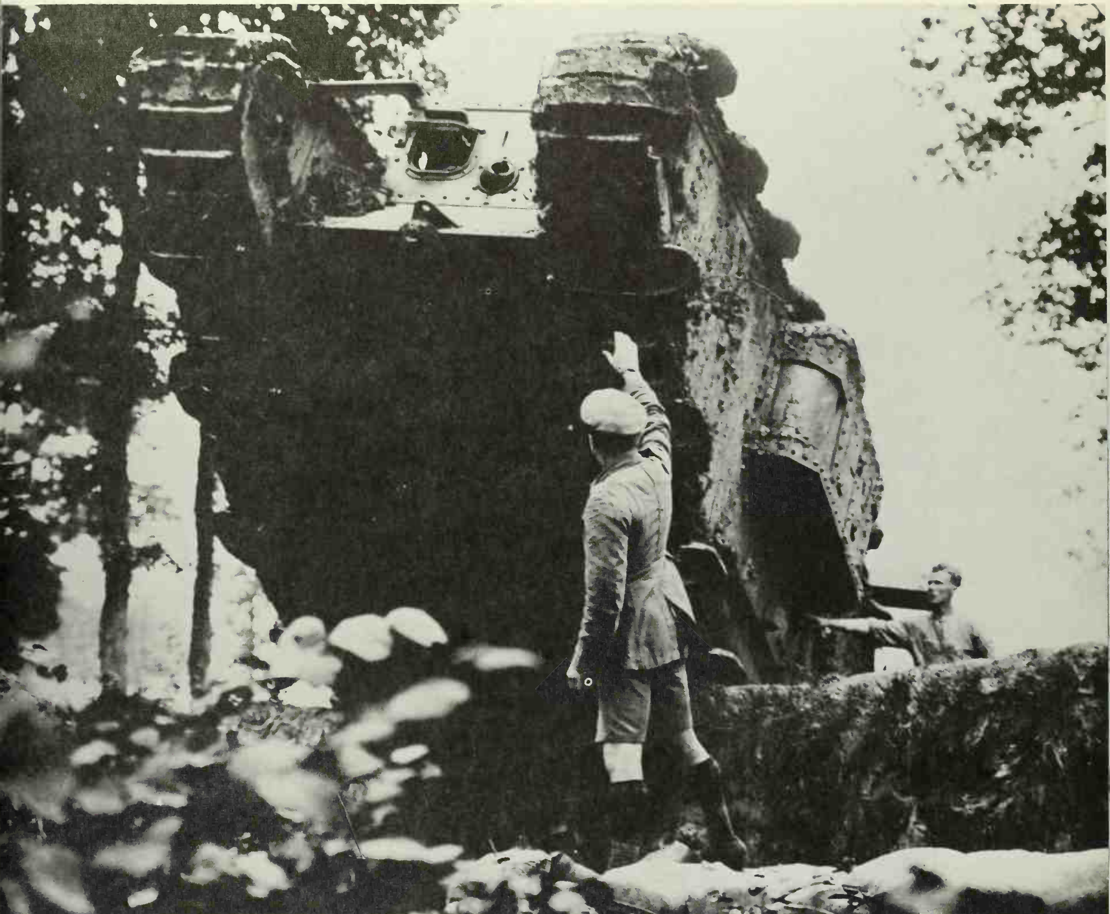
Nearly 400 Mark IV's were assembled, assisted by nearly 100 supply tanks. They were hidden in a wooded area just back of the British line. Night after night, Allied planes droned low over the front to mask the tell-tale clanking of the assembling machines. There was no preliminary bombardment. The field of action was a tankman's dream: instead of a nightmarish lunar landscape or mud or swamps, gently undulating farmland rolled toward the town of Cambrai 7 miles away. The entire field of battle, dotted by an occasional clump of woods, was visible in one sweeping view. The peaceful rural appearance of this "quiet sector" belied the strength of the nearby Hindenburg Line with its dual trench system. Before it great aprons of yet-undefiled barbed wire glinted blue in the sunlight.

At dawn on November 20, 1917, a light mist shrouded a strange scene of primitive improvisation wedded to the most modern land weapon that man had devised. Atop each of the assault tanks was mounted a huge fascine of brushwood. A device had been rigged to tip the bundle into the wide Hindenburg trench as a "bridge" over which the tank could cross. As the tanks moved past the British trenches at 6:20 A.M., nearly a thousand guns, relying on surveys and calculation instead of preliminary registration in order to maintain surprise, delivered a quick, heavy bombardment. Each company of 12 tanks moved in triangular formations of three, the two rearmost machines being followed 100 yards behind by two infantry companies. Astonished German infantrymen, accustomed to the days of bombardment that nearly always preceded an attack, fled when they saw giant machines looming out of the mist, each striped with a new camouflage war paint. They smashed through the barbed wire, dropped their brushwood "bridges," and lumbered across the yawning trenches. Much of the vaunted double-trench system of the Hindenburg Line was taken by British infantrymen in an almost bloodless coup. In 12 hours they advanced 6½ miles on a front of more than 7 miles with only 4,000 casualties.

A bit of German heroism and superb gunnery also marked that day. Behind the crest of a hill at Flesquieres, in the center of the attack, a battery of German "77's" was hidden in the village orchards. They picked off the tanks as they appeared on the skyline, one by one, until all guns were silenced. This early demonstration of antitank gunnery seriously affected the timetable of the attack.

Overall, the tank attack was a success. Some were ditched, and al-

Yanks on way to action in the Meuse region of France, with French machine-gun light Renault tank in foreground, followed by U.S. light tank armed with a 37mm gun.

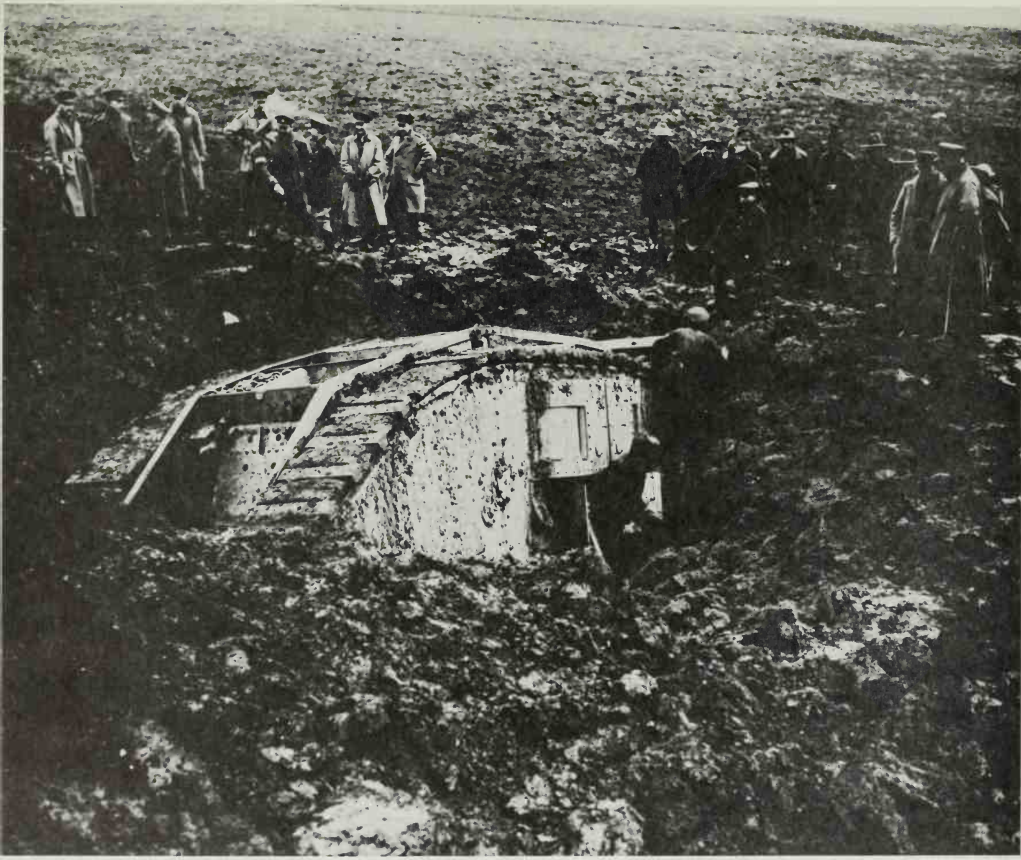


British Mark IV tank crossing an old trench near Elverdinghe, September 11, 1917. Note spuds at intervals along the tracks to improve movement over soft ground. The Mark IV had the same configuration, transmission, and engine as the Mark I, II, and III, and traveled at about 4 mph. Its armament consisted of two 6-pounders and two Vickers machine guns, and it carried a crew of eight. This is the tank that breached the Hindenburg Line trenches en masse at Cambrai in November, 1917.

British heavy tank supporting Australian troops.

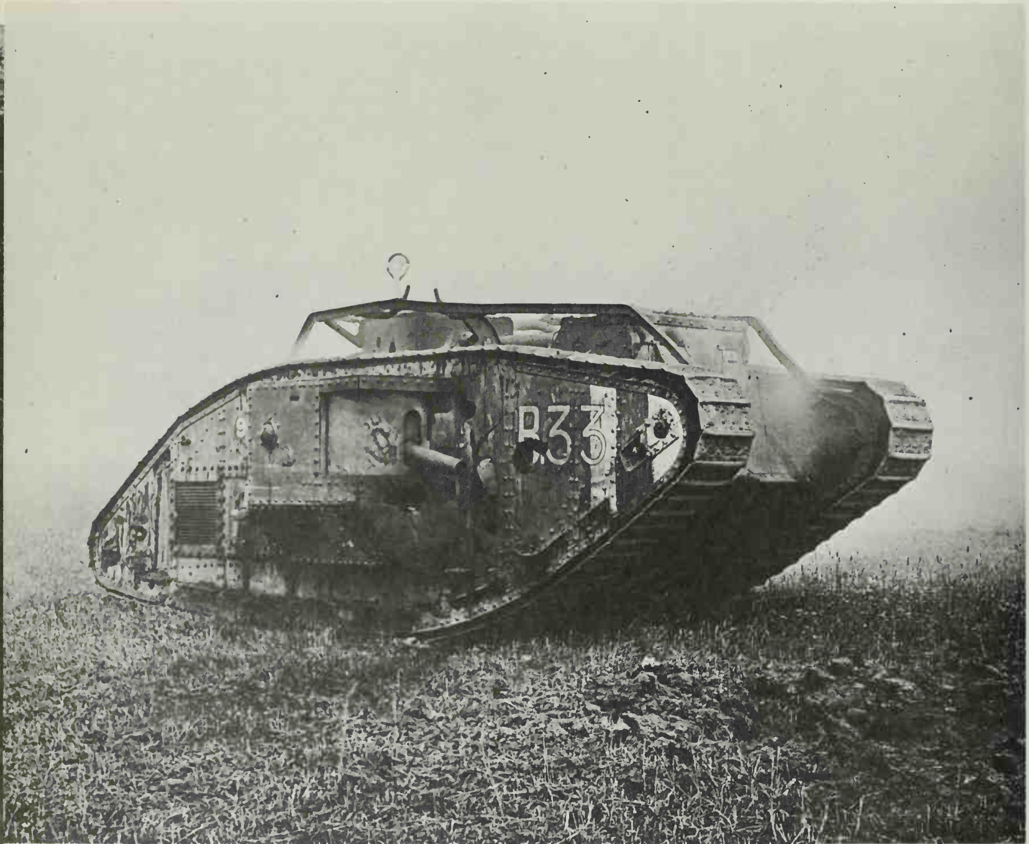
British Mark II tanks preparing to go into action in Palestine, 1917.

British tank in a hole at Bernicourt as 3rd Australian Tunnelling Company practices defense against tanks.



Fresh from one successful engagement, British heavy tanks, followed by Tommies, move forward in preparation for another assault against German lines. Note profusion of captured German 105mm guns in background.

Smoking British Mark V tank shortly after it was blasted out of action by four direct hits from a dug-in German "77" at point-blank range.



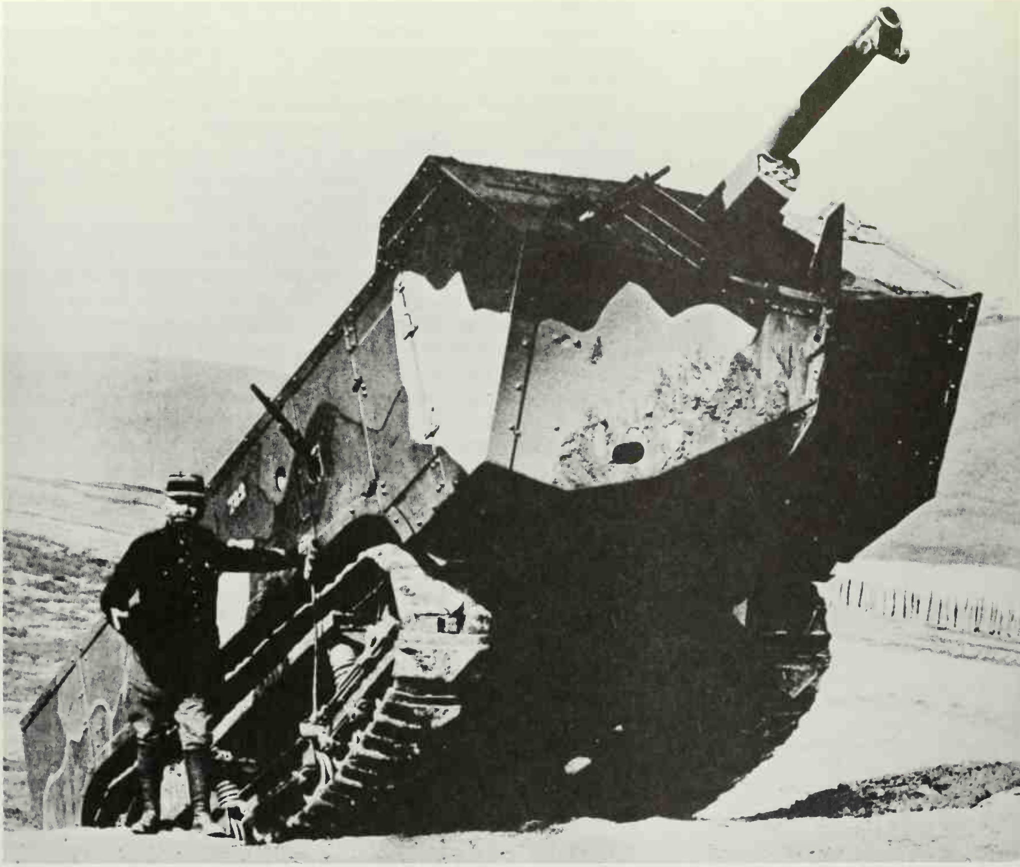
British medium Mark A, or Whippet tank. Gasoline tank and engine are in front under an armored bonnet. Turret in rear carried crew of three men and two .303 Hotchkiss machine guns, which had originally been developed for cavalry use. The Whippets were first used in small numbers near Hebuterne on March 26, 1918, during the first of the final great German offensives.

TECHNICAL NOTES: The Whippet was developed for mobility in mopping-up operations once the trench barriers had been broken. It could travel 8.3 mph. Weight was 15.7 tons, length 20 feet. It was powered by two Taylor 4-cylinder engines of 45 hp each with forced-water cooling. The turret was cooled by fans.

The Saint-Chamond was the better of the French medium tanks. It was 8 meters (26 feet 3 inches) long, carried a full-grown 75mm field-type gun in its nose and four Hotchkiss machine guns. It was unique in the employment of an electric transmission between the 80-hp gasoline motor and the pinion driving the track. It was easy to drive and had a large starting torque. Note wire-cutter on front and rollers underneath to assist trench crossing.

though 179 machines were out of action, only 65 were knocked out by German fire. The mistakes made later in the Battle of Cambrai had no bearing on the performance of the tank or the concept of its use. The tank attack in itself had been executed almost faultlessly. The pattern of future mechanized warfare was cut at Cambrai. The Tank Corps commander, General H. Elles, had ridden into battle with his flag flying from a leading tank in a style to be emulated by Montgomery, Rommel, and Patton in a later war. He had succeeded Swinton, the man most responsible for the evolution of the tank and its tactics, who had been removed from his post for his trouble by his opponents. In the flush of triumph at Cambrai, Elles graciously telegraphed Swinton: "All ranks thank you. Your show."

Hindenburg was to write later: "The English attack at Cambrai for the first time revealed the possibilities of a great surprise attack with tanks. We had had previous experience of this weapon in the spring offensive, when it had not made any particular impression. However, the fact that the tanks had now been raised to such a pitch of technical perfection that they could cross our undamaged trenches and obstacles did not fail to have a marked effect on our troops. The physical effects of fire from machine guns and light ordnance with which the steel Colossus was provided were far less destructive than the moral effect of its comparative invulnerability. The infantryman felt that he could do practically nothing against its armored sides. As soon as the machine broke through our trench lines, the defender felt himself threatened in the rear and left his post." (17)



The Mark V and the "Whippet"

Two lessons were learned at Cambrai, and an earlier one was retaught. The need for easier control—by one man instead of three—had been shown a year before on the Somme. Now interest was rekindled, improvements pushed, and production stepped up. The Mark V, the best heavy tank in the war, had greater power, a better transmission, and epicyclic gears, which solved the steering problem.

The difficulty in crossing the wide Hindenburg Line trenches resulted in the conversion of a number of Mark V's to long Mark V's by adding a section in the center of the hull. The Mark V reappeared with an even more powerful engine, but did not see action.

Finally, Cambrai had shown the need for a faster, more mobile tank for mopping up rear areas. This was met by the 16-ton Medium Mark A, nicknamed the "Whippet." It was manned by three men, mounted two Hotchkiss machine guns, and had a maximum speed of 8.3 mph.

The French *Chars d'Assaut*

The power of necessity in mothering invention was illustrated by the independent invention, or "reinvention" of the tank by the French in December, 1915. Coincidentally, but faced by the same trench deadlock problem and inspired by the same machines—the Holt caterpillar tractors hauling British guns—Colonel J. B. E. Estienne of the French artillery took his idea directly to the commander in chief. In sharp contrast to the official resistance that had met the British tank enthusiasts, Colonel Estienne's interview resulted in an order for 400 *chars d'assaut*, with the design to be worked out by Estienne with the Schneider works. Subsequently the Saint-Chamond works received a separate order for 400.

The promptness of French action on Estienne's idea almost caught up with actual British production. On learning of the secret British project in June, 1916, Estienne proposed that the French concentrate on lighter machines. The Renault firm actually produced a light tank by November, but the *artillerie d'assaut* at first favored mediums and heavies. These were organized into *groupes* of 16 tanks each, and each *groupe* was allotted a light Renault as a "command" tank. The mediums began arriving at training centers in September.

In mobility the French medium tanks were inferior to the British machines. But pound for pound they packed more punch. Neither of the two models carried the track around the entire machine, which restricted their trench-crossing and crater-hopping abilities. The Schneider tank was 6 meters long (about 19½ feet) and was powered by a 60-hp engine. The least successful of the French tanks, it mounted a short 75mm gun on the right side, and two machine guns. The larger Saint-Chamond was 8 meters long (26 feet), had an 80-hp engine, and carried a full-grown 75mm field gun in its nose, plus four machine guns.

Ten *groupes* of tanks were used in General Nivelle's ill-fated offensive along the Aisne in April, 1917. Through the rest of the year, the French repeated British mistakes in several battles. By December, plans for a heavy tank were dropped and attention swung away from the mediums to the light Renault. In January, 1918, orders for the Renault were increased to 4,000, of which 1,000 were wanted for a spring offensive. The little Renault was only 4 meters (about 13 feet) long, but it was tracked all the way around. It weighed only 6½ tons and could be carried by truck as well as by rail. It was powered by a 35-hp engine and could travel at least 6 mph. Two types were made, one mounting the rapid-firing 37mm gun and the other a machine gun. It usually was manned by a driver and a gunner, but this popular "sports model" of the tanks was often used by commanding officers for tours around the front.

The Allies' plans for an offensive in the spring of 1918 were thwarted by the Germans' own massive 38-mile advance toward Paris. From March 21 to midsummer, Germany overwhelmed the Allies in a desperate bid for a decisive stroke before the full force of America could be brought to bear. The British and French tanks were dispersed in small groups along a front of more than 60 miles in efforts to help stem the tide. Light Whippets and Renaults inflicted many casualties, but the little detachments were not important factors in slowing down the onslaught.

The Tank Triumphs: Soissons and Amiens

Allied armor rammed holes in the German lines in the summer of 1918 and was decisive in turning advance into retreat. By July the British were receiving 60 Mark V's a week—plus a number of Whippets—and France had mustered some 700 Renaults and 120 medium tanks in preparation for Marshal Foch's hammering counterattacks along the Marne. Tactics were polished.

At 4:35 A.M. on July 18, French General Charles Mangin hurled his 10th Army, with some American divisions in the line, at Soissons in the Second Battle of the Marne. Several hundred tanks, protected by mist and a smoke screen that limited visibility to 50 yards, fell upon Rupprecht's unsuspecting army without the warning of a preparatory bombardment. The battlefront in this area had been fluid for some time, and the big Hindenburg Line trenches were far away. The little Renaults came into their own, knifing through the lines, wiping out machine gun posts, probing into ravines, and playing havoc in the confused German rear. Ludendorff, the indomitable German tactician, did not know it then, but the brilliant French victory at Soissons marked the beginning of final ebb tide. He left 30,000 prisoners, 800 guns, and an undetermined toll of dead in the huge sack created by his final offensive, now surrounded by Allied armies. Ludendorff managed skillfully to extract most of his forces from the salient, but his plans for future offensives had to be postponed, then abandoned.

August 8 was called by Ludendorff "the black day of the German army in the history of the war." The British called it their most brilliant victory. In a surprise achieved largely by feints in other quarters, some 450 British tanks—about 100 of them light Whippets—swarmed into the German lines at Amiens behind a mighty artillery barrage. Again there were no German trenches, and the Whippets worked with the cavalry corps in a 6-to 8-mile breakthrough. Armored cars even broke onto the roads and shot up a German staff at breakfast.

Allied tanks fought in most major battles from Soissons and Amiens until the Armistice. Indeed, the ugly ducklings came to be looked upon as indispensable.

The German A7V

The Germans had early discounted the value of the tank, and with apparent good reason. Its Somme premiere in 1916 was a turkey, and it had foundered in the mud of Flanders during the summer of 1917. If Cambrai was an eye-opener, it was too late to divert much of Germany's dwindling resources to a crash program of tank building. But there were protagonists for this new war machine in the Rhineland too, and a committee worked hard on the project—again centered around the Holt tractor—throughout 1917.

If the clumsy model turned out in October, 1917, contrasted unfavorably with the usual perfection of German technology, it reflected Germany's flair for the bizarre in weapons. The A7V heavy tank required a crew of 18 men to handle 6 heavy Maxim machine guns and a 57mm cannon, plus the steering and driving duties. This machine weighed 32 tons, was slightly over 26 feet long and 10½ feet wide. It had ordinary caterpillar tractor tracks and looked like a turtle with its armored skirt reaching the top of the tracks. Its range was about 50 miles, and top speed about 6 mph. Controversy surrounds the origin of the 57mm guns, which corresponded in size with the British 6-pounders. Some report they were captured Belgian guns, but the majority were more likely Russian, since the Germans captured great quantities of Russian ordnance early in the war.

Germany used fewer than 100 tanks in 1918, most of which had been captured from the Allies. Although full production of the A7V was ordered in the spring, only about 20 were produced. Several of these engaged British tanks at Villers-Bretonneux, near Amiens, in April—the only sizable tank combat of the war. In their final offensive thrust on July 15 east of Rheims, just before the big French counterattack, the Germans employed 20 tanks and lost them all to the French artillery.

Pits, barricades, and mines—used successfully in isolated cases—were not feasible in the fluid warfare of 1918. The German "77's," dug in or equipped with small wheels, had been fairly successful antitank guns but their diversion was seriously depleting the artillery arm. A powerful antitank rifle firing a 13mm bullet was turned out in early 1918, but its 35-pound weight and heavy recoil made it unwieldy. Armistice Day caught the Germans secretly and desperately trying to mass-produce a new heavy 13mm machine gun—the "Tuf" gun—which could penetrate 1¼ inches of armor. It never saw action.

The U.S. Liberty Tank

Tank action quickly caught the fancy of the newly arriving Americans. As a British account put it, "This form of mechanical warfare appealed to their national characteristics."

With no tanks of their own, the U.S. forces used 64 heavies from the British and 227 light Renaults from France with marked success. They also received their lumps. Colonel George S. Patton, Jr.—the "Old

A French-made light Renault, manned by Americans of the 327th Tank Battalion, 3rd Brigade, 1st Division, in the offensive against the Mont Sec heights during the battle of Saint-Mihiel in September, 1918.

Austin 1917 Model armored car, one of several British models.

German heavy tank in action outside a village in June, 1918, rear-right view. A second tank is barely visible behind trees at extreme right.

German A7V tank "Hagen" on display at Horse Guards parade grounds, London. ("Hagen" was code name of thwarted German offensive against the British in 1918.) The turret and six heavy Maxim machine guns are missing from this tortoiselike battlewagon which crammed 18 men in its 26-foot length when going into battle. It was the only German-made tank of the war, and only about 20 were completed after production began rolling in the spring of 1918.

TECHNICAL NOTES: The A7V's principal mount was a 57mm gun (either captured Russian 5.7cm's or Belgian guns, or both). It weighed 32 tons, was 26 feet, 3 inches long and 10½ feet wide. Range was 50 miles and top speed about 6 mph. Power was supplied by two Daimler 4-cylinder, water-cooled, 150-hp engines. Armor plate was 30mm thick on the front and 20mm thick on the sides and rear.

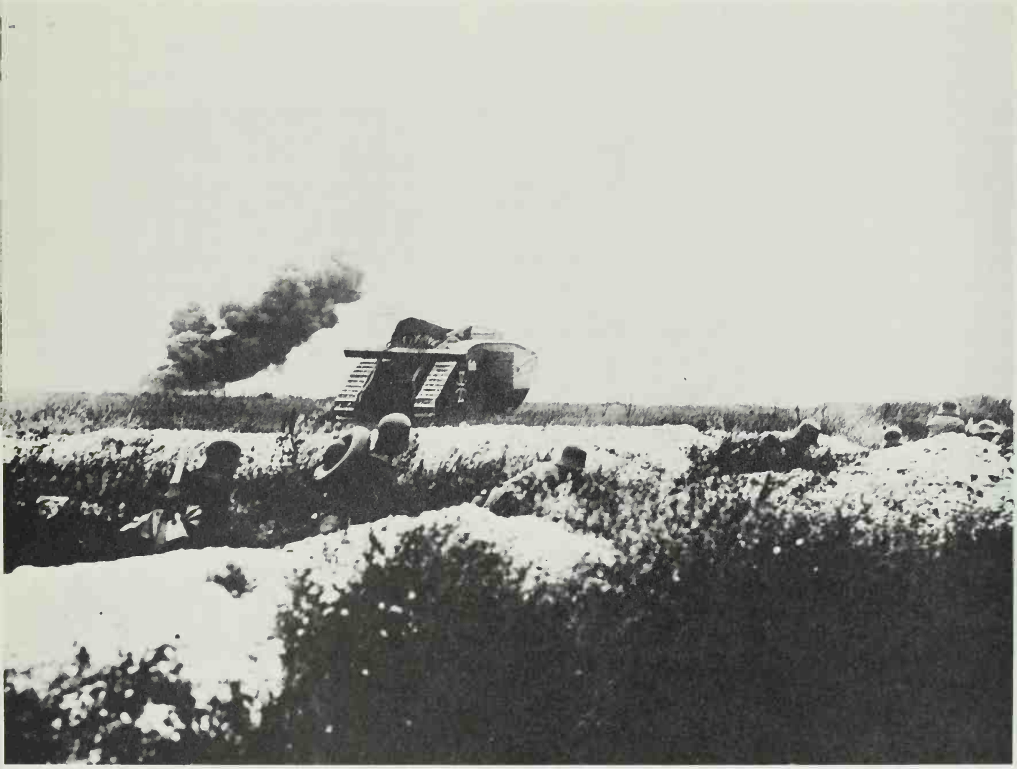
Blood and Guts" general of a later war—earned his Distinguished Service Cross on foot at Montfaucon during the Meuse-Argonne offensive. When his leading tank and most of the other Renaults of the 1st Tank Brigade were stopped by superb German gunnery, Patton rounded up tankless drivers and crews and descended upon some German machine guns with his two ivory-handled pistols blazing.

Even as the sun was setting on Germany's might, the Allied commanders, never too sure that the war would not last another year, were planning an all-out offensive for 1919, centered around the tank. Plans were afoot to overrun the Western Front with 10,000 tanks. The difficulties of supplying armies across country already devastated by previous battles had been clearly demonstrated in the German offensive of March, 1918, which fought itself to a standstill in a month. So plans were discussed also of provisioning the Allied armies with the aid of 10,000 caterpillar tractors.

An Allied commission decided to build a heavy tank variously known as the "Allied," "Liberty," or "International" tank. It was similar to the latest British tank and became the basis for the Mark VIII in the British and American armies. The 30-ton machine was designed to use the Liberty airplane engine being turned out in great numbers in the United States. A factory was also started at Neuvy Pailloux which was expected to produce 1,200 tanks a month.

The United States, meanwhile, had settled on the Renault design for its light tank and tooled up to produce both it and the Liberty in quantity for the 1919 campaign. Although only 64 light tanks had been produced in the States by the time of the Armistice, the production pipeline was filling, and 800 were turned out by the end of March, 1919. In the cooperative heavy tank program, the British were to produce armor plate and the United States was to furnish Liberty engines and the rest of the driving mechanisms for 1,500 tanks. About half the work on American components had been completed by November 11, 1918, and initial units were being assembled.

The U.S. Mark VIII, which was retained as the army's heavy tank for some years after the war, weighed 43.5 tons and carried five .30-caliber Browning machine guns and two British 6-pounders. The British



counterpart was armed with seven Hotchkiss machine guns. The 12-cylinder V-type Liberty airplane engine developed 330 hp and drove the machine at 5½ mph. Despite its forced-water cooling system, the engine could not sustain long running periods.

The originators of the tank in Great Britain almost made a break-through in the final months of the war with a revolutionary tank that would have invited a Cadillac-Model T Ford comparison with any used in World War I. It was to be an amphibious machine with a 200-mile range, speed of 20 mph, and long enough to cross a 12-foot trench. The experimental model completed soon after the Armistice attained a speed of 28 mph and successfully negotiated rivers, but its steering and other mechanical problems were not solved sufficiently to make it reliable. This kind of tank—plus undreamed-of firepower and other mechanization—was to await yet another war.

Germans use a captured Mark IV tank—one of about 75 machines taken from the Allies during the war—to support an attack on the Western Front. Soldier in immediate foreground carries a flamethrower on his back. The Germans never had enough tanks to make their weight felt in any single attack, and did not become proficient in tank tactics.

Positions of U.S. Renault tank driver and gunner, with all doors open and turret door turned toward the front.

Congestion of traffic supplying an army in action is illustrated by this scene back of the American lines in the Argonne in the ruins of Esnes in September, 1918. An American infantry division on the march with trucks, wagons, ambulances, ammunition, and sanitary trains would stretch for 30 miles along one road. The 1918 divisional organization table called for 650 trucks.

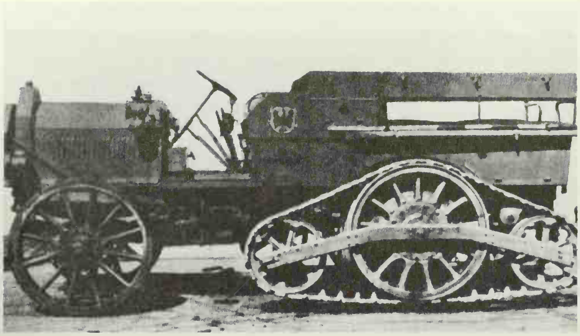
SUPPORT MATÉRIEL

IT WOULD BE AN UNPARDONABLE OMISSION to ignore the tremendous problems of logistics and communications that arose in World War I, even in a book limited to weapons. Communications, transportation, and supply, while not strictly weapons of themselves, were the vital ingredients for a victorious army, no matter what its arms.

More than three years of stalemate on the Western Front radically changed armies to the extent that for every two men in the line, one was engaged in communications and supply to the rear. Strange new units never thought of in previous wars were organized for such tasks as salvage, gas decontamination, camouflage, meteorology, cleaning and delousing of soldiers' clothing, and the like.

In communications each nation entered the war with varying qualities of visual, line, and wireless telegraphy. Great Britain, France, the United States, and, to a great extent, Germany, excelled. Yet it was largely a failure of wireless communications between the field armies and headquarters that aborted Germany's initial drive through Belgium and northern France. Interference from the French station in the Eiffel Tower could be called the earliest instance of wartime radio jamming. On the Eastern Front the Russians, presumably because they had no faith in the receiver's ability to decipher codes, nearly always before great battles sent vital messages "in the clear," which were conveniently intercepted by the Germans. On the dug-in Western Front, telephone cables were driven deeper and deeper by heavy bombardments until they were laid an average of 6 to 8 feet deep. The U.S. Signal Corps strung 100,000 miles of wire over nearly the whole of France. At the peak it was operating 282 telephone exchanges and 133 telegraph stations; there were nearly 15,000 telephone lines and 9,000 stations; and 47,555 telegrams a day averaging 60 words each were sent.

The U.S. Army shipped 1,791 consolidation locomotives of the 100-ton type, nearly 27,000 standard-gauge freight cars, and 423,000 tons of rails and fittings. U.S. engineers built 1,000 miles of standard-gauge track. Some 650 locomotives were shipped already set up on their wheels so they could be unloaded on the tracks in France and move under their own power in a few hours. Here engineers are putting together a large locomotive in France.



This German Benz-Bräuer half-track was one of the more modern military motor transport vehicles to be developed during World War I.

An improvised motorized rig hauling a German gun near Verdun in 1917.

When an army had to leave its elaborate telephone system behind in a quick war of movement, more primitive communications were necessary. The Germans were especially skillful in directing artillery by signal flares, often filling the sky with red, green, and yellow fireworks during an advance. Human "runners" led the most dangerous and unglamorous lives. The animal world participated too, the Germans often using German Shepherd dogs across stretches of no-man's-land. And who, having read something about "The Lost Battalion," has not heard of Cher Ami, one of the more illustrious of thousands of homing pigeons pressed into service, which courageously made its way back with a message, losing an eye and a leg in flight?

Allied motorized searchlights in action, February, 1916.

Transportation ran the gamut from horses to the beginnings of mechanized armies. Railways played a dominant part that could hardly be visualized in a future war. Germany's railroads were developed to such a militarized efficiency that not a track could be laid or changed—even before the war—without military approval. It was Germany's ability to quickly shift an army from one front to another by train that led to the destruction of Samsonov's Russian forces at Tannenberg. In France about 100,000 trains were run from point to point on the front, transporting armies and supplies. French engineer troops built more than 4,500 miles of track, equal to about one-sixth of the French railway system. U.S. troops built 1,000 miles of standard track and 125 miles of narrow-gauge track in France. The main lines were the first mode of transportation to the front, followed by narrow-gauge lines, which were laid quickly as required. For hauling the heavy railway guns near the enemy lines without noise, smoke, or light, the French built several hundred gasoline-electric locomotives equipped with the same type of electric transmission used in the Saint-Chamond tanks.

Beyond the range of the narrow-gauge railway came the motor truck, which could negotiate roads under shellfire. Only about 20,000 Allied motor vehicles were in France in 1914. By Armistice the number exceeded 200,000 and supply never approached demand. The United States shipped 40,000 trucks ranging from ¾-ton to 5 tons in size, of which 33,000 reached France.

Finally, beyond the truck's capability were extensive areas of shell-torn ground that could not be negotiated even by four-wheel-drive vehicles. Caterpillar tractors came into considerable use for gun hauling by all sides and sparked the invention of the tank. Over 1,000 5- and 10-ton tractors were shipped from the United States, plus some even larger machines. Yet, despite the impressive moving to the fore of the combustion engine, the fact is that this still was largely a horse-drawn war employing millions of animals on many fronts. Even on the decisive Western Front, where technology was prevalent, the need for horses was acute. In 1918 the U.S. was forced to convert 23 of the army's best cargo ships to animal transports, though each horse used space that could carry 10 tons of needed cargo.

How the Paris taxis went to war was flashed in headlines to the world in 1914. General Joseph Gallieni, military governor of Paris, whose inspiration directed the blow that turned the flank of Kluck's invading army before the city, was hard put to transport a sorely needed infantry division to the front some 40 miles away. Half the division was sent by available trains, then police went into the streets to enlist the "cabbies." Some 600 taxis made two fast round trips to the hard-pressed front, ferrying a total of 6,000 infantrymen and their equipment. It was the first motorized column in history.

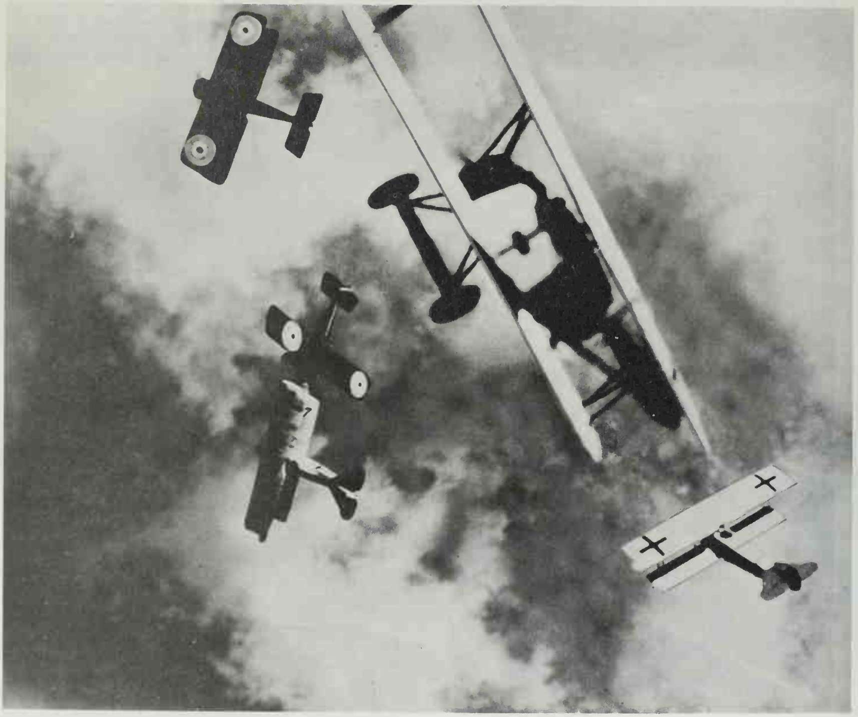
German Shepherd dog with message container. Germans, with higher degree of discipline, had better luck in training dogs than Allied soldiers, who tended to treat them as pets.

Signal Corpsmen strung line with each advance. This member of the 101st Field Signal Battalion is at work in captured German position in Saint-Mihiel area, September, 1918.

Part II

THE WAR IN THE AIR

Dogfight over Western Front.



INTRODUCTION

THE WORLD'S FIRST AIR FORCE was a balloon corps, created by the French before Napoleon attained power. Within six years after the Wright brothers made their memorable airplane flight at Kitty Hawk, North Carolina, on December 17, 1903, a Wright "Flyer" was delivered to the United States Army. The British, French, and Germans had also acquired aircraft for military use.

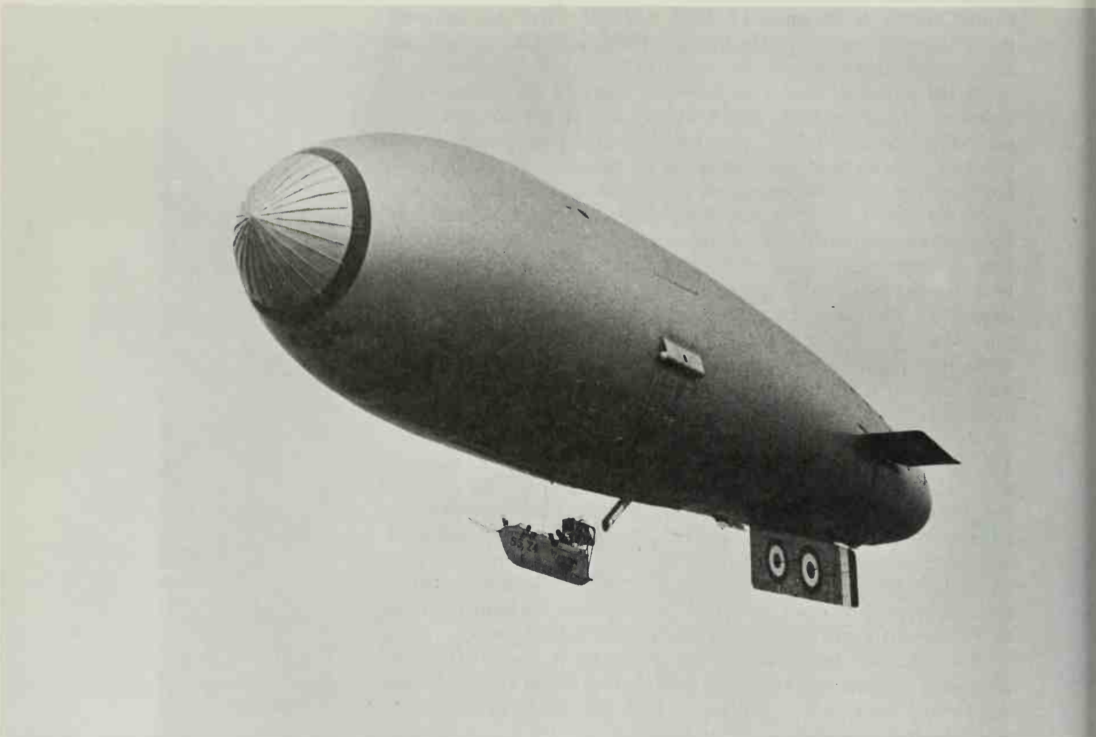
It fell to Italian airmen to introduce many of the rudiments of "modern" air warfare during their brief campaign of 1911–1912 against the Turkish forces in Tripoli. They made extensive photographic reconnaissance with airships, used planes for the first time to bomb enemy positions, and even fired on troops with airborne rifles and revolvers.

World War I provided the testing ground that gave aviation its first great thrust from infancy toward maturity. Nearly every conceivable form of aerial warfare was tried. Balloons, most primitive of air vehicles, were developed to a high degree of proficiency. They were towed by ships at sea; they ringed cities with protective curtains of steel; and, by war's end, they hovered by the score along the entire 600-mile Western Front, performing their basic mission of observation. The rigid airship, while inflicting the first real bombing damage of the war, was found inadequate, though some nations pursued its development for years.

The airplane, on the other hand, matured with astonishing rapidity. The typical 1914 military plane was unarmed, flew at 50 to 75 miles an hour, reached a ceiling of 10,000 feet, and was used only for observation. By 1917, fighters were heavily armed with machine guns, flew 150 miles an hour, and reached 24,000 feet. Bombers carried payloads of two and three tons into enemy territory. By war's end, the true prototype of the most powerful weapon of navies to come—the aircraft carrier—made its appearance, and Great Britain had rendered the supreme salute to military aviation by creating the first independent air force.

Air power was not a decisive strategic factor in the war. But the developing air weapons wove an ever-widening thread of tactical assistance and influence in operations on land and sea. In so doing they also left a legacy of drama and daring.

British naval blimp S.S.Z4 on antisubmarine patrol. It was very similar to the Sea Scouts and to the U.S. Navy Type "A" nonrigid airships.



BALLOONS

SOON AFTER THE START OF WORLD WAR I the Germans produced the Drachen kite balloon—popularly known as the "sausage balloon"—with stability maintained by a pair of small sails and a large air-inflated bag or rudder at the rear to keep the nose to the wind. This type, which could be flown in winds up to 50 miles an hour, was copied by the Allies and later improved upon with the streamlined, three-tailed French Caquot balloon, which could withstand winds of 90 miles an hour.

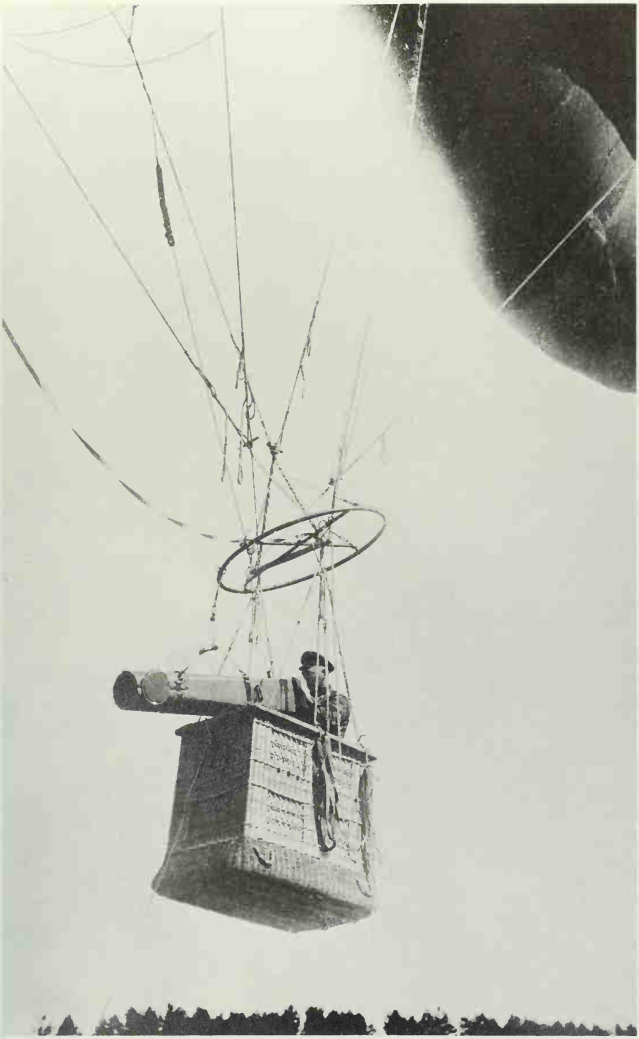
The British navy quickly developed special balloon-carrying vessels and even equipped some sleek cruisers of the main battle fleet with the incongruous-looking sausages. In the Gallipoli campaign, the British inflicted heavy damage on Turkish shore batteries and ships that could be seen only by balloonist observers, floating 2,000 feet above the sea, who directed ships' batteries by means of a telephone wire carried in the core of the balloon cable.

In antisubmarine warfare, extensive use was made of balloons towed by destroyers or balloon ships escorting convoys. So successful was this tactic in dissuading U-boats that deception was often employed by the British: small dummy balloons, complete with small dummy men in the gondolas, which gave the illusion of normal-sized balloons flying at great heights.

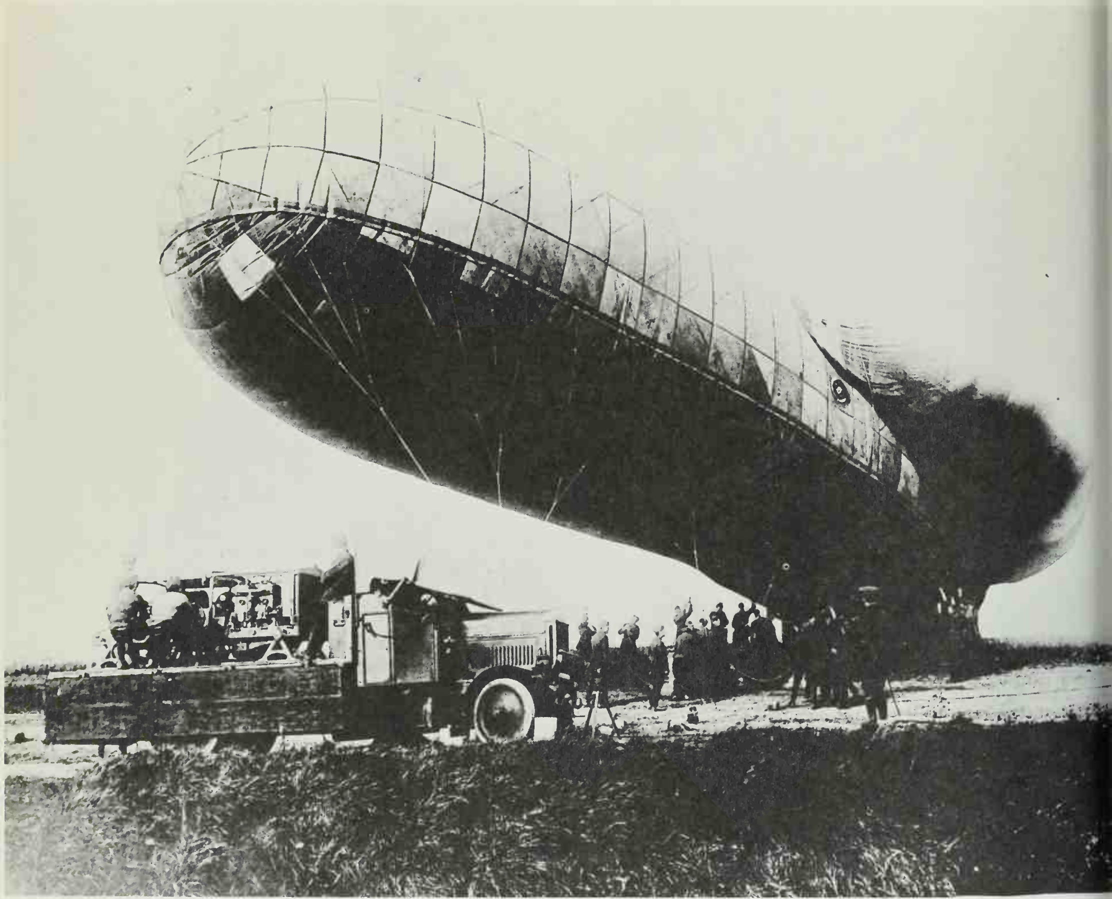
Late in 1917, the British, plagued by air raids on London, devised the barrage balloon system to protect the city. Large "aprons" of steel wires were lifted to a height of 10,000 feet. Each apron consisted of long lengths of piano wire trailing from a horizontal cable supported at three points, 500 feet apart, by kite balloons. This barrier was calculated to either impair bombing accuracy by driving attackers to high altitudes, or force them into antiaircraft fire at very low altitudes.

The Italians also defended their ports against air raids with nets supported by Prassone balloons, similar to the Caquot in design.

This retouched photograph shows how balloon "aprons" were used in the defense of London, starting in the fall of 1917. These larger barrage balloons had a gas capacity of 40,000 cubic feet, were stationed 500 feet apart, and lifted the aprons of trailing wires and their suspension cables to 10,000 feet.

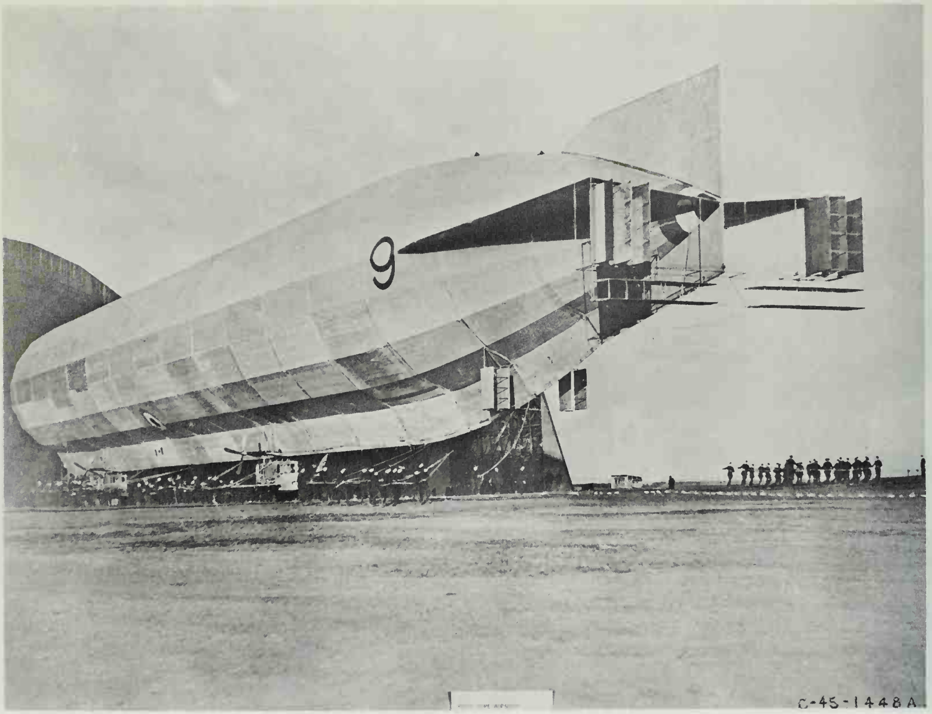


An oversize German camera in use in the basket of an observation balloon.



A Caquot observation balloon, with winch in foreground, is readied for ascent as eyes of the artillery. Balloon's gas capacity was 35,000 cubic feet, ceiling 6,000 feet.

The R-9 was Great Britain's only attempt at design and construction of a rigid airship in World War I, and was substantially inferior to the German Zeppelins. Work on R-9 had been suspended in early 1915, but she was rushed to completion under the pressure of the Zeppelin raids.



THE ZEPPELIN RAIDS

THE TWENTIETH-CENTURY PRACTICE OF BOMBING civilians apparently was inaugurated on August 6, 1914, just two days after Germany marched into Belgium, when the Zeppelin L-Z was sent to Liège in a vain attempt to bomb the town into submission. Some sporadic bombing was done by planes early in the war, but the real shock of city bombing with its morale-cracking sense of insecurity was first brought home to London by Germany's giant Zeppelins, starting in 1915.

* * *

The work of Count Ferdinand von Zeppelin, a retired German army officer, already had made Germany preeminent in the design and construction of the monstrous airships that became synonymous with his name. By the beginning of the war, he had built 26 Zeppelins, the fastest of which could fly 50 miles an hour. Another firm, the Schutte-Lanz Airship Company, also carried out an extensive wartime program.

The high hopes of the German High Command for this bizarre instrument of destruction were reflected in boasts to the German people at the outset. The night bombing of England by these terrifying behemoths was pursued in more than 50 raids, which ended only three months before the Armistice. The raids started inauspiciously on January 19, 1915, with slight damage to two coastal towns by two dirigibles and were stepped up substantially until the end of 1916.

British defenses were ineffective at the start. Night flying of pursuit planes was learned the hard way. Eight of 16 planes crashed on landing after chasing Zeppelins in one raid. As late as February, 1916, two airships were able to hover over the city of Hull at low altitude and bomb it without interference. The Zeppelin bombing reached its peak during 1916, when 126 airship flights were made over England.

German naval airship L-35 coming in for landing. The British forced down a sister ship, L-33, and built two copies, R-33 and R-34, which were not completed until after the war.

Fighter planes were hampered by their inability to fly at high altitudes. The supercharger was not developed until the war's end, then was not widely used for another decade. Airships, even with a payload, could soar to 16,000 feet and, light, to almost five miles as their crews sucked at bottles of pure oxygen.

Defenses, however, improved. Airship forays slowly gave way to systematic bombing by the big Gothas. Zeppelins, caught in the glare of searchlights, were holed by 3-inch antiaircraft guns and finished off by fighter planes as they labored back over the Channel. Before the explosive bullet doomed the hydrogen-filled Zeppelins, they were difficult to destroy.

L-33, after dropping twenty 110-pound bombs on London in September, 1916, was hit repeatedly by ground guns. Losing gas, and with one engine damaged, she struggled over the North Sea as the crew threw all loose gear overboard. A pursuit plane overtook her and pumped machine gun bullets into the fabric for twenty minutes before the commander brought her down near Colchester. The British built a direct copy of L-33 in the R-33.

In October, 1917, eleven German airships met over England at night. Forced to an altitude of 16,000 feet by the balloon barrage around London, they were caught in a gale from the north while a mist on the ground shrouded landmarks. As the London defenses remained silent and kept searchlights covered, the Zeppelins drifted blindly south. Only one managed to return to Germany directly. Six made their way back after flying over Holland or the Allied lines, and four were destroyed in France the following day.

Germany used about 80 airships during the war, and all but 7 were destroyed. They made more than 200 bombing flights over England and dropped 6,000 bombs—more than twice the number loosed by planes—killing more than 500 and wounding some 1,100 persons. One raid was made on Paris. The High Seas Fleet, which carried no planes, depended on airships for reconnaissance and were warned on several occasions of the approach of the British fleet.

Great Britain failed in the development of satisfactory large airships, but came up with a line of blimps that saw thousands of flying hours in antisubmarine patrol. The small Sea Scout was the first model in 1915, followed by the Sea Scout Twin in 1917, which could fly at 50 mph and patrol for 50 hours at a time. A larger "North Sea" type attained 55 mph. The United States Navy in 1916 produced five types of blimps, the largest capable of 60 mph and a range of 1,800 miles.

The British also had primitive "pushers." An unarmed F.E.2C with "cinematograph" mounted in observer's seat.

AIRPLANES

AVIATORS BEGAN WORLD WAR I as the low men on the military totem pole and ended up as knights of the twentieth century.

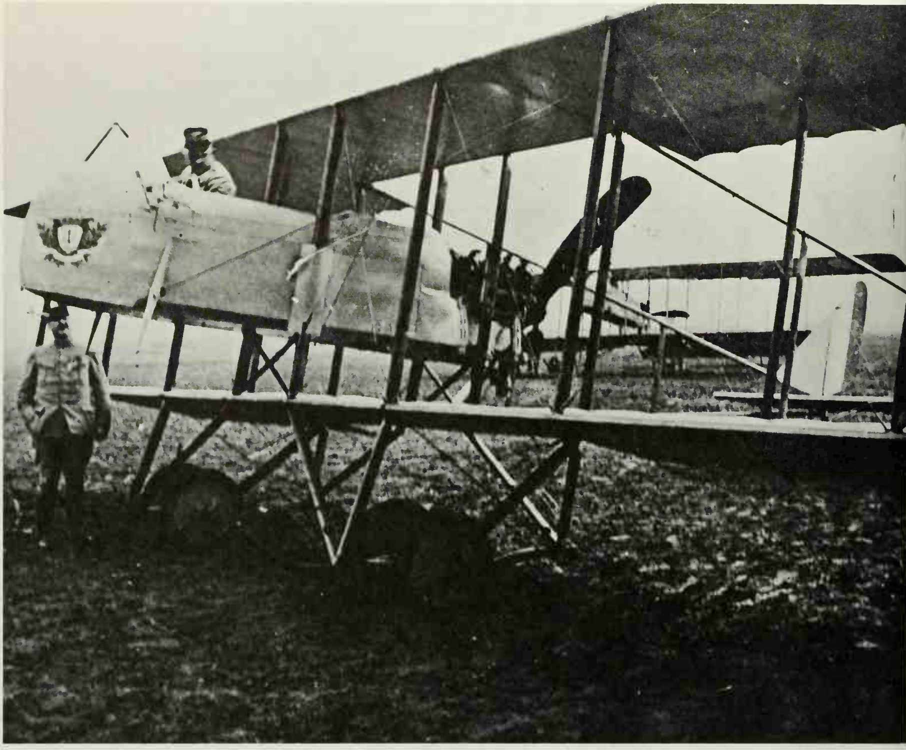
The European nations had been probing with aviation—mostly on an experimental basis—when the storm broke, and the United States also had shown mild interest, but was far behind. It was the common view of all belligerents at the outset that the flying machines were good to send up once in a while to see if they could tell what the enemy was doing, and make a report. And that's about all the 1914 machines were capable of—frail, wooden contraptions covered with doped fabric, and held together with bailing wire and struts. Some could attain 50 miles an hour and struggle up to 10,000 feet after an inordinate length of time, but they could scarcely lift the weight of the pilot, observer, and gasoline for initial takeoff.

Aviation was hardly in a position to be competitive with other services under such circumstances, and the military commanders had good reason to regard it lightly—that is, until the opening, climactic days of the great German sweep through Belgium and France.

Observation

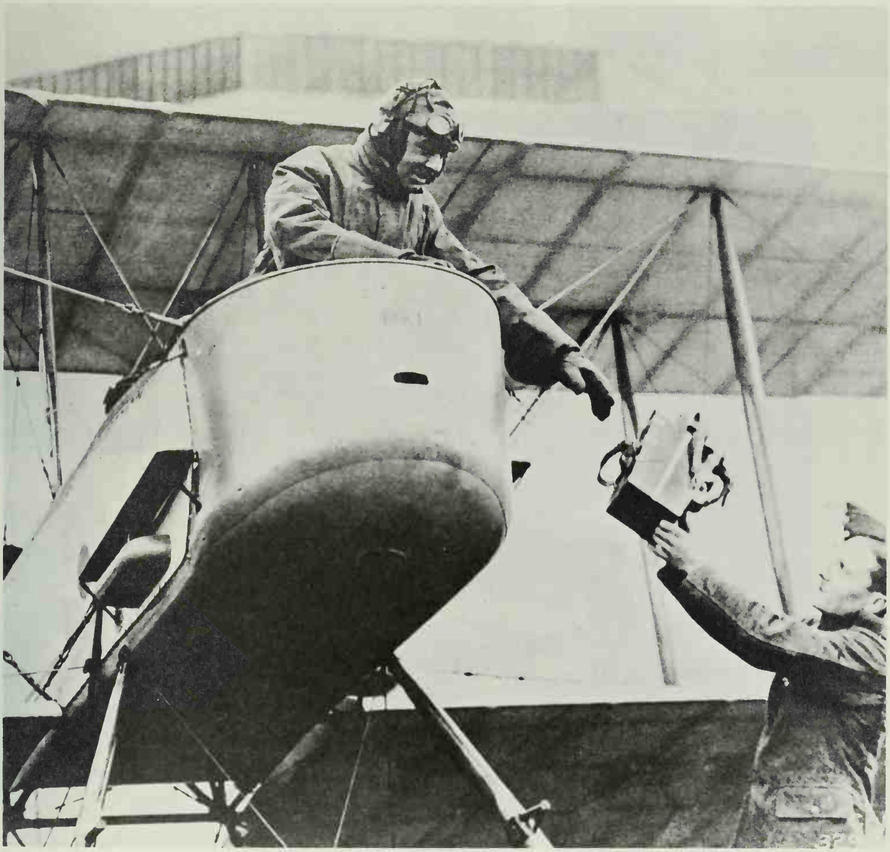
France had a few planes, and Great Britain sent some forty machines across the Channel with the B.E.F. Most were pusher types with the propeller in the rear of the short, fat fuselage, which seemed the proper thing to do—keep the engine and propeller away from the pilot, and particularly away from the work of the observer. The makes generally were B.E.2's, Henri Farmans, Blériot monoplanes, and Avro biplanes.

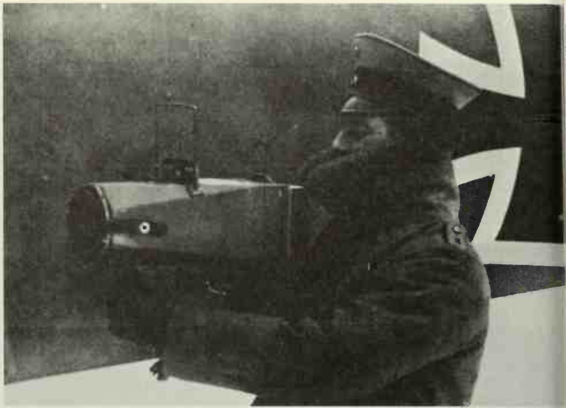
Almost immediately the British, during their first contact with the Germans at Mons, discovered from air observation that they faced an



First planes were little more than plywood and fabric held together by bailing wire. Here, a French colonel checks out a Maurice Farman S.11 Shorthorn at Etampes aerodrome. Sole mission: reconnaissance.

Camera is handed to observer in another British "pusher."





(left) Aerial cameras began improving in 1915. An observer operates a Graflex camera.

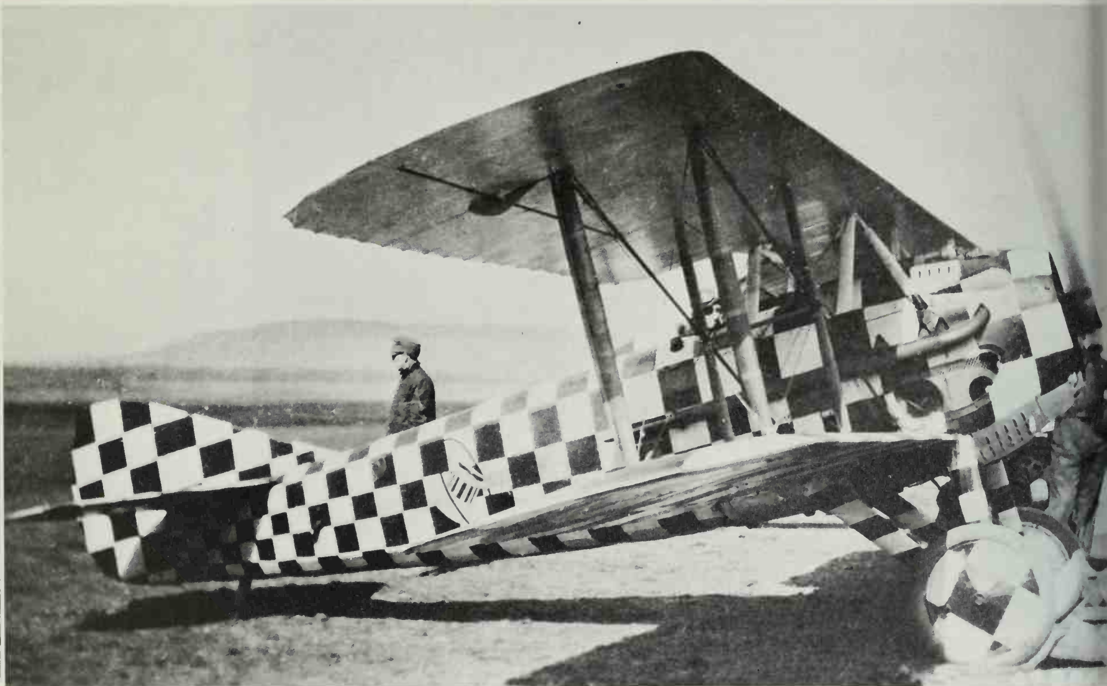
(right) A German "pistol camera."

By the time of the Somme battle in the spring of 1916, the British army was excitedly learning to piece together aerial photographs to show enemy lines and gun positions.

overwhelming mass of the enemy—a fact that the Germans themselves did not know. The British pulled out tactfully. Next, the idea of attacking Alexander von Kluck's flank and rear when he made the premature turn in front of Paris instead of sweeping behind the city as planned came as the result of air observation. In the apparently doomed city, General Joseph Gallieni's staff was notified by French airmen that enemy troops were moving from west to east, and this was confirmed later by British planes. These vital observations and Germany's failure to achieve air superiority at the outset cost the Central Powers dearly, and led to the breaking of the Kaiser's drive.

As a result of the trench stalemate, aerial photography was soon being used to detect changes in positions, sizes of armies, and the like, and good aerial cameras become available in early 1915. The aerial war, for the most part, was built around observation, with combat and bombing secondary. For artillery spotting, pilots at first used colored signal flares. Radio was never completely reliable. The first extensive use of aerial photography in an Allied campaign was in the Battle of the Somme, in the spring of 1916, when mosaics of the German lines and positions were pieced together from photographs.

The French Spad (along with the Nieuport) ran the original Fokker monoplane out of the skies in the late summer and fall of 1916.



Combat

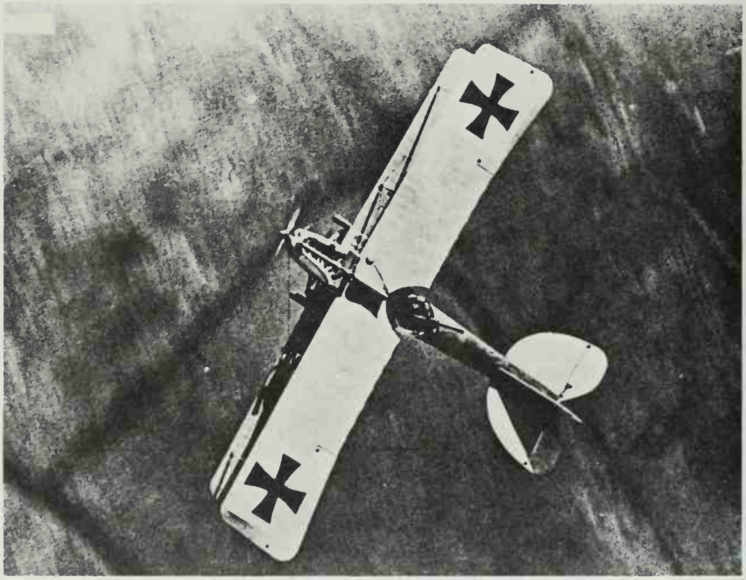
The emerging importance of aerial reconnaissance induced the move toward combat, primitive as it was in the beginning. Pilots stopped waving at enemy planes as they passed, and instead took potshots with pistols, rifles, and shotguns. The Allies decided they had the best combat plane of 1914 in the two-seater Farman pusher, not only because the observer had a free field of fire, but also because the plane was the slowest around, affording the observer a chance to take good aim with his rifle at the Albatrosses as they buzzed by. This concept was short-lived. A machine gun was put on the Farman, and development of fast "tractor planes" (with propellers pulling from the front) began.

Then came the first real shocker in the air war. Anthony H. G. Fokker, Dutch boy wonder who had set up an aircraft factory near Berlin at the age of twenty-two, came forth with the Fokker monoplane. It was equipped with an interrupter gear permitting a machine gun to be fired nose-first between the propeller blades, and as such was the first true air instrument of war. The Allies were to wait for many months to develop their own synchronization, and it was costly.

Throughout 1915 the Fokkers dominated the B.E.2's, the Vickers and F.E. two-seaters, and the D.H.2 single-seater pusher produced by the British, as well as the French planes. Britain produced the fast single-seater Bristol Scout, with a tractor "air screw" (propeller) in front, but had to mount the machine gun high on top of the wing to fire over the blades.

The Germans were wreaking destruction on Allied planes and had absolute mastery of the air at the opening of the Battle of Verdun in February, 1916. But the French achieved a balance by introducing the technique of sending formations of planes across the lines to seek out and attack the German aircraft before they got to the front. Germany

An early Albatross photographed from above by a British aviator.



countered with the famous "flying circuses," handled by outstanding pilots such as Manfred von Richthofen and Oswald Boelcke. The circus of planes, whose pilots were chosen on a highly personalized basis by its leader, moved to various parts of the front where air services were needed.

In the summer of 1916, Britain was finally able to introduce into its fighters the synchronized gear for firing through the propeller, starting with the highly maneuverable Sopwith "Pup." Air superiority soon reverted to the Allies with the Sopwith and the French Nieuport and Spad, only to be lost again in the fall to the German Halberstadt and an improved version of the Albatross.

The rapid technological development of the airplane as a fighting machine in the seesaw battle produced aces with fantastic records. Germany's von Richthofen was credited with downing 80 Allied planes before being killed in action in 1918. The French aces René Fonck and Georges Guynemer shot down 75 and 53 planes, respectively, and Billy Bishop, a Canadian, bagged 72.

Many Americans joined British and French air squadrons in advance of the United States' declaration of war, and one group formed its own unit, the Lafayette Escadrille, within the French air force. America's greatest ace, Eddie Rickenbacker, shot down 22 German planes and 4 balloons.

"Balloon busting," a hazardous enterprise into the teeth of protective antiaircraft fire and enemy planes, became a specialty of some aces. Frank Luke, America's number-two ace with 18 kills, destroyed more than a dozen German observation balloons in a little more than two weeks before perishing himself.

The French introduced an electrically fired rocket—the Adam of the powerful wing rockets of World War II and Korea—especially for "balloon busting."

The German air superiority, with the help of the Halberstadt and Albatross D.III, became very marked in the early months of 1917. In addition to better performance, these single-seaters outgunned the Allies' two-seater craft with the first twin machine gun mounts of the war. By spring, however, Britain brought to the Western Front the single-seater S.E.5, followed in the summer by the splendid Sopwith Camel and two-seaters of exceptional performance: the D.H.4 and Bristol Fighter.

France produced an improved version of her great Spad, and the Allies slowly regained control of the air, which they never completely lost before the Armistice.

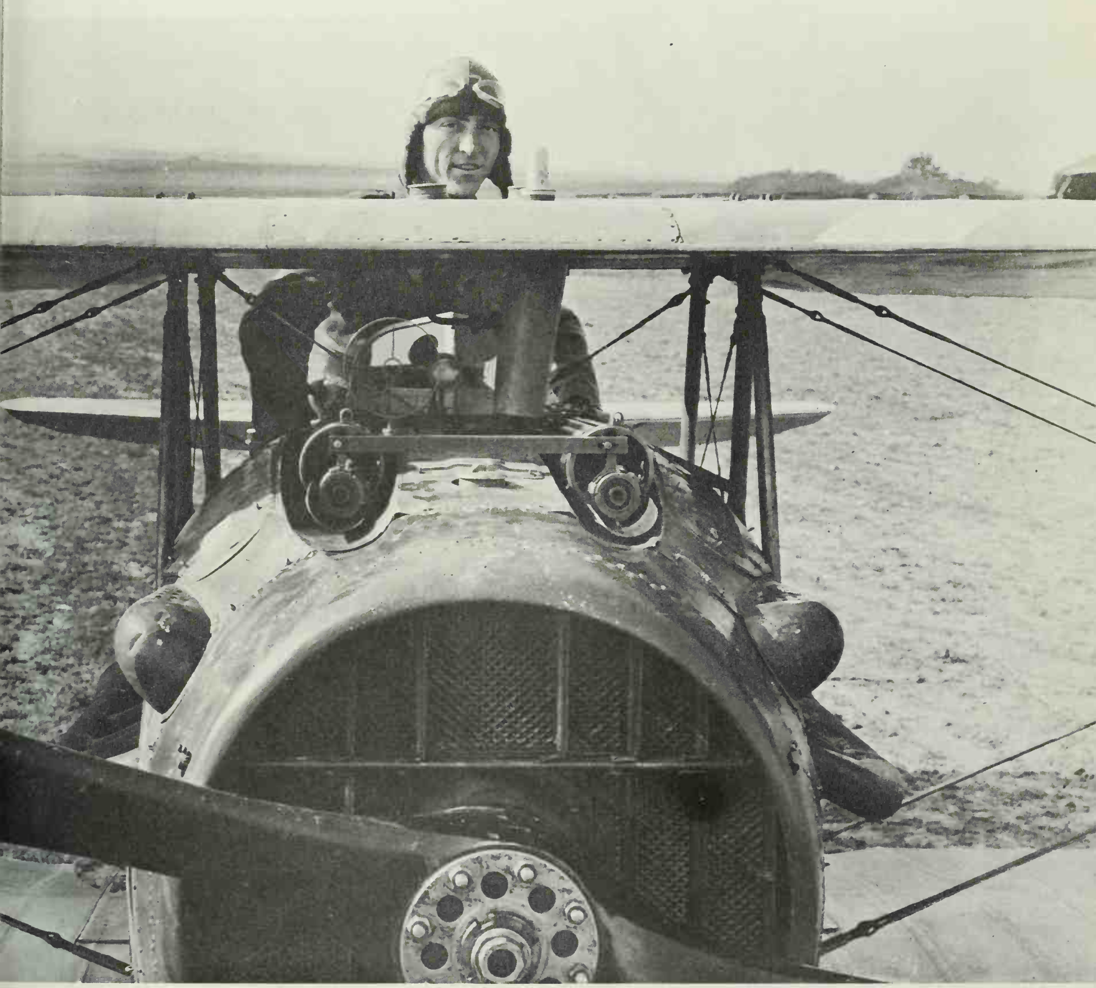
Concurrent with the last great offensive of the Germans, beginning in March, 1918, a flood of old and new planes was unleashed that won temporary local air superiority and at times threatened the Allies' lead. Earlier general-purpose types of German aircraft such as the Rumpler C-111, Albatross C-111, and L.V.G. C-111, which had been relegated to the Russian front due to obsolescence, were pressed into the German drive.

New German types included a powerful A.E.G. single-engine plane;

the Albatross D.V, a single-seater scout resembling the French Baby Nieuport; the D.F.W. with 200-hp Benz engine; three models of "Kondors"—including one with metal wings—which could fly about 125 mph; and a Fokker triplane. The triplane caused a sensation with its radical departures, but a new Fokker D.VII made the greatest inroads on the worn-out Nieuport 28's being flown by American pilots along the Marne. The problem was solved with their replacement by fast new Spads.

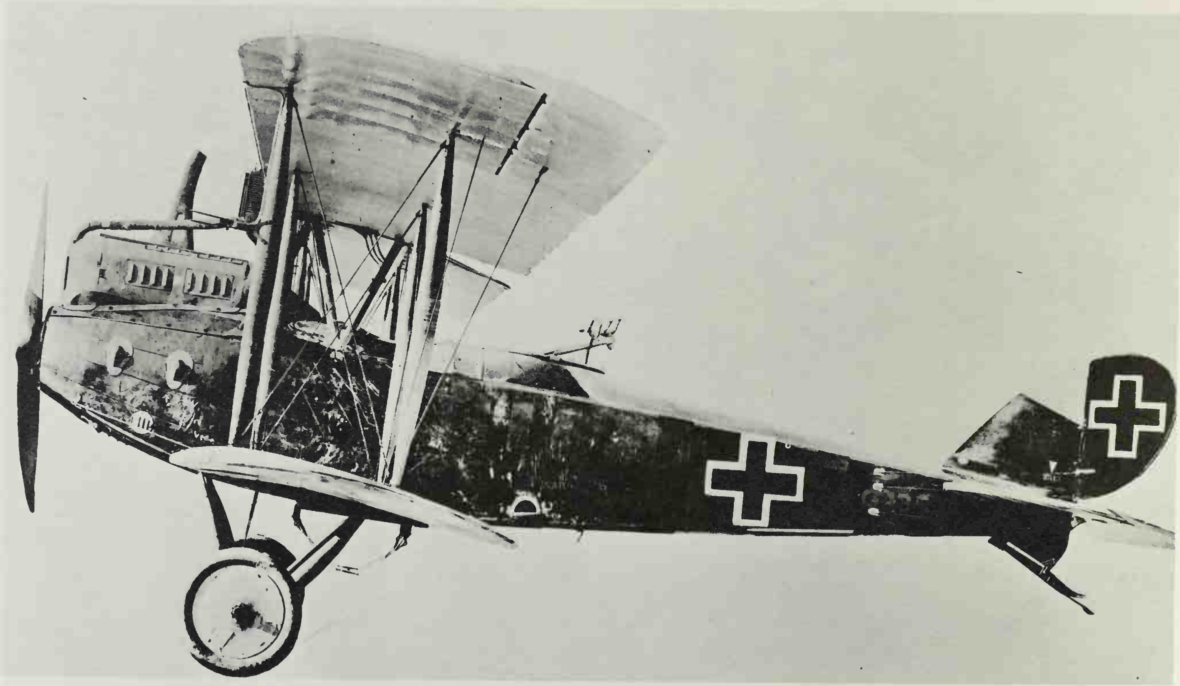
Individual combat heroics had faded in 1917 as planes flew in larger and larger groups for more effective action and protection, the number at times approaching 50 to 60. A final great air spectacle took place during the Battle of Saint-Mihiel in September, 1918, when an Allied air armada of nearly 1,500 planes under Colonel William "Billy" Mitchell scoured German planes from the area during the American advance.

America's greatest World War I ace, Lieutenant Eddie Rickenbacker, stands in his Spad, Meurthe-et-Moselle, in October, 1918. He shot down 22 planes and four balloons.

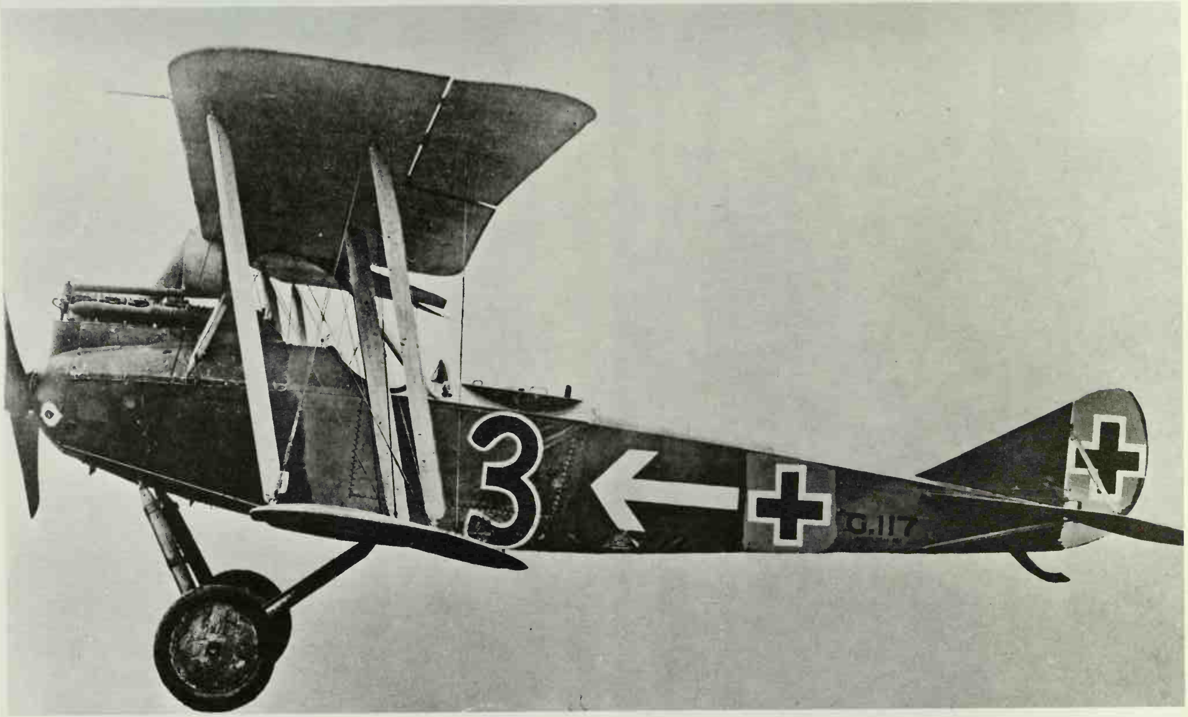


British De Havilland 5 biplane, powered by a 110-hp Le Rhone engine.

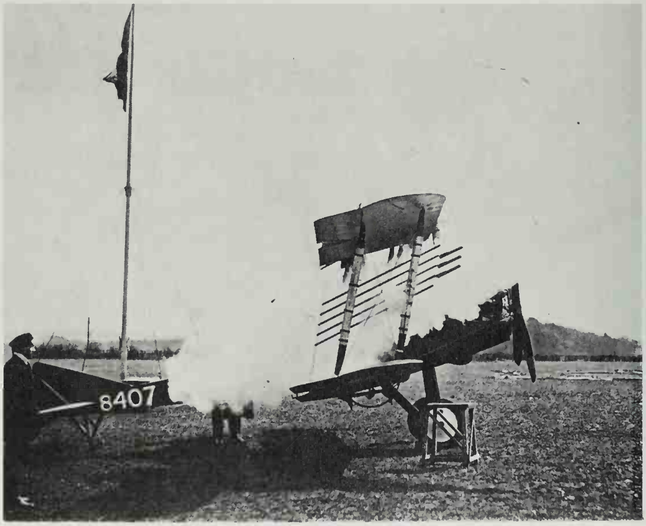
Three-quarter view of a captured German Halberstadt, with Allied colors.



German L.V.G. two-seater.



German Rumpler, another early two-seater.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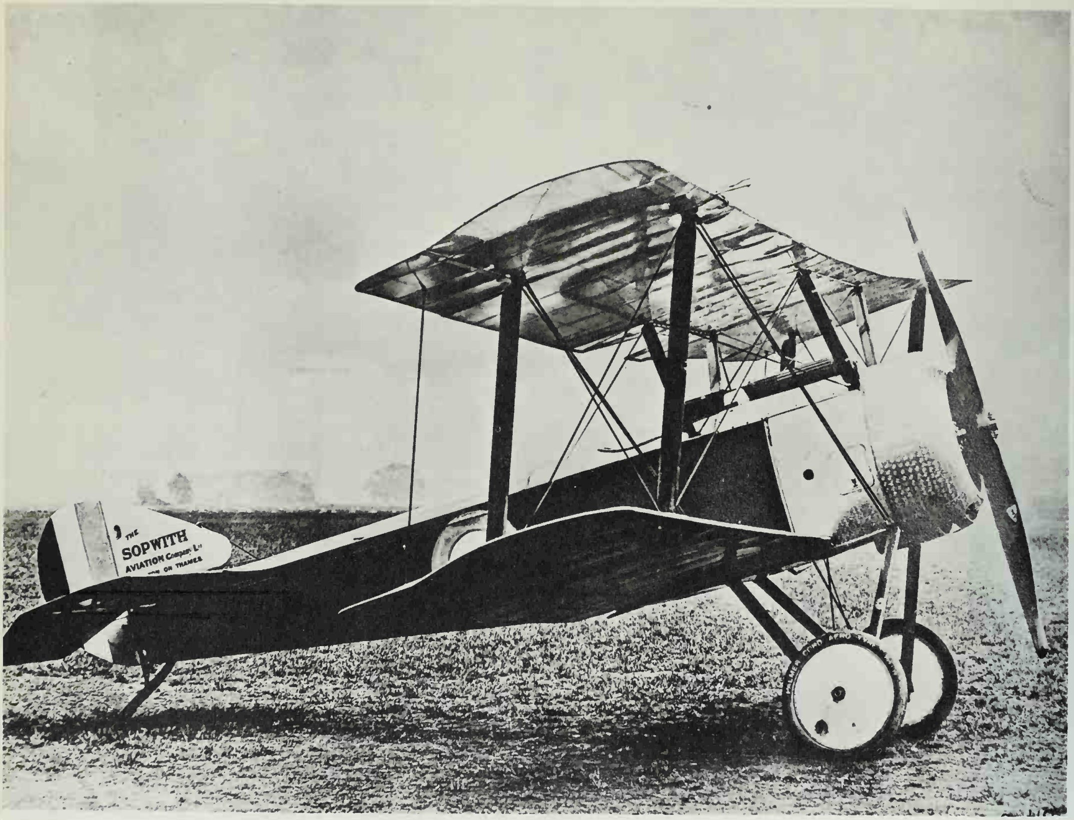
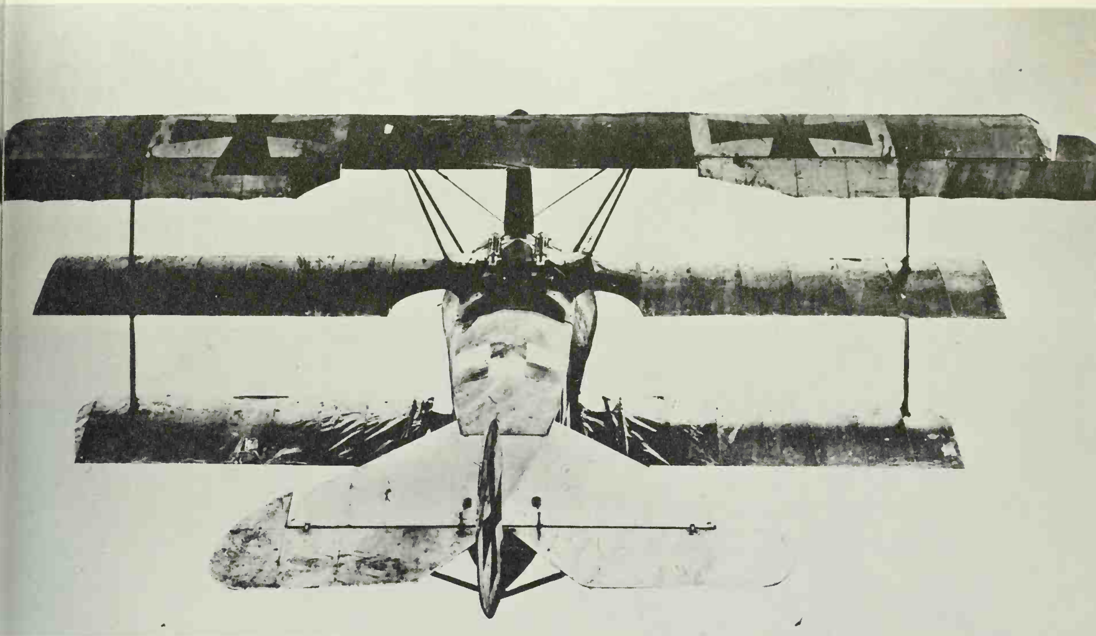
An American pilot attached to the Lafayette Escadrille, shown with his baby Scout Nieuport equipped with balloon-strafing rockets, in 1916.

Even wing-mounted rockets were developed in embryonic form during World War I. Testing is shown here of Le Prieur rockets attached to the interplane struts, which were fired electrically. Invented by Lieutenant Vaissean Y. A. G. de Prieur, a French naval officer, these rockets had a range of 300 to 400 feet, and were used to destroy balloons and airships.

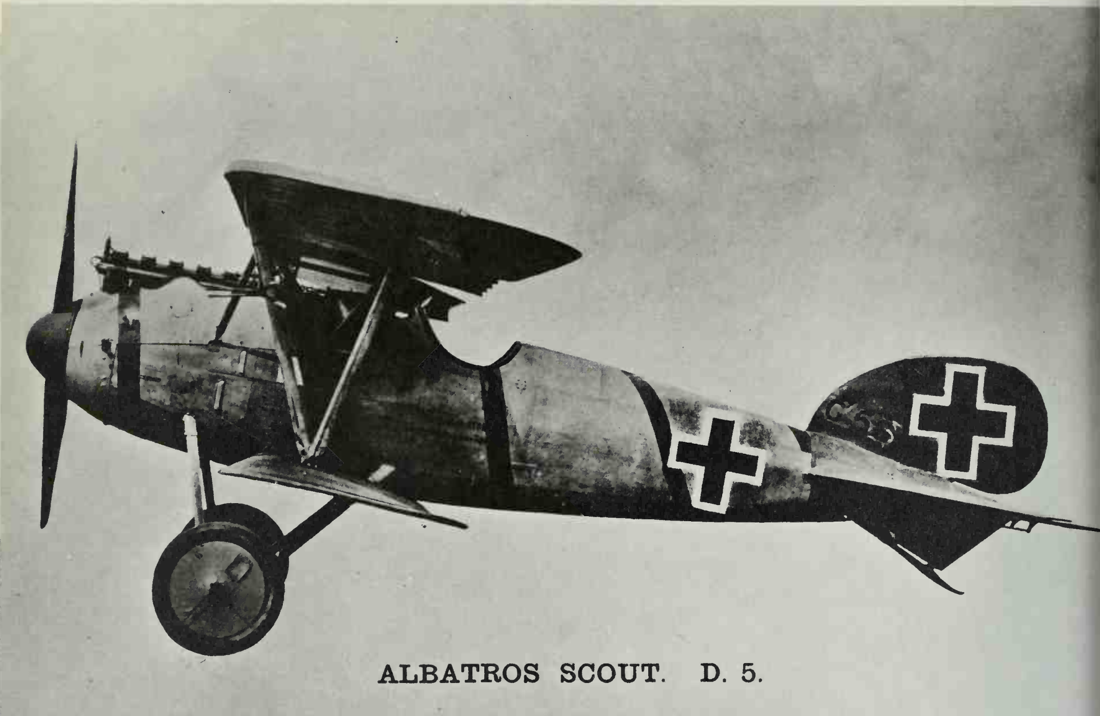
Sopwith produced a great line of British fighters. The Sopwith "Pup" was the first British plane to be equipped with a machine gun synchronized with the propeller. It was driven by an 80-hp Le Rhone engine.

The Sopwith Camel, one of the most versatile fighters, was standard plane carried by cruisers and battleships. Engine was 130-hp Clerget.

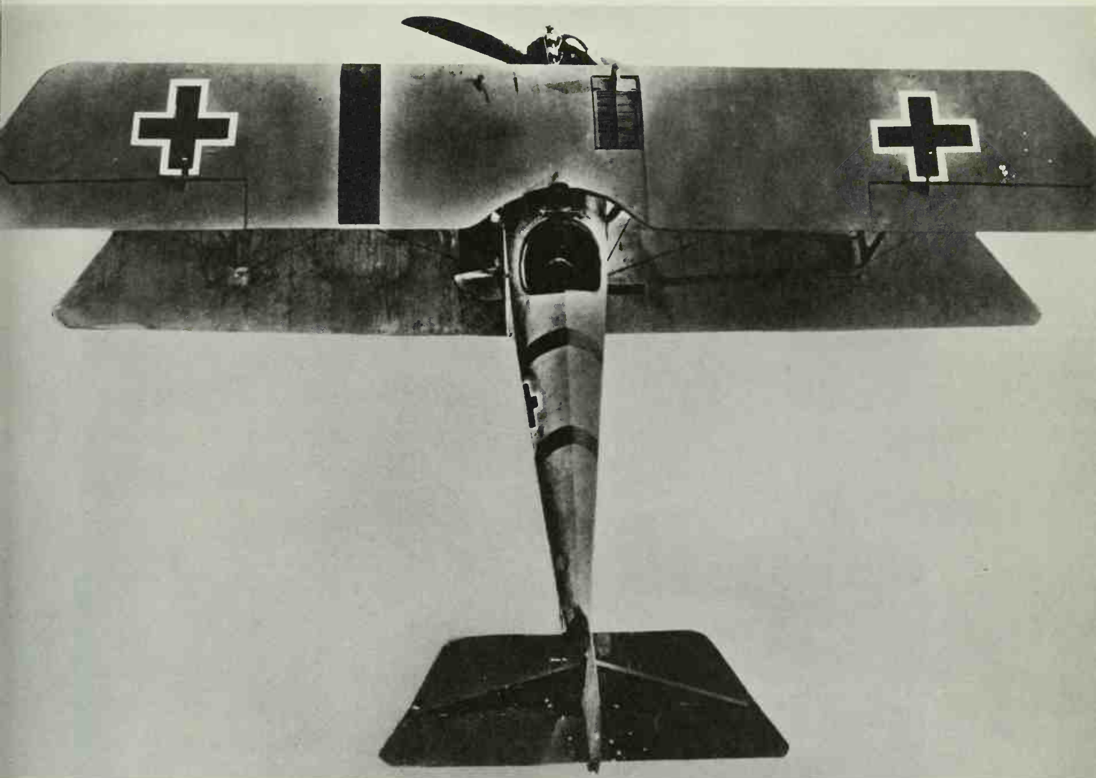




Fokker triplane single-seater created sensation among designers.

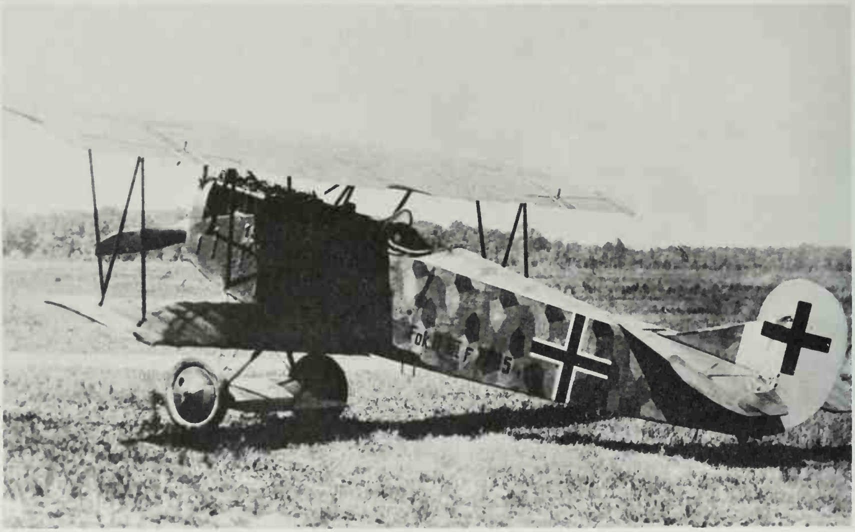


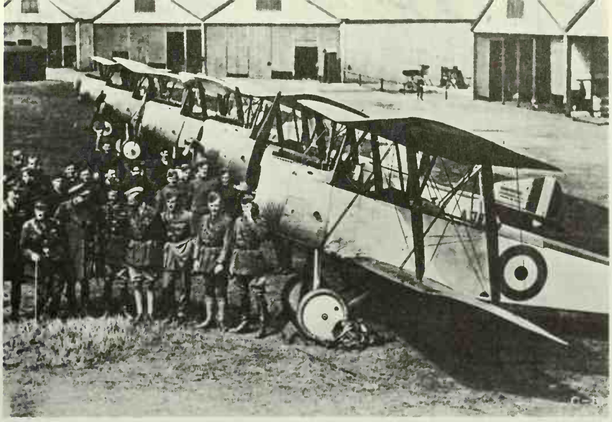
The Albatross Scout D.V, appearing in 1918, was the best of a steadily improving line of this German make. Developed from the D.III, it was lighter but more powerful, with a 180-hp Mercedes engine.



Another German high performer was the single-seater Pfalz Scout.

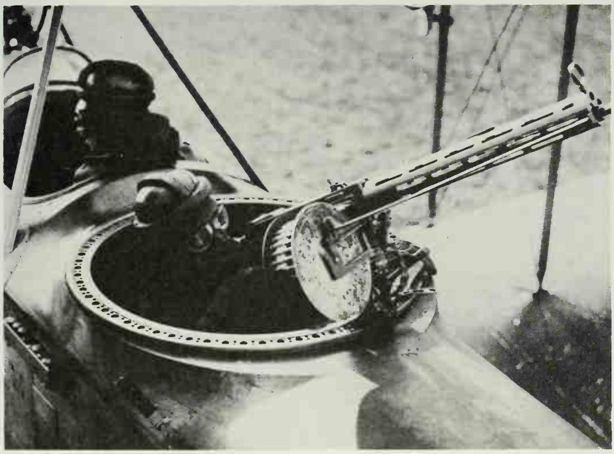
The German Fokker D.VIII was the best fighter on the Western Front in 1918 until an improved French Spad appeared in the summer.



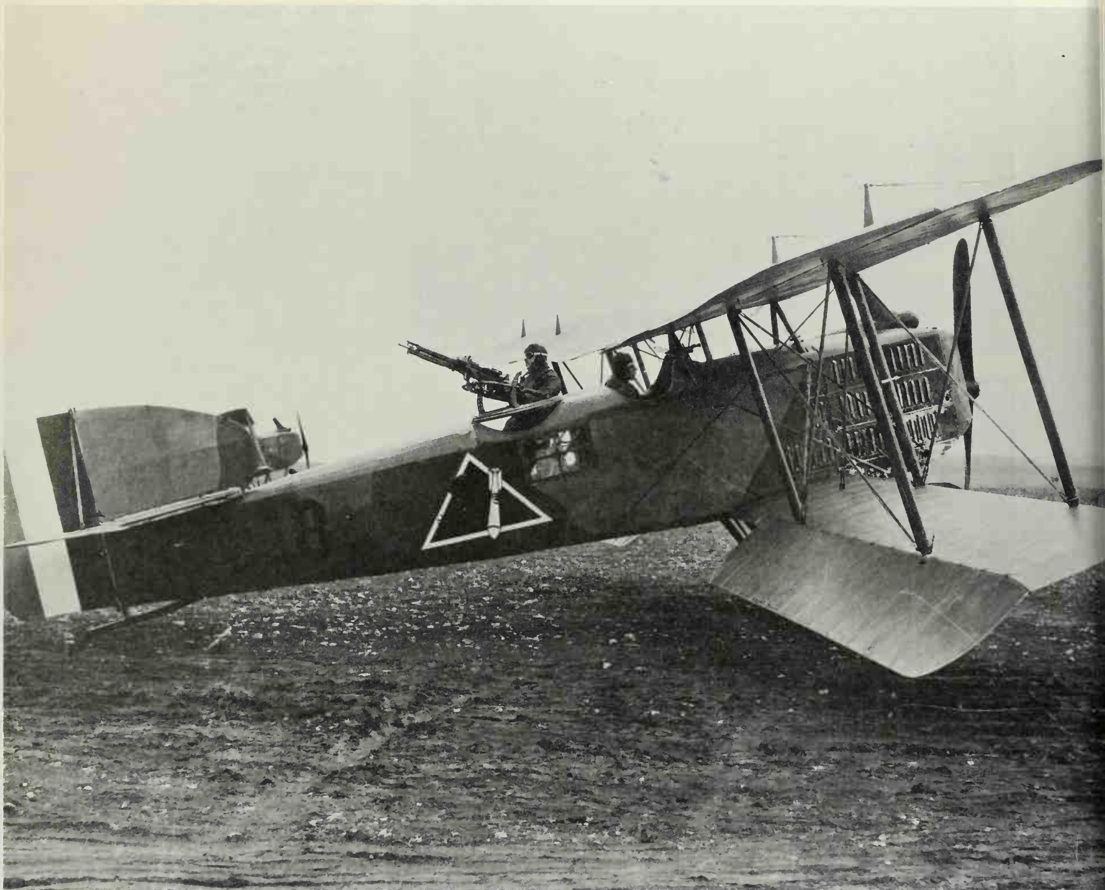


This R.A.F. squadron gave the name "Gotha Strafers" to their two-seater Sopwith 1½ "Strutters." Sopwith also produced the "Dolphin" and tiny "Kitten" models.

Captain Baron Manfred von Richthofen's pursuit flight poses on the Western Front.



Close-up of German Parabellum machine gun in a two-seater plane.



French Bréguet bomber about to take off as flagship of first American bombing squadron to raid Germany (96th Aero Squadron, Amanty Field, France), on July 29, 1918.

Bombers

All the war capabilities of the airplane seem to have developed hand-in-hand. It did not take long for observers in the early planes to begin carrying a sack of bombs on reconnaissance trips. The British and French began early to bomb military objectives in and behind the trenches—communications, depots, and munitions dumps.

The French Bréguet was an excellent all-purpose bomber, and heavily armed. Smaller planes soon were equipped with racks for small bombs and performed harassing, if not very effective, missions.

The first bombing raids on enemy territory, away from the fighting front, were carried out by Germany—notably on Great Britain. Scattered bombing by planes and seaplanes started in December, 1914, then gave way to the concentrated attacks of the Zeppelins through most of 1916.

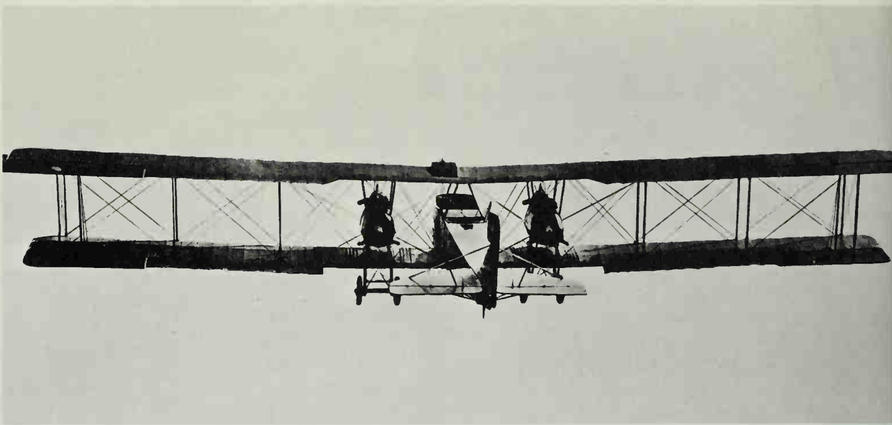
In the spring of 1917, a special airplane squadron was formed by the Germans for the systematic bombing of England—particularly London. The raids were almost invariably carried out by moonlight. Gothas—eventually giant Gothas that carried 660-pound bombs—dropped explosives on England in the twelve-month span from May, 1917, to May, 1918, killing 788 persons and wounding 1,844. The effect on munitions output and morale was considerable. Near-panic prevailed in the East End of London, where some 300,000 people poured nightly into the underground railways and slept on the platforms, whether raids were in progress or not.

After losing 7 out of 30 to 40 bombers sent over England in May, 1918, the Germans quit the London area. Other scattered German raids were directed at Paris and French towns. Retaliatory attacks were made by the British and French on Stuttgart, Cologne, Karlsruhe, and towns in western Germany.

The British mood of retaliation resulted in the formation in 1918 of the "Independent Air Force" for the purpose of attacking industrial targets inside Germany. To be employed primarily was the big Handley Page bomber, which became available only in 1917. It was capable of carrying sixteen 112-pound bombs and remaining airborne for eight hours. The aircraft was used for night attacks, while the D.H.4 and D.H.9 dropped their 500 to 600 pounds of bombs by day.

American aviators made their first bombing attack on Germany in July, 1918, and in October dropped 32 tons of bombs behind the German lines with more than 350 planes.

On another front, in September, 1918, relays of British planes caught what was left of the Turkish 7th and 8th armies in a deep gorge leading to the Jordan River and bombed and strafed it to extinction.

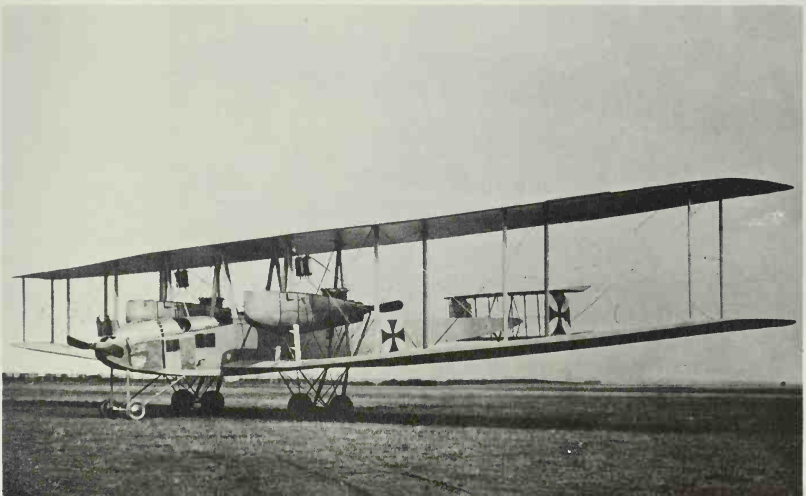


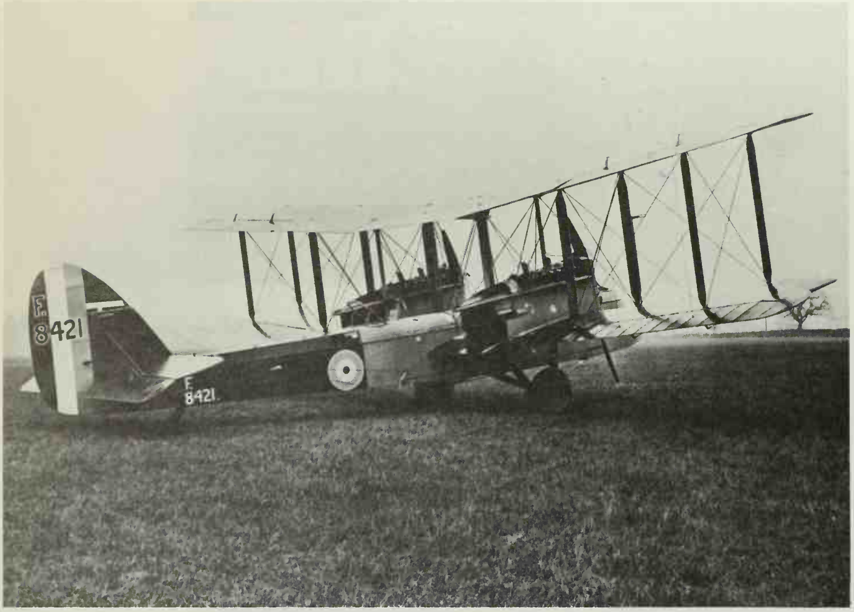
(top) The big Gotha bomber that participated in heavy German raids on London in 1917 and 1918, then turned to Paris. It had a 60-foot wingspread, was 18 feet high, 50 feet long, and constructed of wood covered with fabric. It was powered by two 260-hp Mercedes pusher engines.

(bottom) The Germans came out with a variety of huge planes in 1918, some of which were completed in time for bombing missions. Most were converted to passenger planes after the war. Shown is German bomber R-34.

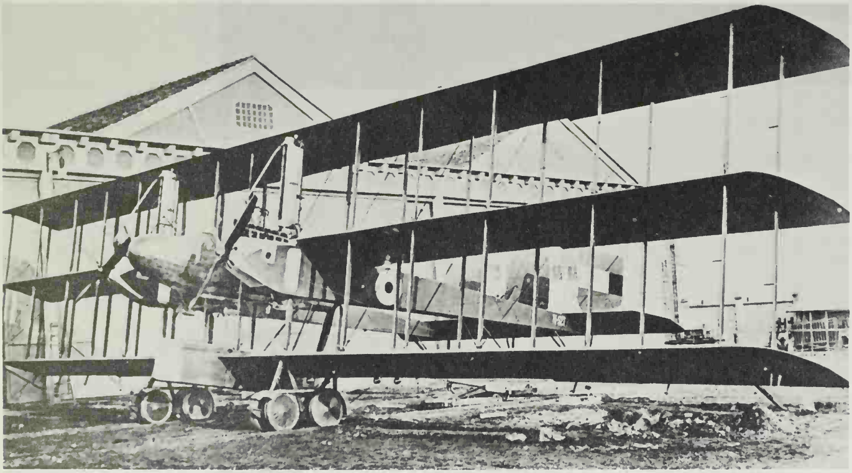
(top) German V.G.O. III bomber.

(bottom) The British Handley Page, the Allies' biggest bomber, appeared in 1917 and was copied to some extent in the giant German Gotha. A Handley Page flew from London to Constantinople. This big night bomber carried sixteen 112-pound bombs, could remain aloft for 8 hours.

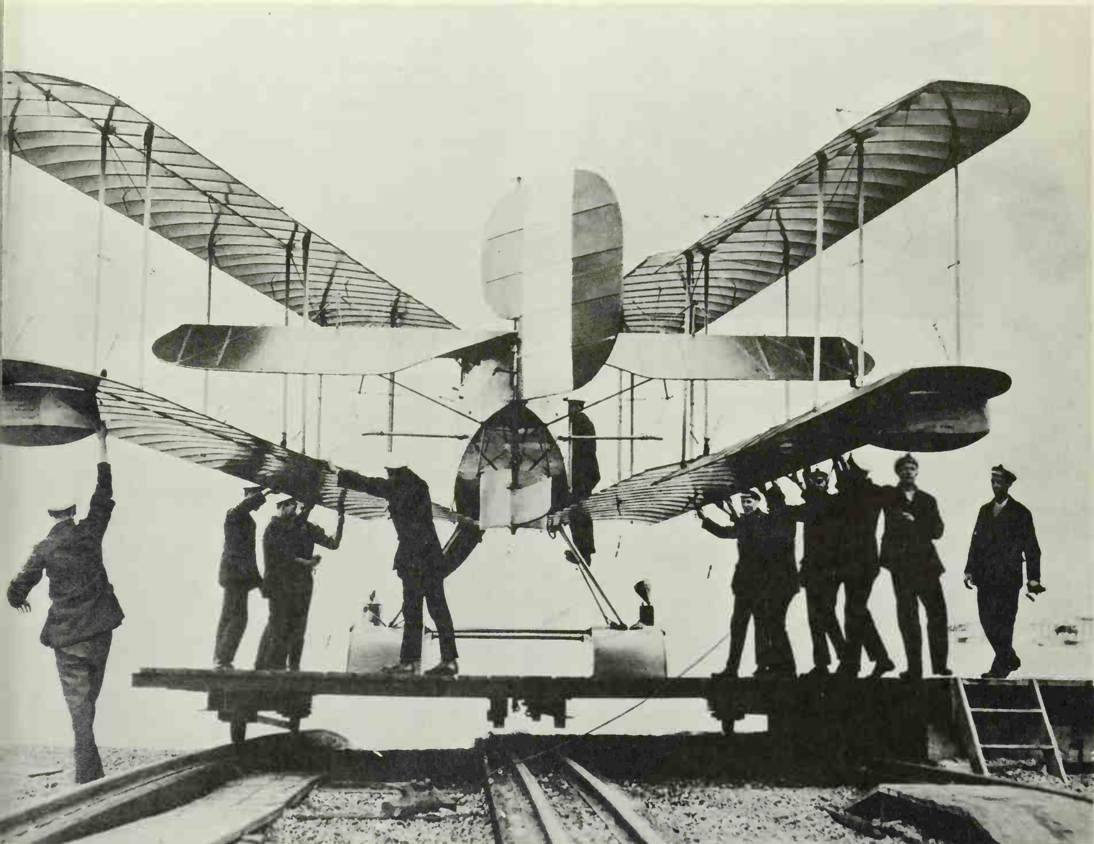




British-built De Havilland 10.A. Amiens Mark IIIa was powered by two 400-hp Liberty engines.



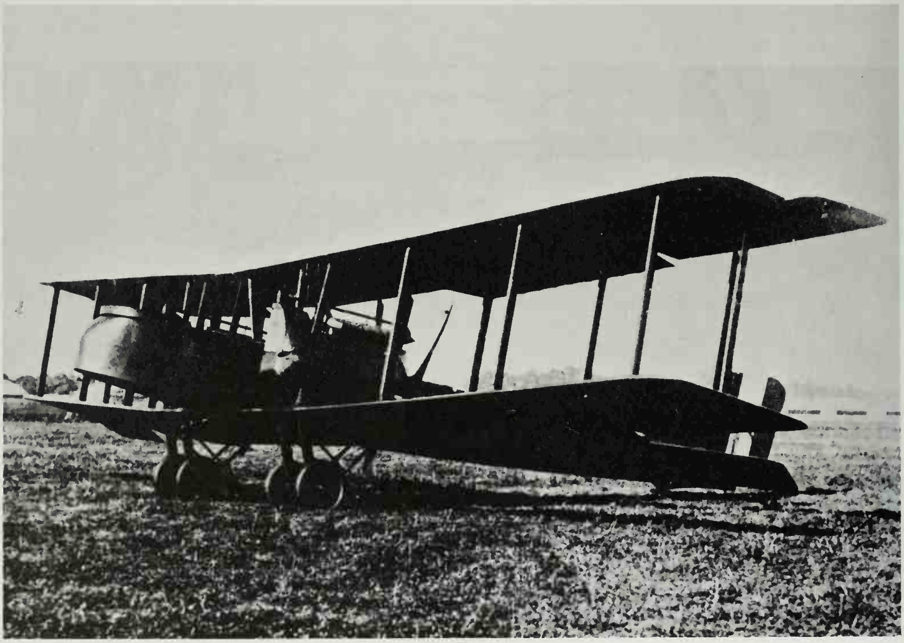
Italian Caproni Ca.41 triplane bomber, one of six purchased by the Royal Naval Air Service. It had three 250-hp Fiat engines.

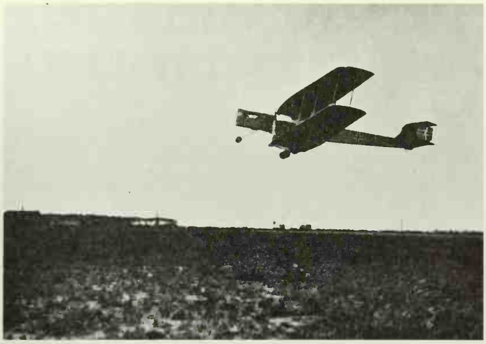


American sailors working on H16 type of flying boat at Brest naval air station, Finistère. It carried an observer, pilot, machine gunner, radio operator, and mechanic, and could also carry four bombs. Lifting capacity: 5 tons.

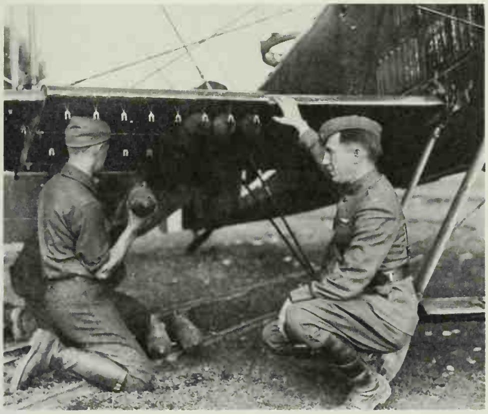
Close-up of twin machine guns mounted on rear cockpit of a French Bréguet 14.A.2 biplane shows why these dependable bombers were rough customers for German fighters.

Quarter view of a German Gotha G.V repainted with Allied colors. Machine gunners' cockpits were carried in the front and rear.





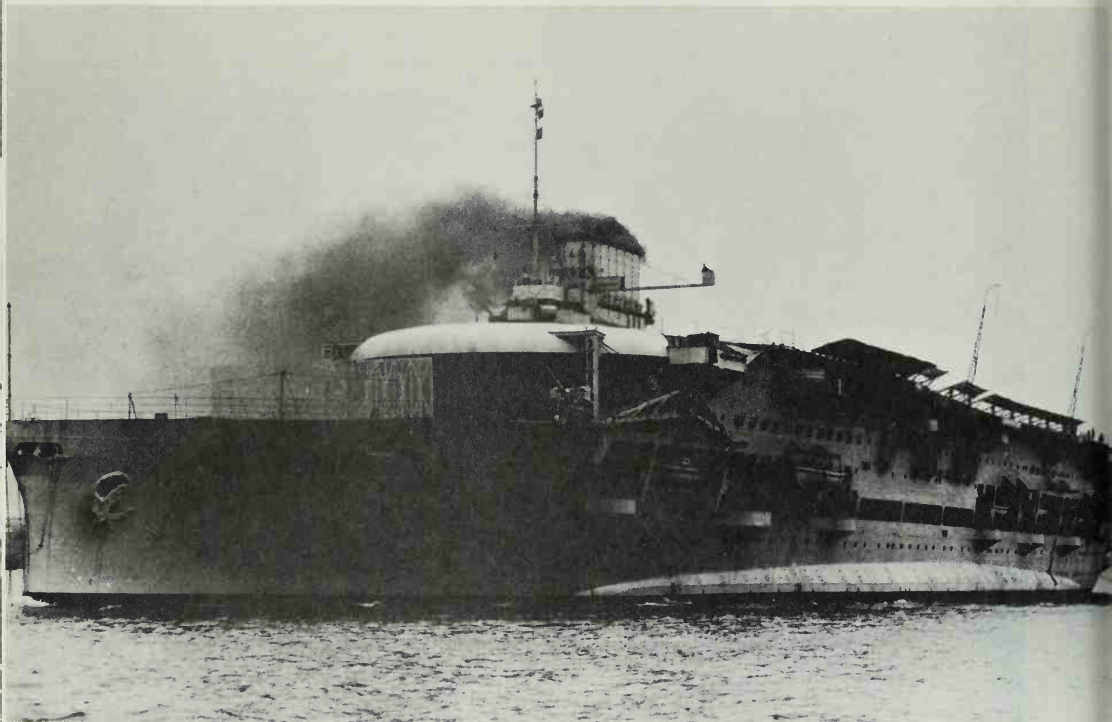
Staakener Giant, built by Zeppelin Works, had wingspread of 140 feet, was 65 feet long, carried 25 passengers or 3½ tons of bombs. It was powered by five 260-hp Mayback engines with speed of 75 mph. Construction was of wood.



Loading the bomb racks on a Bréguet, Amanty, France.

German airman takes bombs aboard. They were dropped the same way in the early days before bomb racks and bombsights.

Glorious, a sister ship of *Furious* when completed as a battle cruiser, was converted to a carrier after the war, along with *Courageous*.



EVOLUTION OF THE AIRCRAFT CARRIER

BOTH GREAT BRITAIN AND THE UNITED STATES had been active in shipboard experimentation soon after the first military planes were procured in 1909. The first notable success was on November 14, 1910, when Eugene Ely, a Curtiss exhibition pilot, flew a plane off the deck of the cruiser *Birmingham*. On January 18, 1911, Ely landed a Curtiss biplane on a wooden platform mounted on the cruiser U.S.S. *Pennsylvania,* anchored in San Francisco Bay.

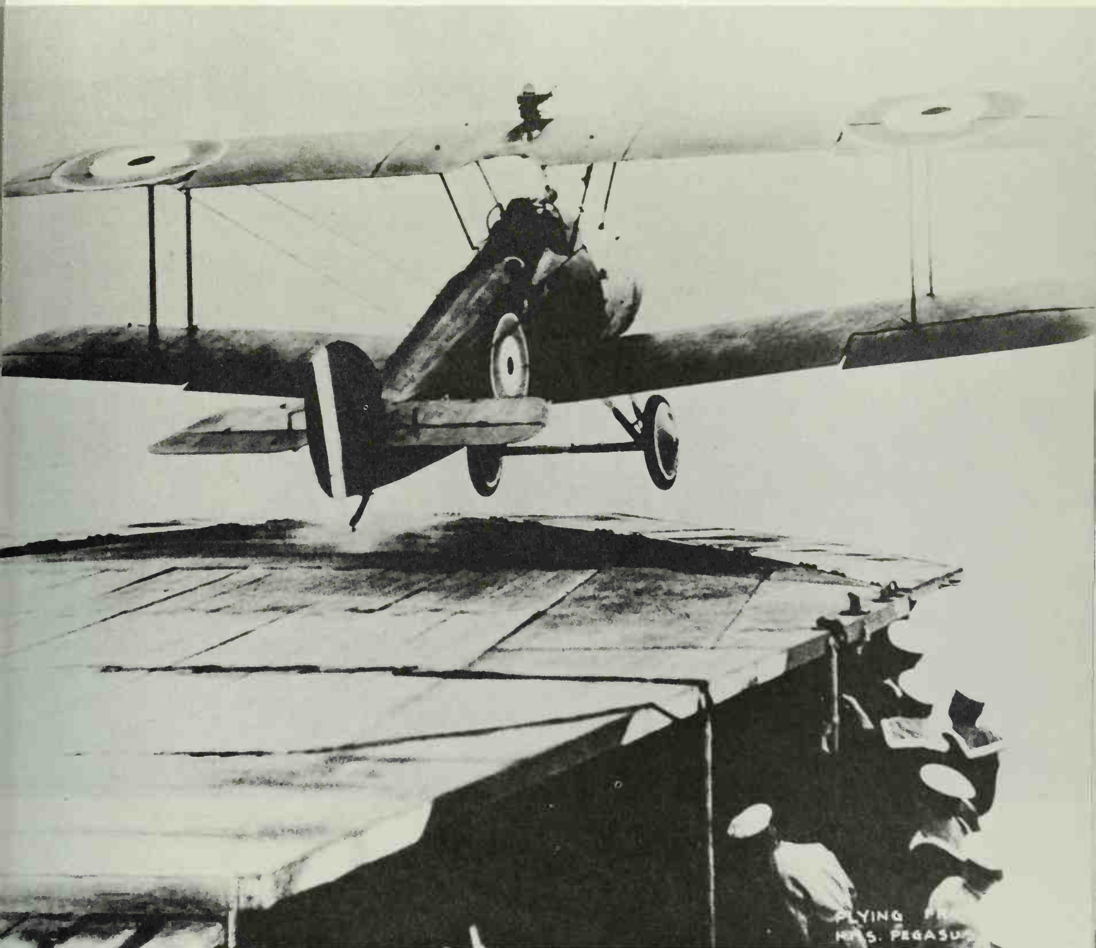
At the beginning of World War I, naval emphasis had shifted to seaplanes, and the British produced the first carrier in the *Ark Royal,* a converted tramp steamer. She was fitted with a flying-off deck forward and cranes to lift the returning seaplanes inboard to a hangar. Britain next took over several fast passenger vessels for conversion: *Campania, Ben-My-Chree, Engadine, Manxman, Empress, Riviera, Pegasus, Nariana,* and *Argus.* Two of these seaplane carriers established landmarks in naval aviation history.

On August 12, 1915, the first successful torpedo plane attack was carried out against a Turkish steamer off Gallipoli by a plane from *Ben-My-Chree*. The *Engadine,* at Jutland in May, 1916, was the first carrier involved in a fleet action, sending a lone seaplane aloft to observe German ship movements—but its message was never received by Admiral Beatty, the battle cruiser force commander.

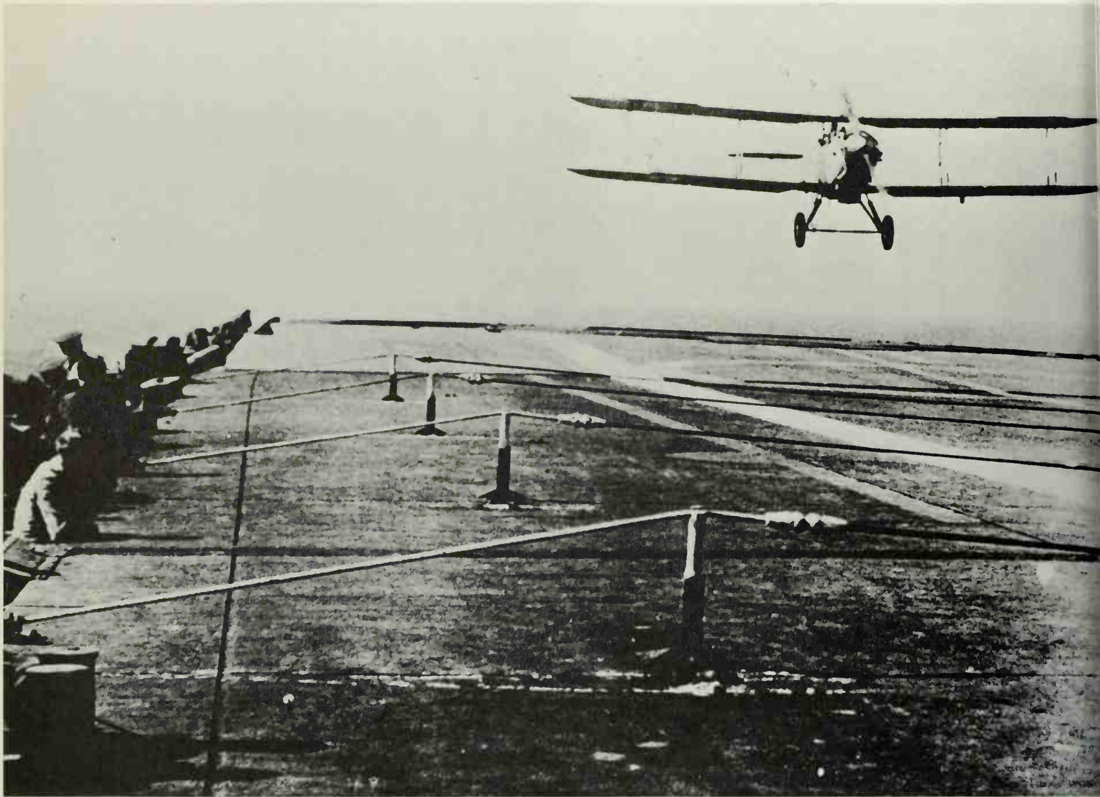
Progress toward a true aircraft carrier was slow. Although successful takeoffs from forecastle platforms on two "pre-dreadnoughts" had been staged in 1912, it was not until a land plane flew off the cruiser *Vindex* in 1915 that emphasis shifted from seaplanes. Little Sopwith Camels became standard equipment on larger vessels, more than 100 being carried by fleet units as spotters by 1918. Capital ships carried two, mounted fore and aft. Destroyers occasionally towed platforms at high speed from which a small land plane could become airborne.

In 1917 the Admiralty appropriated a battle cruiser under construction (as the United States was to do with the powerful *Lexington* five years later) and began a two-stage conversion. The *Furious* was originally designed as a "light battle cruiser"—at 22,700 tons displacement—with main armament of two 18-inch guns. The forward gun was removed, and the ship converted to a partial carrier with a flying-off deck for both land and seaplanes.

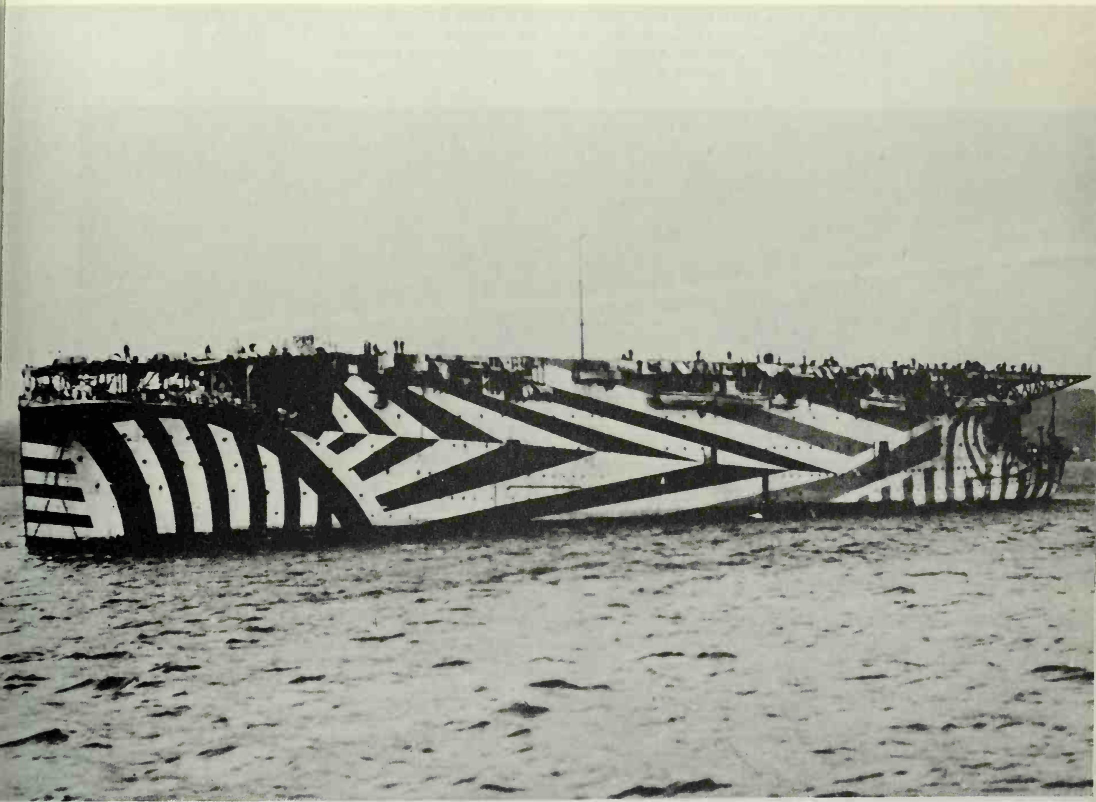
The after turret was removed in 1918, and full conversion completed. In July, *Furious* made history when seven Sopwith Camels flew off her deck and bombed the Tondern Zeppelin base, destroying two airships. In August, land planes alighted on her deck for the first time. The evolution of the true prototype of aircraft carriers was complete. The elated British laid up the battle cruisers *Courageous* and *Glorious* after the Armistice for eventual reconstruction, and they served as carriers in yet another war. At the same time, plans were drawn and construction started on *Hermes,* the first ship to be designed from keel up as an aircraft carrier.



A wheeled plane taking off from *Pegasus*. Takeoffs had been achieved earlier from forecastle runways of battleships and cruisers. Note machine gun mounted above the wing in order to fire outside the propeller arc.

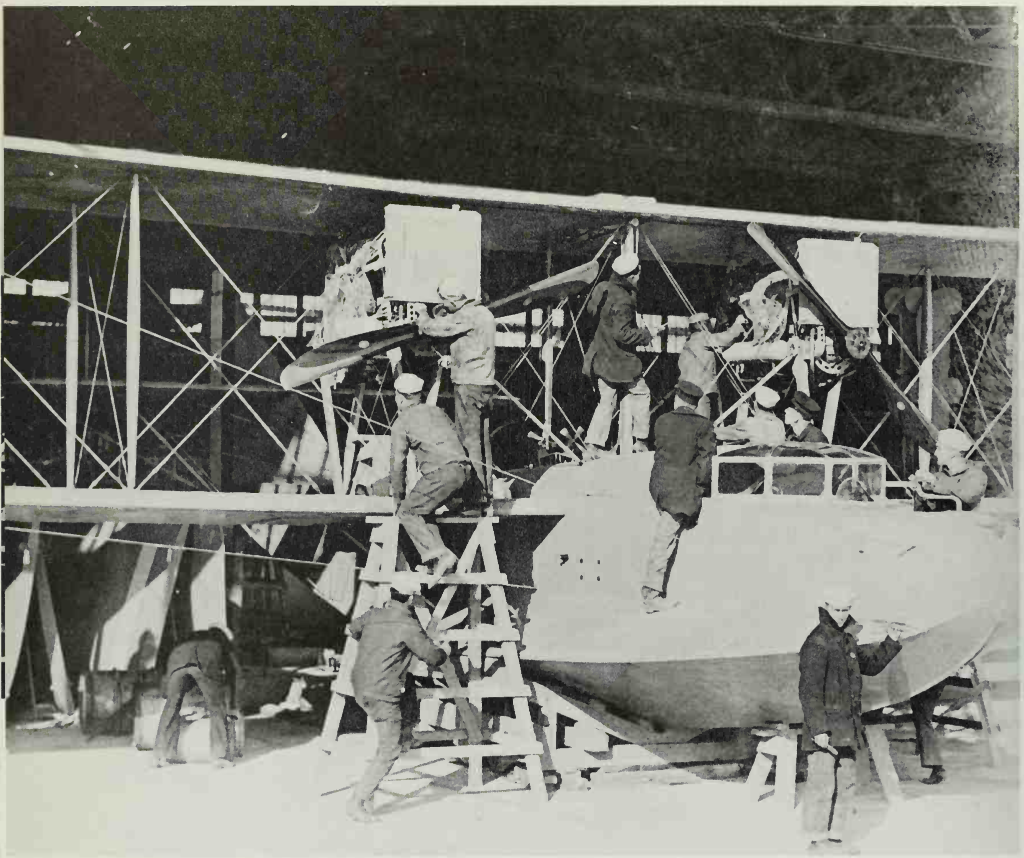


First successful landing of an aircraft on a carrier under way took place on H.M.S. *Furious* on August 2, 1918.



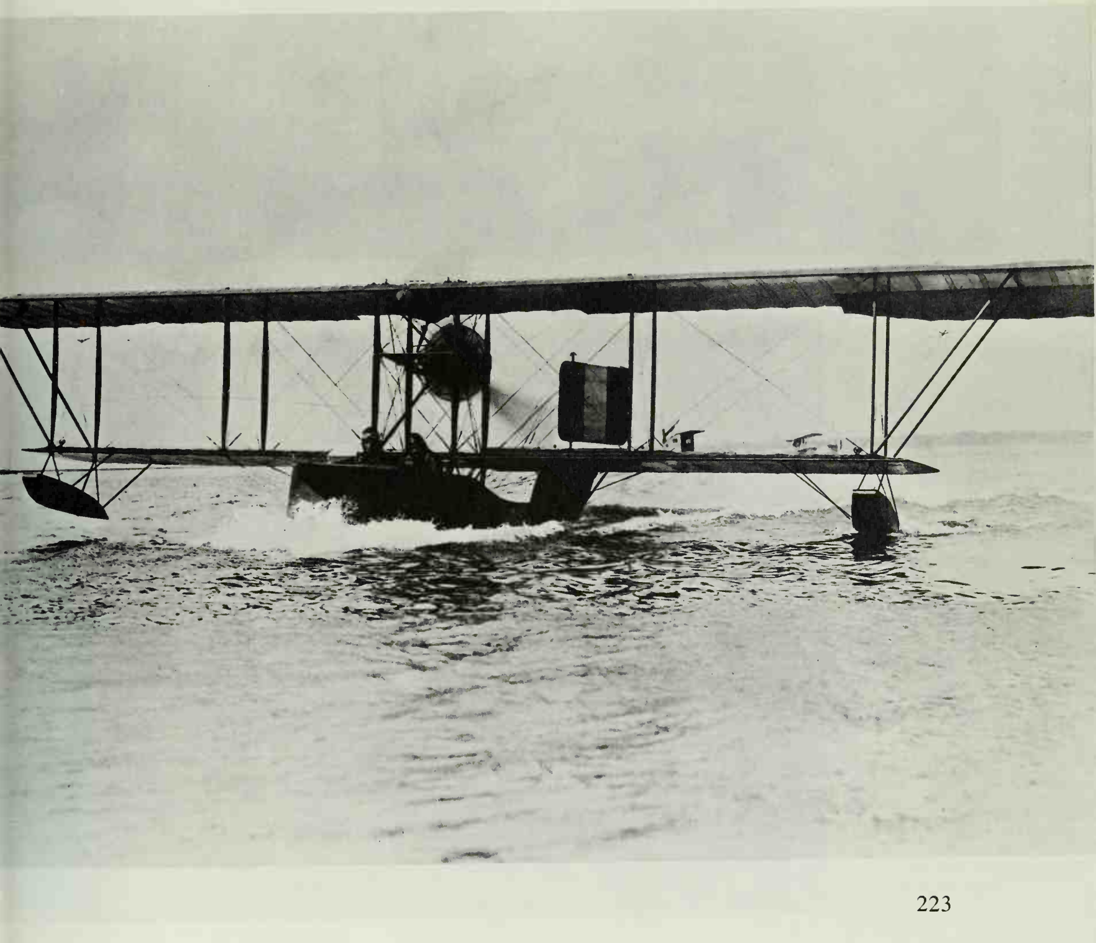
The *Argus*, started as an Italian liner, was completed in late 1918 as a carrier with full flying deck, and also served in World War II. She carried 20 planes, but was 200 feet shorter and 10 knots slower than *Furious*.

The big U. S. Navy H-16 flying boat, which arrived in Brest late in the war, was a predecessor of the yet larger NC Class (the 'Nancies') which were to be the first planes across the Atlantic in 1919. This class had a wingspan of nearly 100 feet and carried a crew of five.

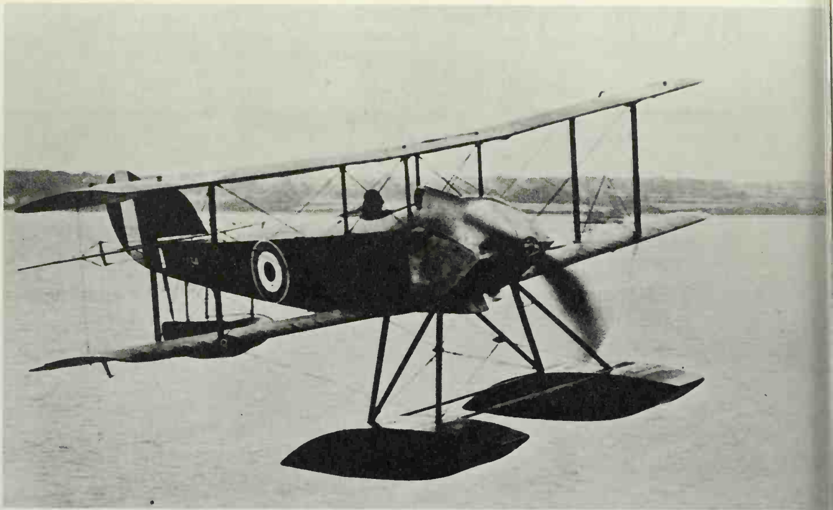


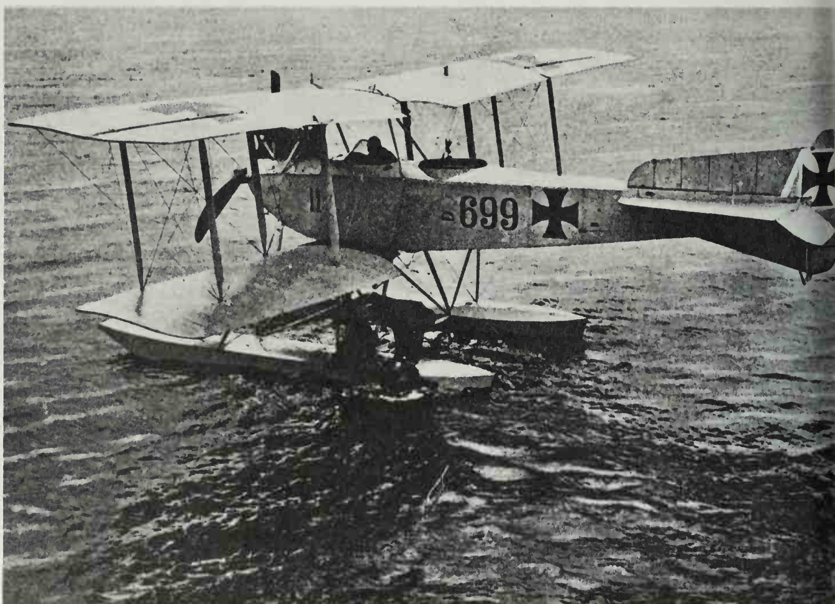
SEA PLANES

French Nieuport flying boat.

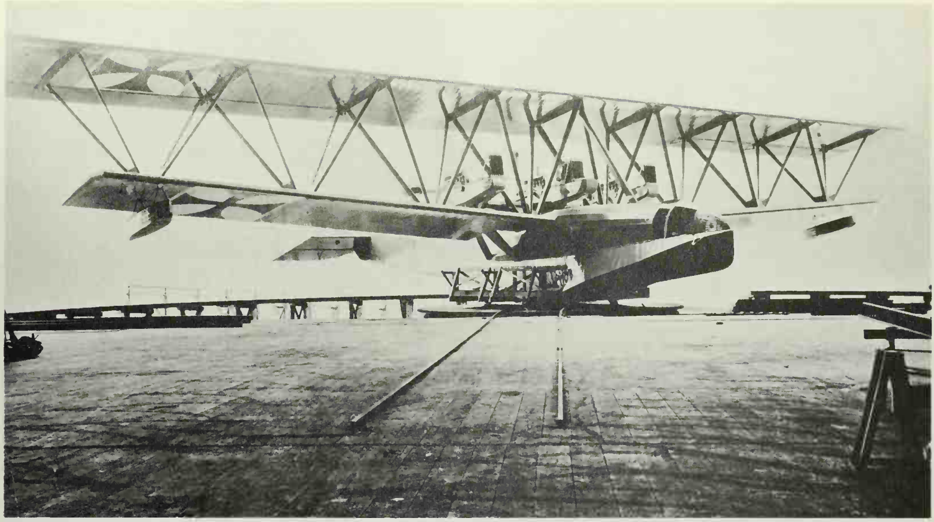


British "Schneider," fastest and smallest seaplane of its time.

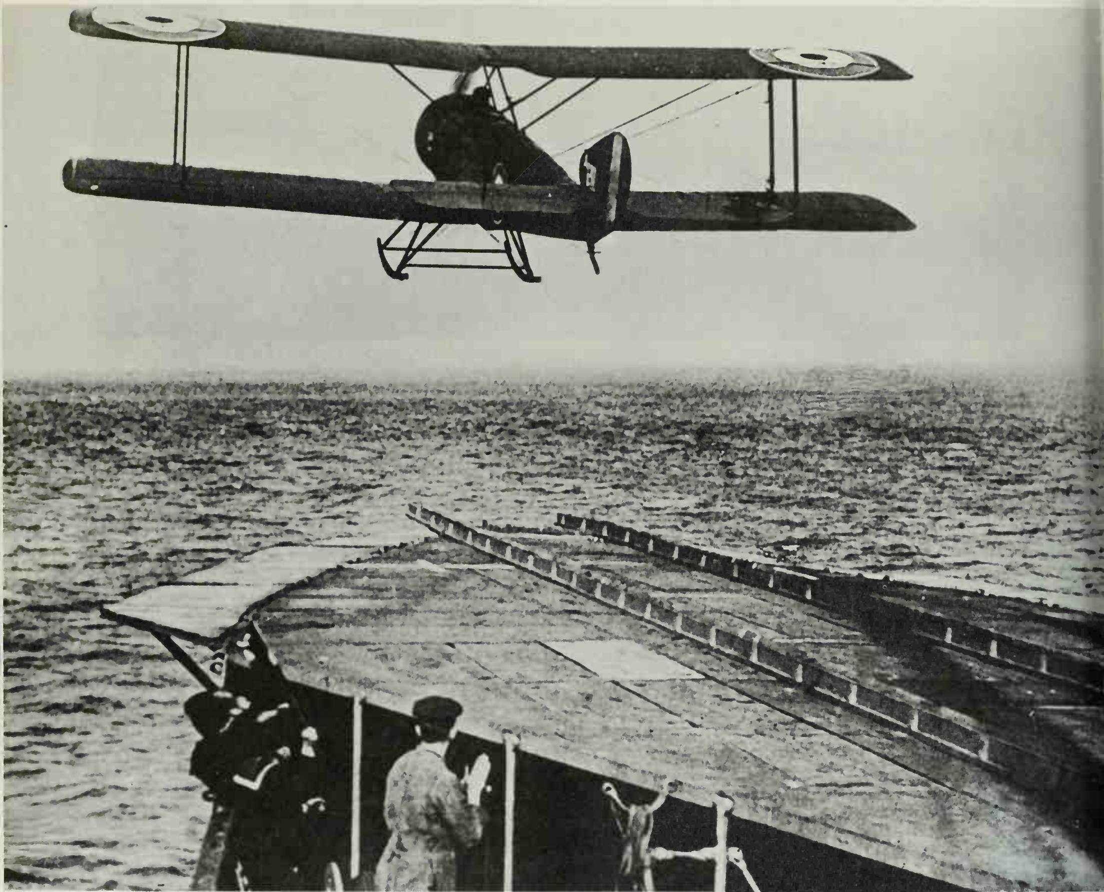




German Friedrichshafen FF.33e seaplane, with 150-hp Benz engine.



German Dornier flying boat.



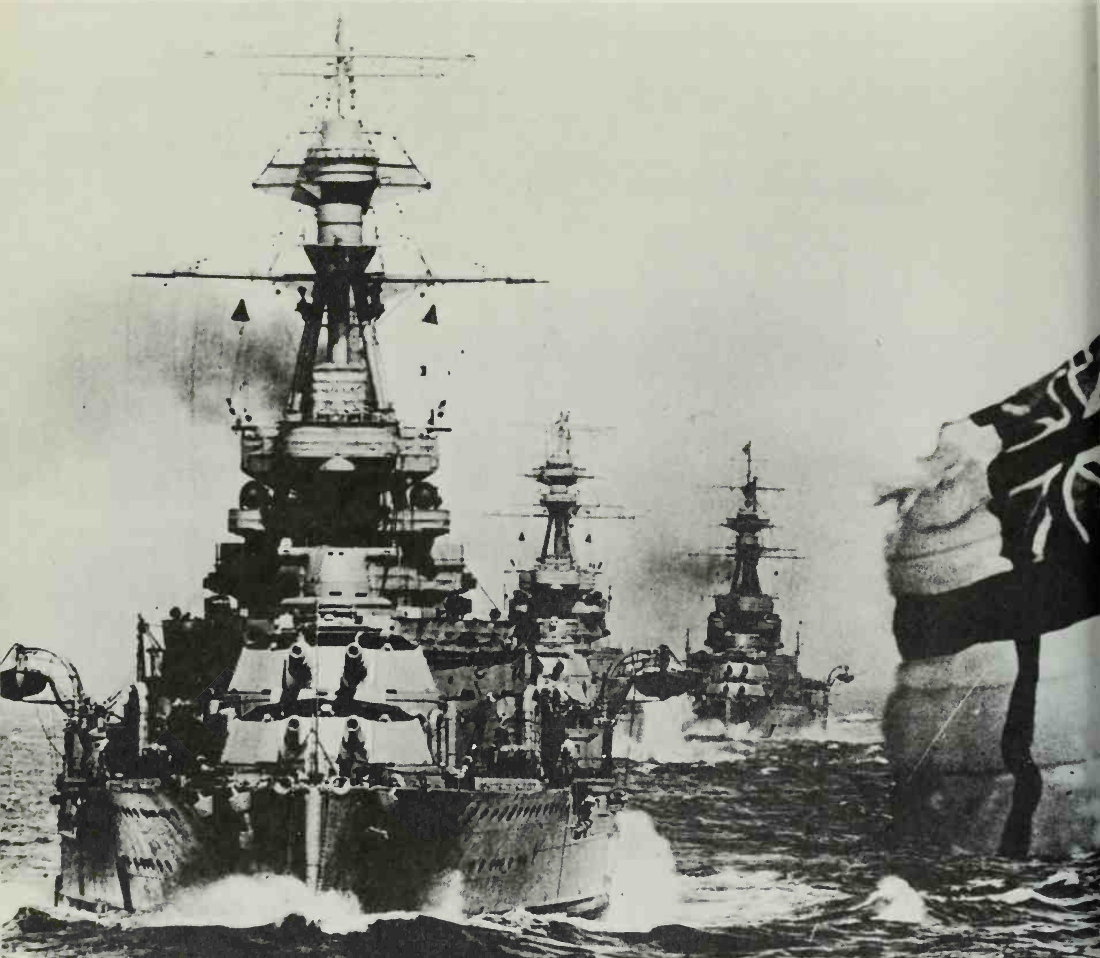
(above) Sopwith 1½ "Strutter" with skids leaves a British carrier equipped with special rails in days before the full flight deck.

Part III

THE WAR AT SEA

H.M.S. *Royal Oak* leads a majestic procession of British battleships. Having roughly the same armament and size of the "Queen Elizabeths," she and four sister ships of the "Royal Sovereign" class lived on to serve in World War II. *Royal Oak* was the only one destroyed by the enemy, being torpedoed five times at anchor in Scapa Flow in 1939.

TECHNICAL NOTES: The "Royal Sovereigns" had only half the horsepower of the "Queens," thus were 21-knot ships compared with 25. But they were more massive—31,250 tons' displacement *vs* 31,000—and carried two more 6-inch guns in the secondary armament. Belt armor was 13 inches in both classes.



CAPITAL SHIPS

INTRODUCTION

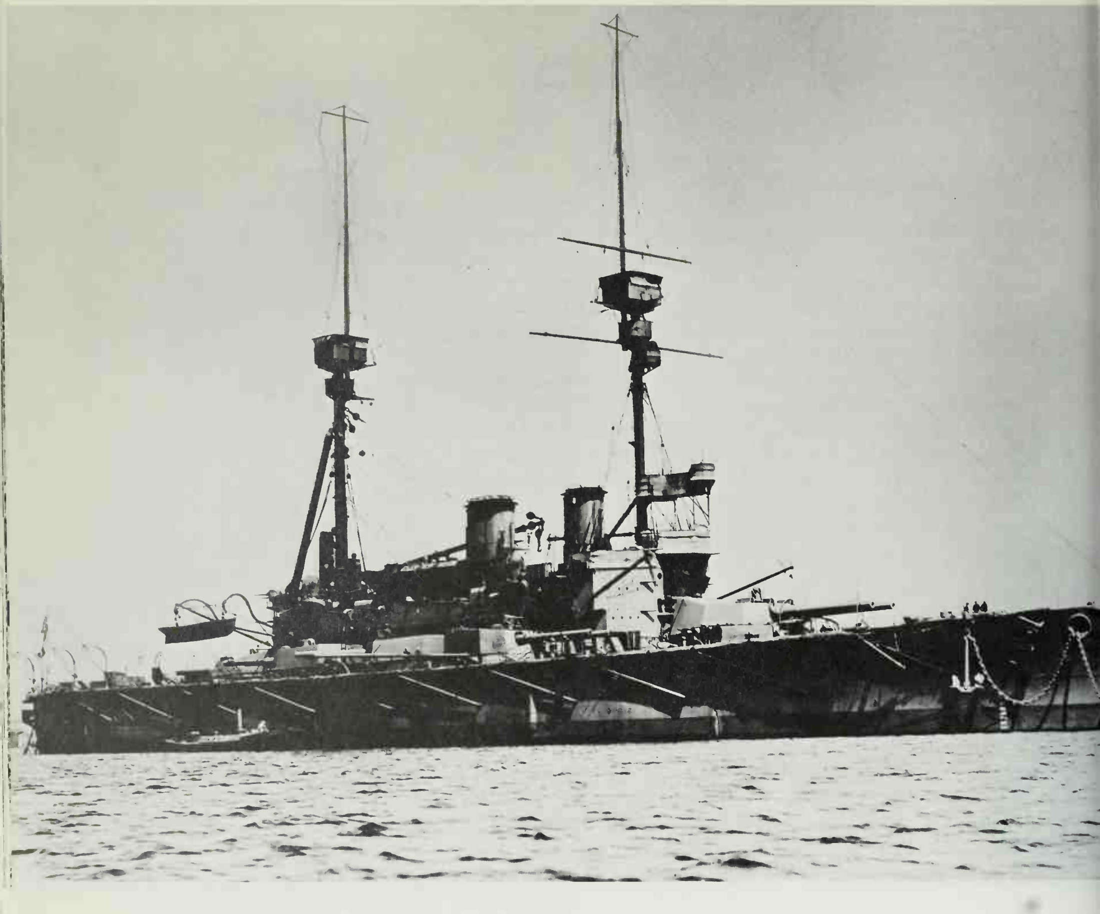
THE FOREMOST GOAL of the major naval powers up to World War I and beyond was the production of the largest unsinkable ships carrying the biggest guns. The battleship and battle cruiser came into being just prior to the war and were perfected during the conflict. These capital ships were direct descendants of the traditional "ships of the line"—the 74- to 100-gun wood-hulled sailing vessels on which Great Britain had relied for the latter part of her more than 300-year reign as mistress of the seas.

Changes in naval construction and armament since 1860 had been nothing short of revolutionary, and continued right on through World War I. Breakthroughs had been enormous: the demonstration of ironclad warships and the revolving turret in the battle of the *Monitor* and the *Merrimac* during the American Civil War, steel construction less than two decades later, introduction of the high-speed, triple-expansion steam engine by 1890, and the powerful steam turbine by the turn of the century. As with land-based artillery, the sizes and ranges of great naval rifles increased tremendously and armor-piercing projectile improvement stimulated a counteracting development of special steels for armor. Finally, the relatively new introduction of fast torpedo boats forced installation of secondary batteries of quick-firing guns to deal with close-in attacks and use of heavier and heavier belt armor and bulges for protection.

The upshot of this rapid evolution was that the naval powers, particularly Great Britain, threw into service aggregations of many types of "battleships." Many were one- or two-of-a-kind in their experimental classes, which became obsolete as soon as they were built. In effect, the war was fought with fleets of "sample" ships.

H.M.S. *Agamemnon*, completed after *Dreadnought* in 1907, was one of last two pre-dreadnought battleships built and the only one to be retained (as a radio-controlled target) after the war. She took terrific punishment in the Dardanelles.

TECHNICAL NOTES: *Agamemnon* and *Lord Nelson*, armed with four 12-inch and ten 9.2-inch guns, were last "mixed battery" ships built by the British, due to difficulty experienced by gunners in distinguishing between the splashes of the shells when both types of these large guns were firing. Length was 445 feet, beam 80 feet, displacement 16,500 tons, belt armor 14 inches, speed 19 knots on two screws powered by triple-expansion engines. In addition to primary and intermediate guns, *Agamemnon* carried fifteen 12-pounders and smaller guns and five 18-inch torpedo tubes. Complement was 865 men.



PRE-DREADNOUGHT BATTLESHIPS

ALTHOUGH THEY EVENTUALLY WERE relegated to secondary duties, two-thirds of the battleships that Great Britain and Germany could muster at the outbreak of the war were "pre-dreadnoughts," some dating to 1895.

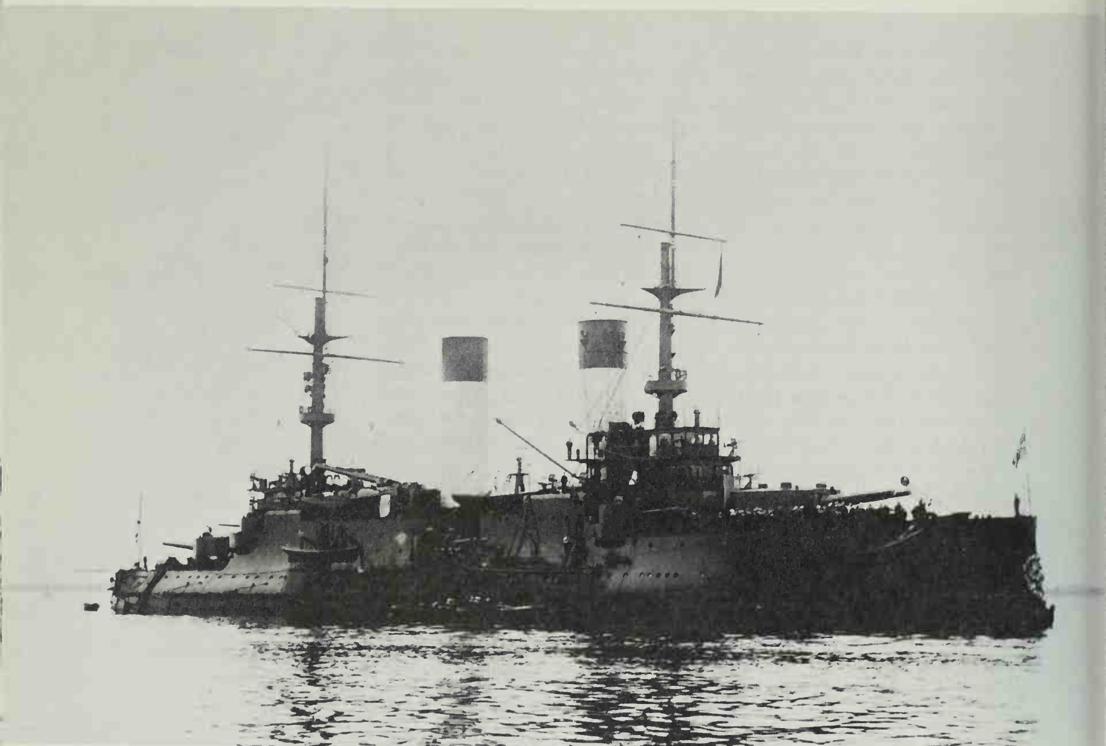
Britain had forty in service. The "Majestic" class of 1895 and the others following until the advent of the *Dreadnought* displaced from 12,000 to 16,500 tons and carried a standard armament of four 12-inch guns and twelve 6-inch guns. In the "King Edward" class of 1905–1906, however, an intermediate battery was added—four 9.2-inch guns in single turrets.

The final transition from traditional battleships of the day to the powerful dreadnoughts were the *Agamemnon* and the *Lord Nelson*. Actually completed after the *Dreadnought* (1907 and 1908) because construction was well along, they were the last British capital ships with reinforced ram bows, and the last to have "mixed batteries" of 12-inch and 9.2-inch guns.

Rugged war duty was the lot of the British pre-dreadnoughts, scattered from the English Channel to Africa and the East Indies, while their more modern sisters played a more glamorous role with the British Grand Fleet, which kept the German High Seas Fleet at bay in the North Sea. Ten were lost, mostly to the U-boats, of which five were sacrificed in the British debacle in the narrows of the Dardanelles. *Britannia* won the dubious distinction of being the last man-of-war to be sunk in World War I, the victim of a torpedo from the U-50 in the Straits of Gibraltar on November 9, 1918. All surviving British pre-dreadnoughts were scrapped except *Agamemnon*, which served as a target ship until 1926.

Of the twenty-two pre-dreadnoughts kept in service by Germany. ten of the "Wittelsbach" class were assigned to the Baltic to keep Russian units in check. The shortage of capital ships to match British sea power forced the Germans to press six of their better pre-dreadnoughts into service with the High Seas Fleet. All six, their 11-inch guns grossly overmatched by British firepower ranging up to 15-inch rifles, served at Jutland, the *Pommern* succumbing to a torpedo attack by destroyers.

The Russian battleship *Slava*, which was sunk by German battleships in the Baltic in 1917 attempt to open up the Gulf of Riga. Laid down in 1903, she displaced 13,500 tons.

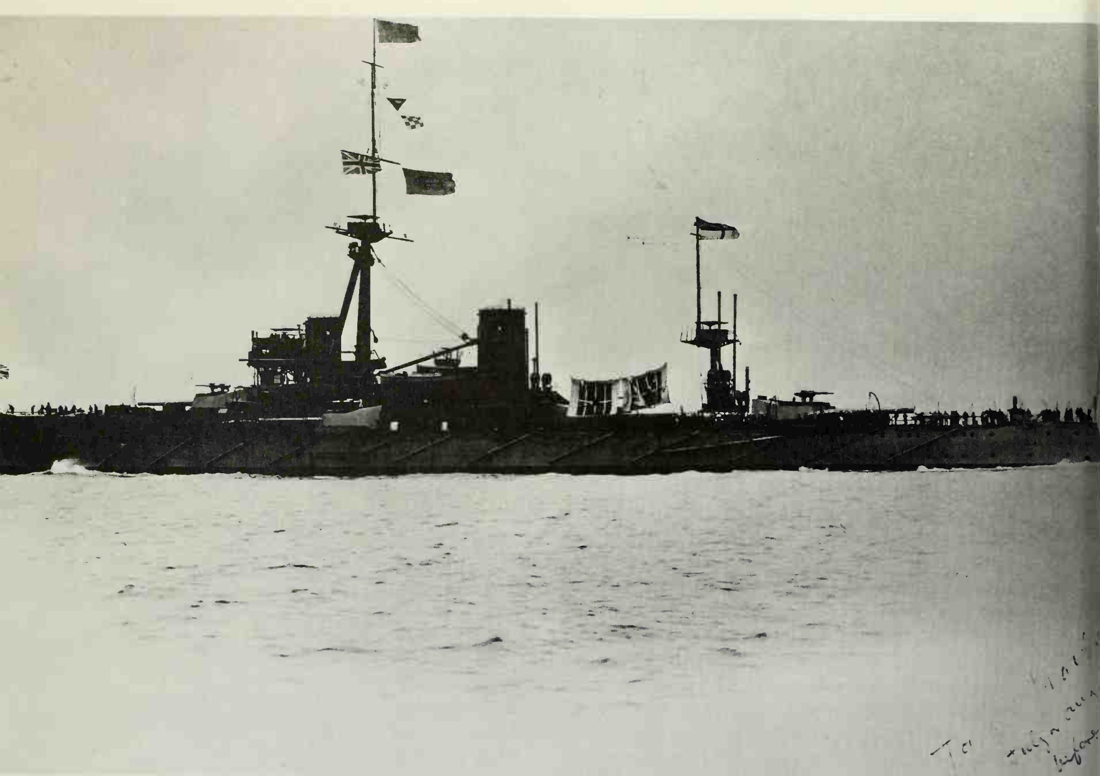


THE FEARSOME DREADNOUGHTS

EVEN BEFORE THE LAUNCHING of *Dreadnought* in 1905, many naval powers were busily modernizing their fleets to take full advantage of new technologies evolving from the industrial revolution. Italy was among the first to espouse monstrous ships armed with monstrous guns. Unable to match her European rivals in numbers, she laid down two battleships carrying two 12-inch and twelve 8-inch guns as early as 1901, and the great Italian designer Cuniberti had even completed a design for a battlewagon with *twelve* 12-inch rifles before *Dreadnought* appeared, but it did not reach the stocks. The United States of America, also before the advent of *Dreadnought*, had produced the world's most advanced design for battleship turret arrangement in the *South Carolina* and *Michigan*, but they were not completed until 1909.

It remained for Great Britain, jealously guarding her three-century preeminence in sea power, to launch the ship that revolutionized all navies. Spurred by lessons observed in the Russo-Japanese War of 1904–1905, when Admiral Togo crushed the strong Russian fleet, Britain laid down *Dreadnought* in October, 1905, and had her commissioned and at sea in the record-breaking time of fourteen months.

H.M.S. *Dreadnought* was designed by a select Admiralty committee of naval officers and civilian experts. It has been said ironically that "a camel is a horse put together by committee," but *Dreadnought*'s success was instantaneous and complete. Not only was she larger than her contemporaries—526 feet long; 82-foot beam; displacement, 17,900 tons—and the first all-big-gun ship with ten 12-inch guns mounted in twin turrets, but she also brought battleships up to the 21-knot class. Steam turbines were adopted for the first time in a large warship, developing 23,000 hp on four shafts. Secondary armament was twenty-four 12-pounders to deal with torpedo attacks. The British had been improv-



H.M.S. *Dreadnought*, mother of modern battleships, completed in October, 1906. In 1915 she rammed and sank U-29, whose captain had sunk three British cruisers with U-9 in 1914.

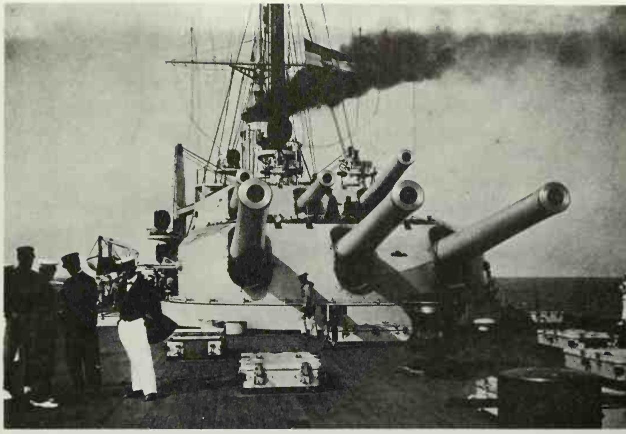
ing fire-control equipment for some time, and installed a tripod mast on *Dreadnought* to eliminate vibration from the spotting problems.

Ten more 12-inch-gunned British dreadnoughts appeared in succeeding classes up to 1911, each progressively larger and more powerful. Most ranged from 20,000 to 22,000 tons in displacement. Secondary batteries were beefed up to sixteen 4-inch guns. With the "St. Vincent" class, including *Collingwood* and *Vanguard,* turret armor was increased from 8 to 11 inches, approximately matching the belt armor thickness, and long 50-caliber 12-inch guns were adopted. With the *Neptune, Colossus,* and *Hercules,* completed in 1911, the wing turrets were placed in echelon and the after turrets were superimposed in an effort to achieve full ten-gun broadsides. *Agincourt,* the final 12-inch-gunned British ship, deserves mention as the only capital ship to have fourteen big guns and seven turrets. Ordered from a British shipyard by Brazil and transferred to Turkey, she was taken over by the Royal Navy when the war began. Displacing 30,250 tons, *Agincourt* also boasted the heaviest secondary armament of any battleship used in the war—twenty 6-inch and eight 3-inch guns. For the first time, two 3-inch antiaircraft guns were also incorporated, a feature that was soon backfitted to all previous dreadnoughts.

In terms of first-class fleet units, *Dreadnought* put all previous battleships on the road to obsolescence, including Great Britain's own tremendous inventory of ships of the line. All nations except the have-nots had to rebuild navies afresh. Dock facilities were expanded. Germany found it necessary to enlarge the Kiel Canal.

Germany had already built her maritime fleet to its highest pinnacle immediately preceding World War I, and now strove mightily to challenge Great Britain's naval supremacy. Seventeen dreadnought-type battleships were completed from 1909 to the end of 1914. The first four, of the "Nassau" class, like Germany's pre-dreadnoughts before them, had a main armament of only 11-inch guns—but twelve of them, mounted in six turrets—and secondary batteries of twelve 5.9-inch and sixteen 3.4-inch guns. Armament of the "Helgoland" class of four ships commissioned in 1911–1912 was increased to twelve 12-inch, fourteen 5.9-inch, and fourteen 3.4-inch guns. Despite the armament of twelve heavy guns, these 20- to 21-knot vessels suffered from the same wing-turret arrangement as the early British dreadnoughts. Two of the six turrets were disposed on each side, enabling only an eight-gun broadside. This defect was partially solved in the "Kaiser" class of 1912–1913 (five ships), and completely eliminated with the "König" group of four ships completed in 1914. Both these classes were 23-knot vessels equipped with turbines and displacing from 24,000 to 25,390 tons. With a more efficient turret arrangement, the number of 12-inch guns was reduced to ten.

The United States lost no time in the naval race, although American battleships entered the World War I scene so late (December, 1917) that they saw no major battle action. Starting in 1906, the United States laid down its first two 12-inch-gunned ships with the 20,000-ton "Dela-



Detail of the afterdeck of the Austrian battleship *Viribus Unitis,* which was sunk by a limpet mine attached by Italian "frogmen" who penetrated heavily guarded Pola harbor in 1918.

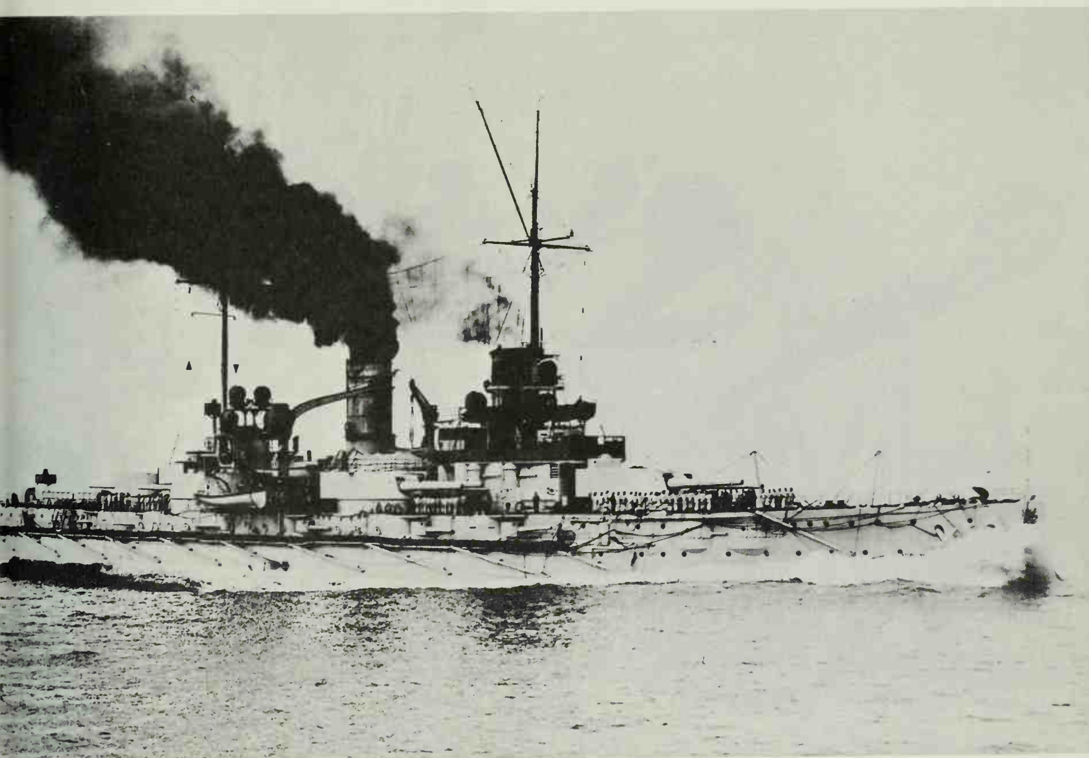
ware" class, followed by the "Florida" and "Arkansas" classes of two ships each. Secondary batteries were fourteen 5-inch guns. With the "Texas" and "Nevada" classes, the United States introduced the powerful 14-inch guns, five of which saw duty as railroad artillery in France. All these ships were capable of 21 knots.

Italy laid down her first dreadnought, the *Dante Alighieri,* in 1909, followed by the "Cesare" and "Duilio" classes of two ships each. All carried 12-inch guns and 4.7-inch or 6-inch secondary armament.

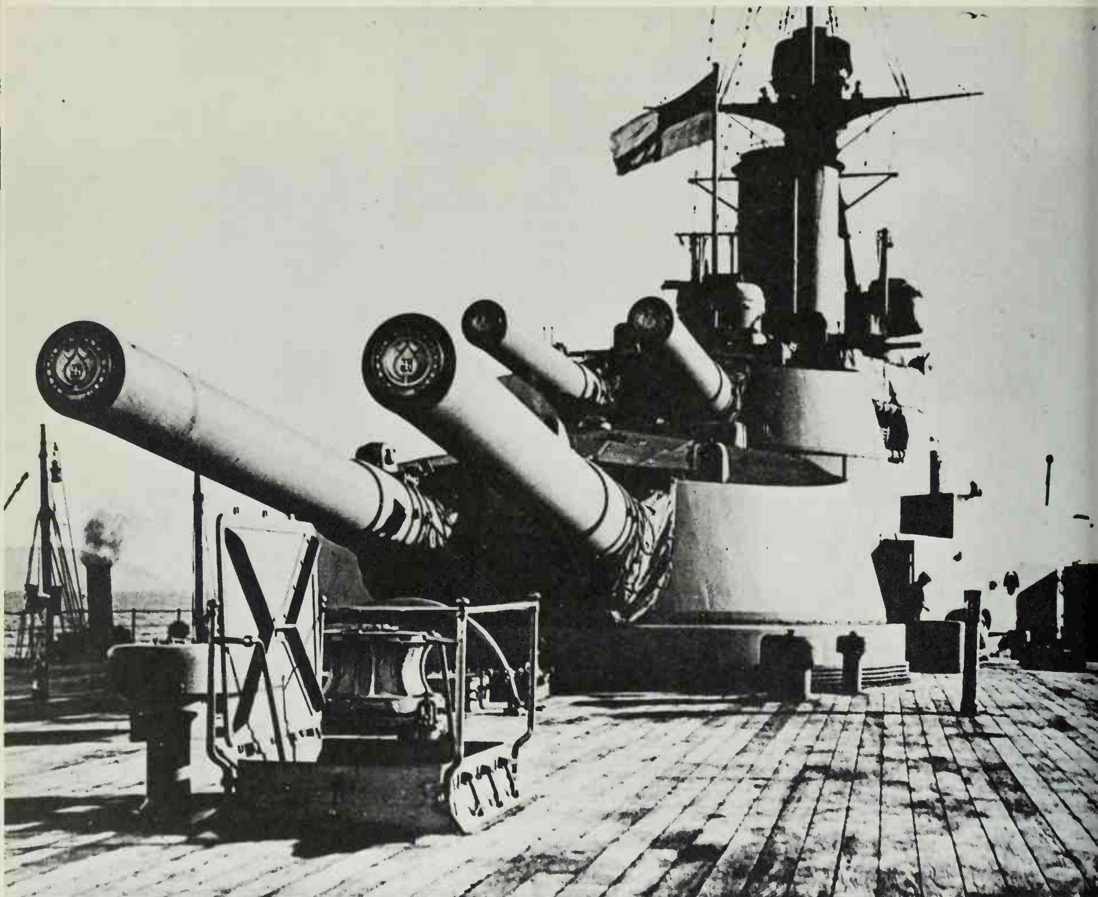
Japan entered the new capital ship derby in 1909 in a race that ended with the destruction of her fleet by the U.S. Navy in World War II. In that year she started construction on her first dreadnought class with the *Kawachi,* a 21-knot vessel of 20,800 tons armed with twelve 12-inch, ten 6-inch, and eight 4.7-inch guns.

France was the last major power to start construction in the dreadnought era, laying down four ships of the "Jean Bart" class in 1911 with twelve 12-inch and twenty-two 5.5-inch guns.

S.M.S. *Nassau*, one of Germany's first class of "dreadnoughts," mounting twelve 11-inch, twelve 5.9-inch, and sixteen 3.4-inch guns. Speed was 20 knots, length 478 feet, beam 89 feet, displacement 18,900 tons.



After 13.5-inch guns of the *Emperor of India*, of the last big class ("Iron Duke") of super-dreadnoughts completed by the British in November, 1914.



THE SUPER-DREADNOUGHTS

THERE FOLLOWED A SPATE of shipbuilding in England from 1911 through 1914 whose results struck pride in the heart of every Briton. These fourteen ships, generally armed with ten 13.5-inch and twelve to sixteen 4- or 6-inch guns, averaged about 600 feet in length and displaced from 22,500 to more than 30,000 tons.

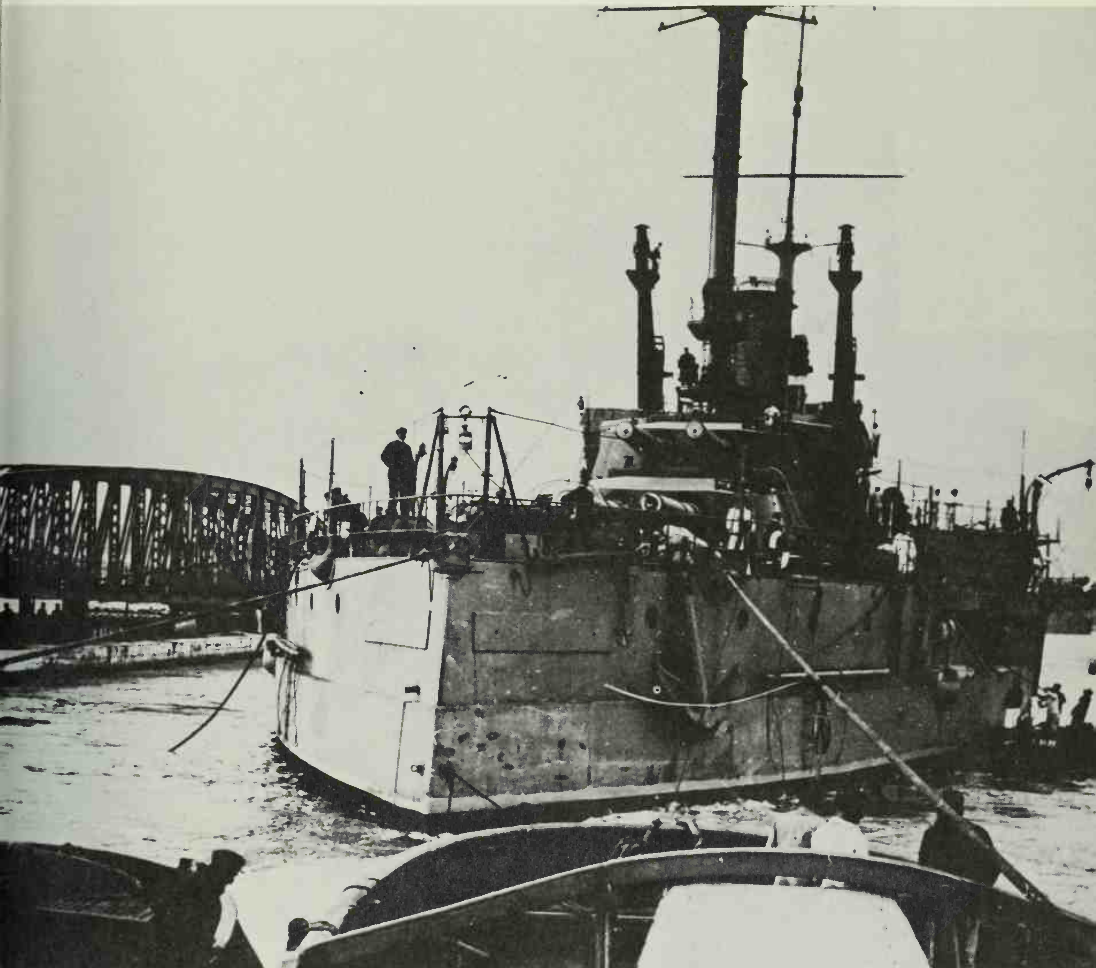
"Wartime additions in the way of director platforms, searchlight towers, etc., produced a slightly more subtle outline but the impression of great dignity and power has hardly been surpassed," wrote H. M. Le-Fleming in his *Warships of World War I*. "At first, gun trials took place in the Channel and the writer remembers considerable vibration at a distance of 60 miles. Near the coast many windows were shattered and thereafter the big ships did their trials out in the Atlantic.

"Few of the works of man have presented such a magnificent spectacle as a battleship or battle cruiser at full power. Steaming at 25 to 33 knots, with bow and stern waves piled high, the smoke pouring from her funnels was visibly lifted by the forced draught. When firing, the ship was momentarily blotted out by globes of dazzling orange flame, followed by the tremendous concussion of her guns whose blast caused ripples and a flurry of spray on the water. A moment later the thin brownish cloud of burnt-out cordite was drifting away astern. When firing broadsides the combined flash was sometimes so great as to give the impression that the ship had blown up." (23)

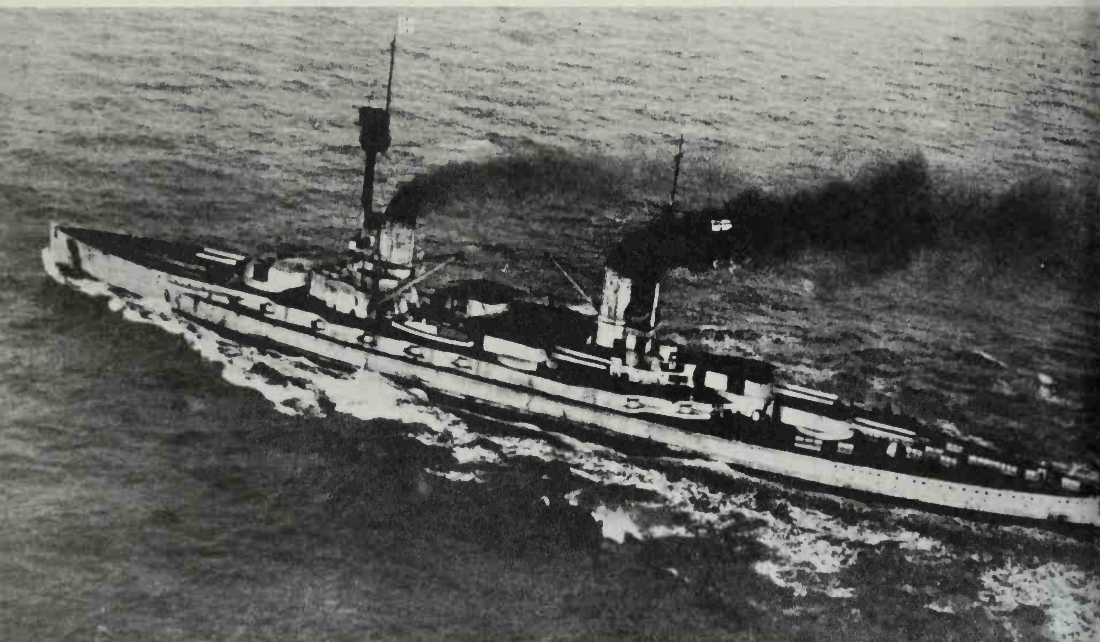
Three classes of four ships each—"Orion," "King George V," and "Iron Duke"—were commissioned in 1912, 1913, and 1914. In the "King George V" class the 13.5-inch projectiles were increased from 1,250 pounds to 1,400 pounds and director-controlled secondary batteries and searchlights were introduced. Protected by 12-inch belt armor and 11-inch armor for the turrets, none of these ships was sunk by torpedo. Several were scrapped after the war under terms of the Washington Naval Conference, and one was sunk as a blockship at Normandy in 1944. The *Canada,* which was taken over while under construction for Chile, displaced 32,000 tons, was capable of 24 knots, and was the only British battleship to be equipped with 14-inch guns. Completed in 1915, she was returned to Chile in 1920 under her original name, *Almirante Latorre,* and served another forty years.

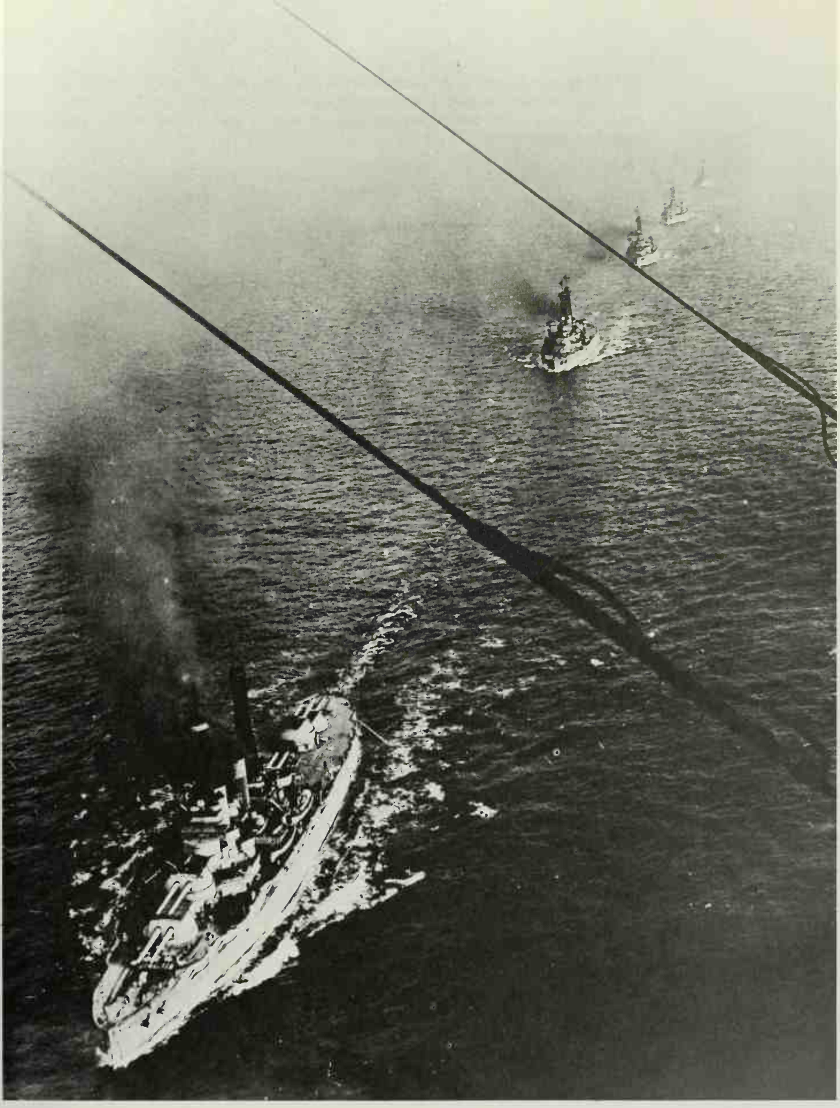
Few nations produced vessels that matched the British super-dreadnoughts, and fewer were inclined or economically able to match such a building program. Germany's nine ships of the "Kaiser" and "König" classes of 1912 to 1914 were intended to equal Britain's best, but the Germans merely increased primary gun size to 12-inch. What they lacked in firepower, however, was more than offset by superior gunnery, armor, and damage control, as the British were to learn at Jutland. France produced the nearest approximation to the super-dreadnoughts with the three-ship "Bretagne" class carrying ten 13.4-inch and eighteen 5.5-inch guns. Following up with the five-vessel "Normandie" class, which was dismantled at the conclusion of the war, the French ceased building capital ships for some years. The United States, however, came up with her even more powerful super-dreadnoughts packing 14-inch guns.

French battleship *La Bretagne* passing at the Pont-Tourant (Turning Bridge, in background), Toulon, France.



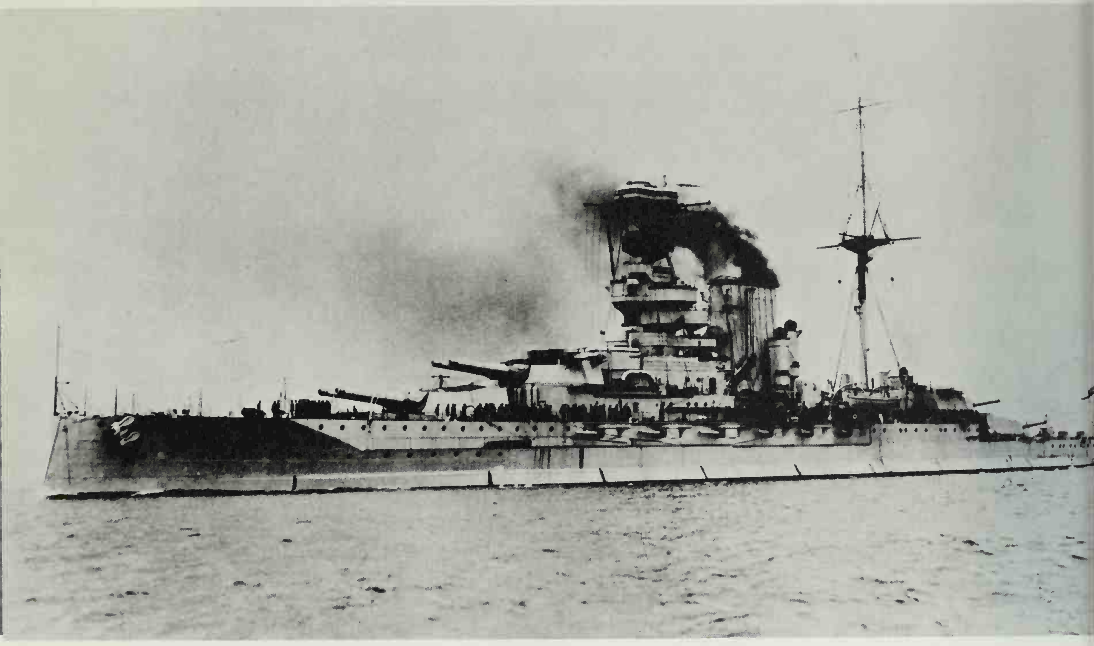
Friedrich der Grosse, flagship of the High Seas Fleet, and four other battleships of the "Kaiser" class mounted ten 12-inch guns, were the first German dreadnoughts equipped with turbines, and could steam at 23 knots. All German battleships except the "Baden" class had three screws.





Flagship U.S.S. *New York* heads powerful force of nine battleships that arrived in England in December, 1917, to reinforce the British Grand Fleet. *New York*'s five turrets of twin 14-inch guns are clearly visible in this photograph taken in 1918. Other ships of the 6th Battle Squadron were *Texas, Oklahoma, Nevada, Arizona, Arkansas, Wyoming, Florida, Utah.*

H.M.S. *Queen Elizabeth* as reconstructed after the war along with sisters of the class. Massive blocklike superstructure was added and secondary armament changed from twelve 6-inch guns to eight 6-inch, eight 4-inch, and four 3-pounder guns.



THE MIGHTY "QUEEN ELIZABETHS"

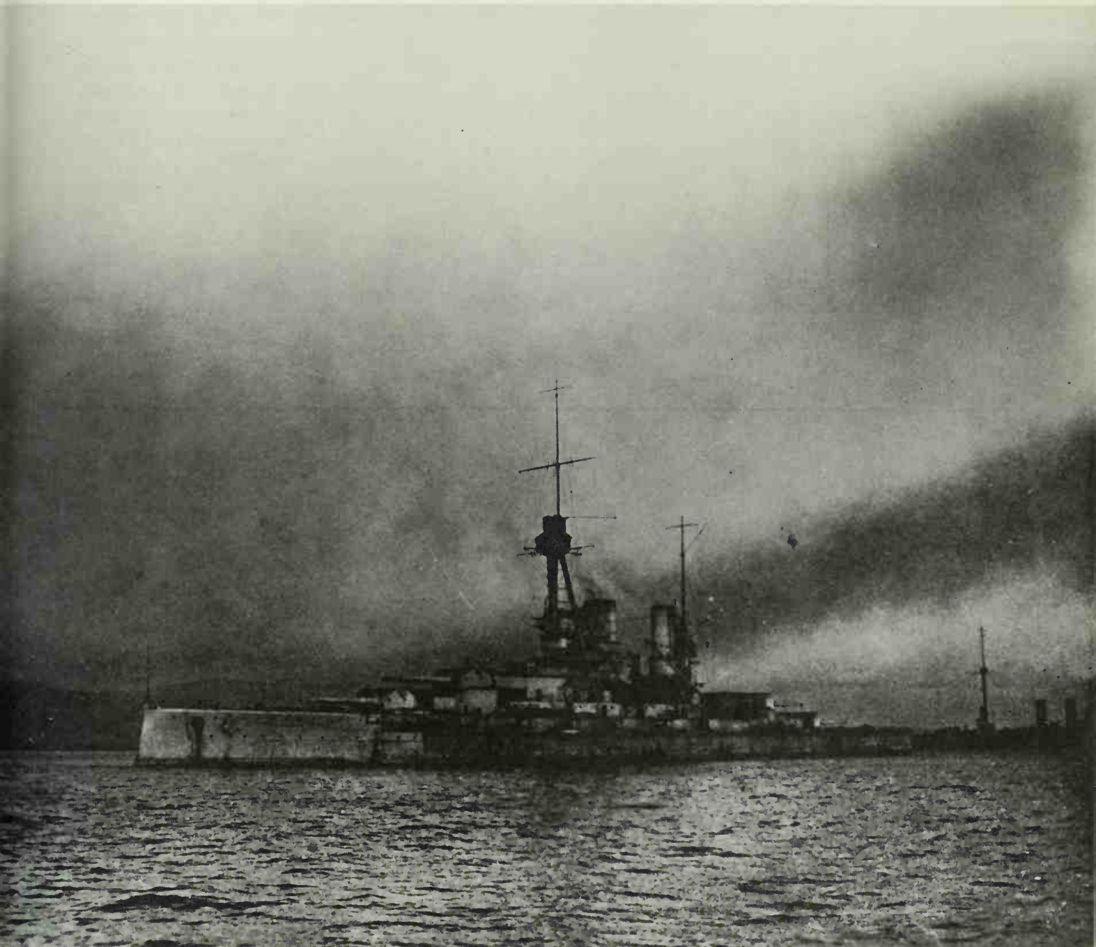
THE FINAL CRUSHER that doomed Germany's surface fleet ambitions was Great Britain's production, on an assembly-line basis, of ten 15-inch-gunned battleships in the "Queen Elizabeth" and "Royal Sovereign" classes. Nine of these massive vessels joined the Grand Fleet within the two years from January, 1915, to December, 1916.

All ten of these powerful ships lived to serve in World War II—several with distinction—and, in fact, constituted two-thirds of the serviceable British battleships on hand at the outbreak of that war in 1939. *Queen Elizabeth* and her sisters *Warspite, Barham, Valiant,* and *Malaya* were the finest battleships of their day. They represented the final conversion to oil fuel, whereas the super-dreadnoughts depended on oil for only one-fourth to one-third of their fuel supply. Turbines generated 75,000 hp on four shafts for a speed of 25 knots—a 4-knot advantage over the standard of other nations. They mounted eight 15-inch guns disposed in two twin turrets on each end. Belt armor was increased to 13 inches, and displacement was about 31,000 tons.

Royal Sovereign, Revenge, Royal Oak, Resolution, and *Ramillies* packed the same punch but their power plants developed only 40,000 hp, putting them in the 21-to-23-knot class.

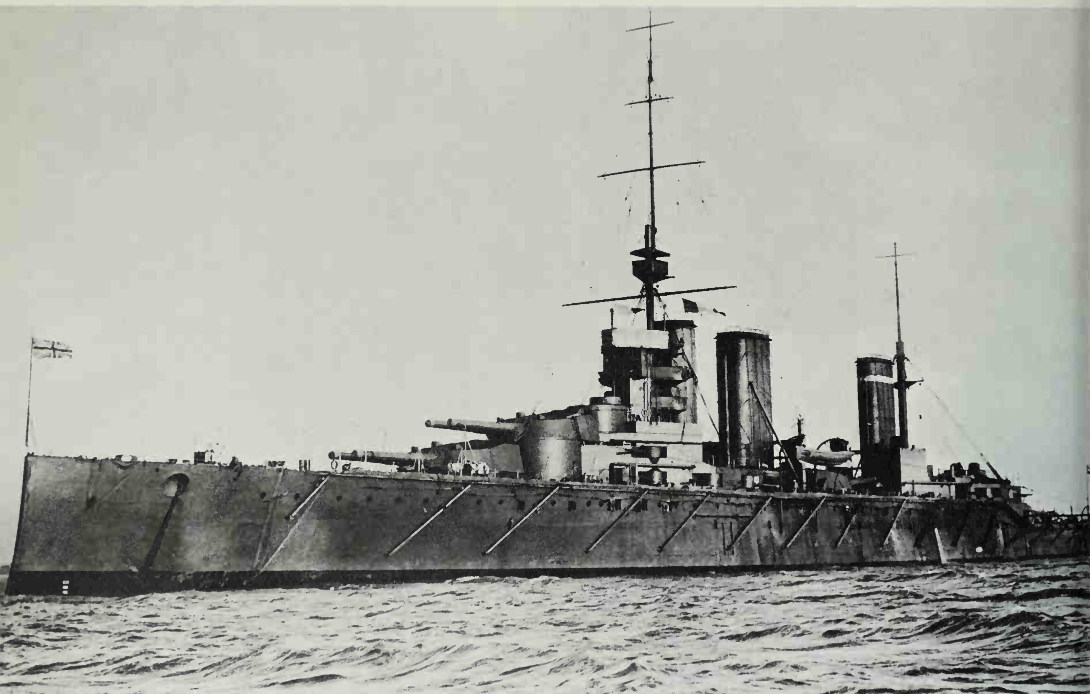
Germany's responses to the "Queens" were not completed until after Jutland: the magnificent *Baden* and *Bayern,* also carrying eight 15-inch guns and armor nearly 14 inches thick. But it was too late. Work on two sister ships was suspended in 1917, when the Germans gave up in the surface fleet race and turned fully to submarine warfare.

The German battleship *Baden* was the first of a new class of 15-inch-gunned vessels intended to match the "Queen Elizabeths," but it never saw action. Only *Baden* and *Bayern* were completed. Armament was eight 15-inch, sixteen 5.9-inch, four 3.4-inch AA guns, and five torpedo tubes. Length was 623 feet, beam 99 feet, displacement 28,000 tons, speed 22 knots, armor nearly 14 inches on sides and turrets.



H.M.S. *Princess Royal*, completed at the end of 1912, was a member of that elite group of four "Splendid Cats," pride of Britain's battle cruiser force which boasted 13.5-inch super-dreadnought guns. She was a sister of *Lion*, chosen by Admiral Beatty as flagship.

TECHNICAL NOTES: H.M.S. *Princess Royal* was designed for 28 knots but could make 32 on 80,000 hp. Displacement was 29,700 tons, length 700 feet, beam 89 feet, armor 9 inches. With more armament than contemporary battleships—eight 13.5-inch, sixteen 4-inch, and two 3-inch antiaircraft guns—this class had a complement of nearly 1,100 men.



THE "SPLENDID CATS"

THE BATTLE CRUISER WAS a peculiarly British creation, the brainchild of the same Admiralty committee that conceived the *Dreadnought*. The concept was a giant cruiser of exceptional speed and battleship armament that could chase down and outgun lesser opponents while keeping out of range. This called for the surrender of heavy battleship armor in favor of speed, a sacrifice that cost dearly in both world wars. The plan called for generally the same armament as contemporary battleships, but minus two big guns further to strip the vessel for speed.

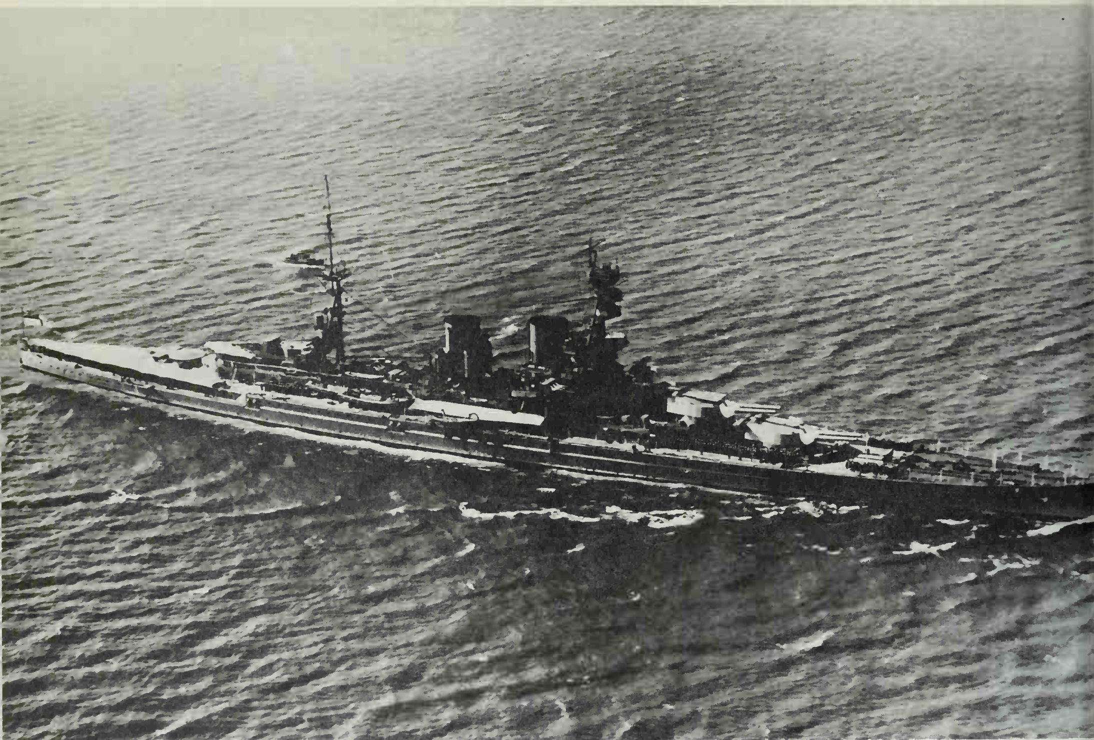
Thus the "Invincible" (1908) and "Indefatigable" (1911–1912) classes of three ships each came into being as counterparts to the dreadnoughts. Each carried eight 12-inch guns in four turrets, secondary armament of sixteen 4-inch guns, and three torpedo tubes. Speed was 25 to 27 knots, and armor was only 6 inches.

These were followed immediately by four ships popularly known as the "Splendid Cats," which, along with the previous battle cruisers, bore the brunt of fighting at Jutland. *Lion, Princess Royal,* and *Queen Mary* mounted eight 13.5-inch guns in the style of the super-dreadnoughts that were coming down the ways in 1912–1914. These 700-foot cruisers—substantially longer than contemporary battleships—displaced about 30,000 tons, had a beam of 89 feet, and could travel up to 32 knots on 70,000 to 80,000 hp. H.M.S. *Tiger,* of the same group, was in a class of her own. Modified along the lines of the Japanese battle cruiser *Kongo,* which was building in a British shipyard, *Tiger* was fitted with twelve 6-inch guns for secondary armament. She was the heaviest ship built in the war, displacing 35,000 tons, and was the first to develop over 100,000 hp.

The only clear-cut examples of battle cruisers carrying out their intended purpose as a type occurred in August, 1914, when Admiral Beatty aggressively surprised a German force in its lair of the Heligoland Bight, sinking three light cruisers and a destroyer; and in December, 1914, when *Invincible* and *Inflexible* were secretly sent to overwhelm a weaker force of German cruisers off the Falkland Islands in a mission of vengeance. Thus encouraged, Great Britain converted the hulls of two battleships that had been laid down for the "Royal Sovereign" class, and in the latter part of 1916 completed the battle cruisers *Renown* and *Repulse*.

Renown and *Repulse,* magnificent battle cruiser equivalents of the "Queen Elizabeth" battleships, never saw serious action in World War I, but lived on to fight in a larger global conflict. Completed in twenty months from initial design, they displaced about 31,000 tons, could steam in excess of 31 knots, and carried six 15-inch and seventeen 4-inch guns. These were the last battle cruisers built during World War I. So obsessed were the British with the ill-fated type, however, that they drew up plans in 1916 for H.M.S. *Hood,* destined to be the world's largest warship until her brief and tragic career in World War II.

H.M.S. *Repulse* (shown) and *Renown*, completed in late 1916, were the last word in battle cruisers. They were constructed in lieu of two additional battleships of the "Royal Sovereign" class, carried six 15-inch, seventeen 4-inch, and two 3-inch AA guns. Displacement was 32,700 tons, length 794 feet, beam 90 feet, speed up to 33 knots on 120,000 hp.



GERMAN BATTLE CRUISERS

EXCEPT FOR AMBITIOUS JAPAN, which completed four powerful ships of the "Kongo" class (eight 14-inch and sixteen 6-inch guns) in 1913, Germany was the only other major power to indulge in battle cruiser construction.

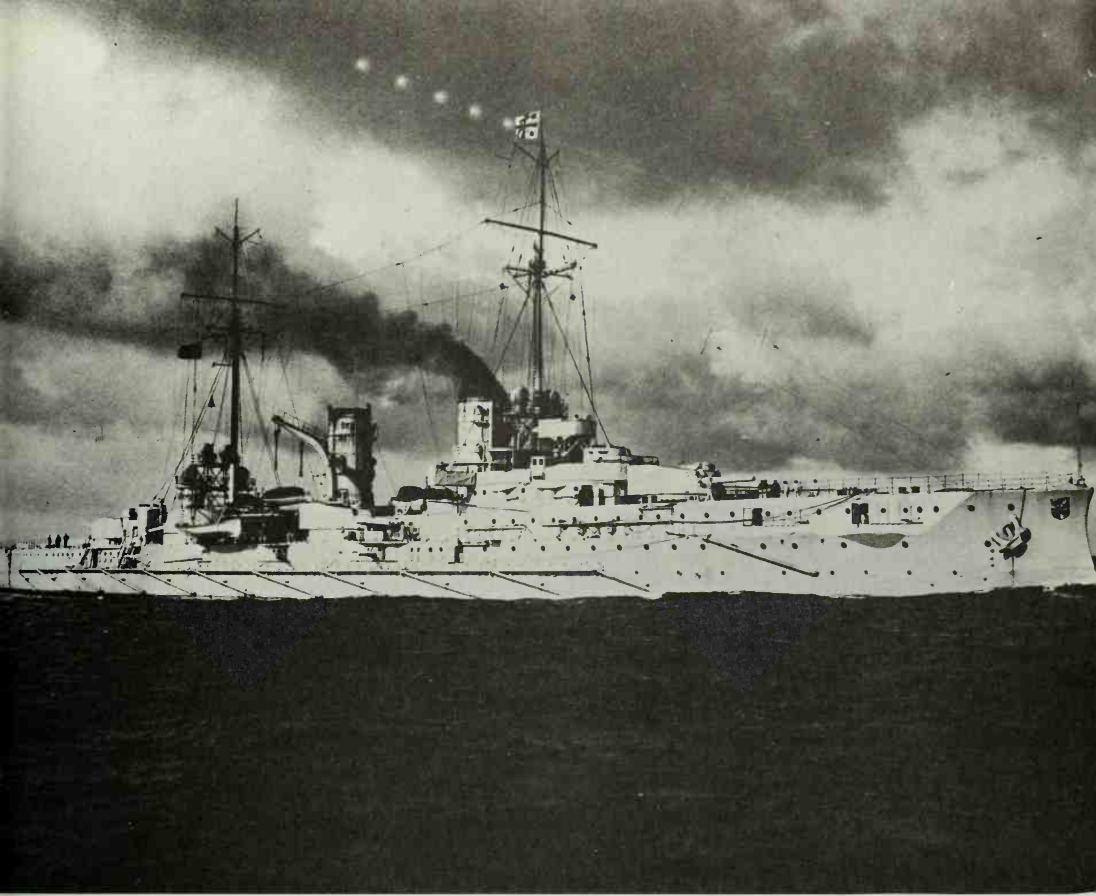
Forced into the imitator's role by Britain's ingenuity and experience in naval architecture, Germany consistently lagged in matching firepower and speed. Ironically, however, major German vessels generally were superior in watertight integrity, damage control, gunnery, and ammunition handling. Except for a disastrous false start with the *Blücher,* this was particularly true of the battle cruisers when pitted against the fragile-skinned British cruisers.

S.M.S. *Blücher* was more properly a large armored cruiser equipped with 8.2-inch guns—a transition to German battle cruisers—but she was intended to match the British "Invincibles," and so traveled in fast company. The result was disaster in her first encounter with the British 12-inch and 13.5-inch guns.

Germany was able to complete only seven true battle cruisers for use in World War I, and though all took terrific punishment, only one was sunk as the result of enemy action. Leading off in the construction race was *Von der Tann,* completed in 1910, with a displacement of 20,000 tons. She was the first German capital ship to be equipped with turbines and quadruple screws (instead of three), and could work up to more than 25 knots. The Germans, characteristically confident in the quality of their naval guns and gunnery, eschewed the British trend toward larger-and-larger-caliber rifles. They also were unwilling to go to the extremes demonstrated in the British battle cruisers of sacrificing armor protection for speed. Consequently, *Von der Tann* mounted only 11-inch guns compared with 12-inch guns of her early British counterparts, but was protected with 10½-inch armor as opposed to only 6 inches. *Moltke* and *Goeben,* which followed in 1911 and 1912, were slightly larger and equipped with ten 11-inch guns, but could attain 29 knots.

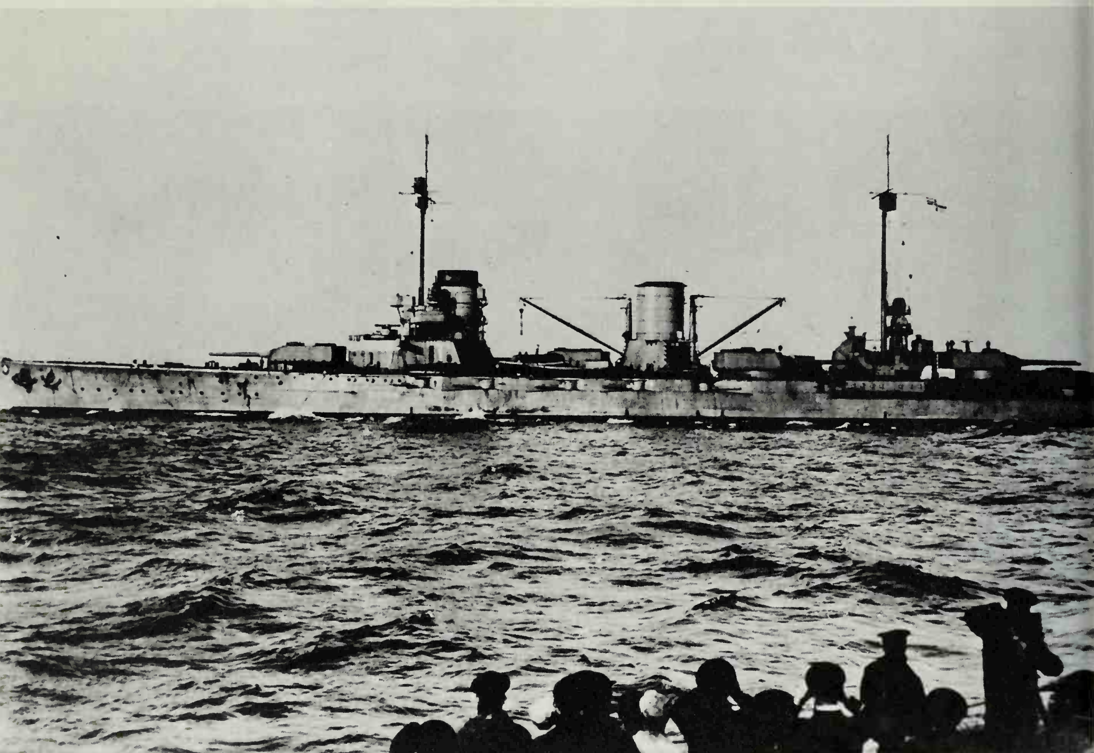
Seydlitz, completed in 1913—and along with *Derfflinger* considered the crack gunnery ship of the German battle cruisers—was the fastest of the fleet. Though heavier at 24,600 tons, and with belt armor increased to 11¾ inches, she was credited with 30 knots.

While the British were building 13.5-inch- and 15-inch-gunned battle cruisers, the Germans launched their final "Derfflinger" class with 12-inch guns. They included *Lützow* and *Hindenburg,* the latter finished in the middle of 1917, too late for action at Jutland. These vessels displaced 27,000 tons, had a speed of 28 knots, and were protected by 11¾-inch belt armor and 10¾ inches of turret armor.



The *Blücher*, a product of the Kaiser's shipyards in 1909, displaced 15,500 tons and had a main battery of 8-inch guns. An early version of the swifter, more heavily armed battle cruisers, *Blücher* could make 25 knots.

S.M.S. *Moltke* (shown) and sister ship *Goeben* were great improvements over the *Von der Tann*. Ten 11-inch guns gave a powerful broadside, backed by twelve 5.9-inch and twelve 3.4-inch guns. Length was 610 feet, beam 97 feet, displacement 22,640 tons, speed 29 knots.



THE BATTLE OF DOGGER BANK

THE FIRST CLASH OF THE BATTLE CRUISERS came on January 24, 1915. The British—for months in possession of the German naval wireless code—surprised Admiral Hipper's squadron on a hit-and-run mission against the British fishing fleet off Dogger Bank in the North Sea. Hipper, in addition to an assortment of destroyers and light cruisers, had *Seydlitz, Moltke,* and *Derfflinger,* with obsolescent *Blücher* bringing up the rear. Admiral Beatty's superiority in firepower was about 75 percent as represented in the 13.5-inch guns of his "Splendid Cats"—*Lion, Tiger, Princess Royal*—and the 12-inch guns of *New Zealand* and *Indomitable.*

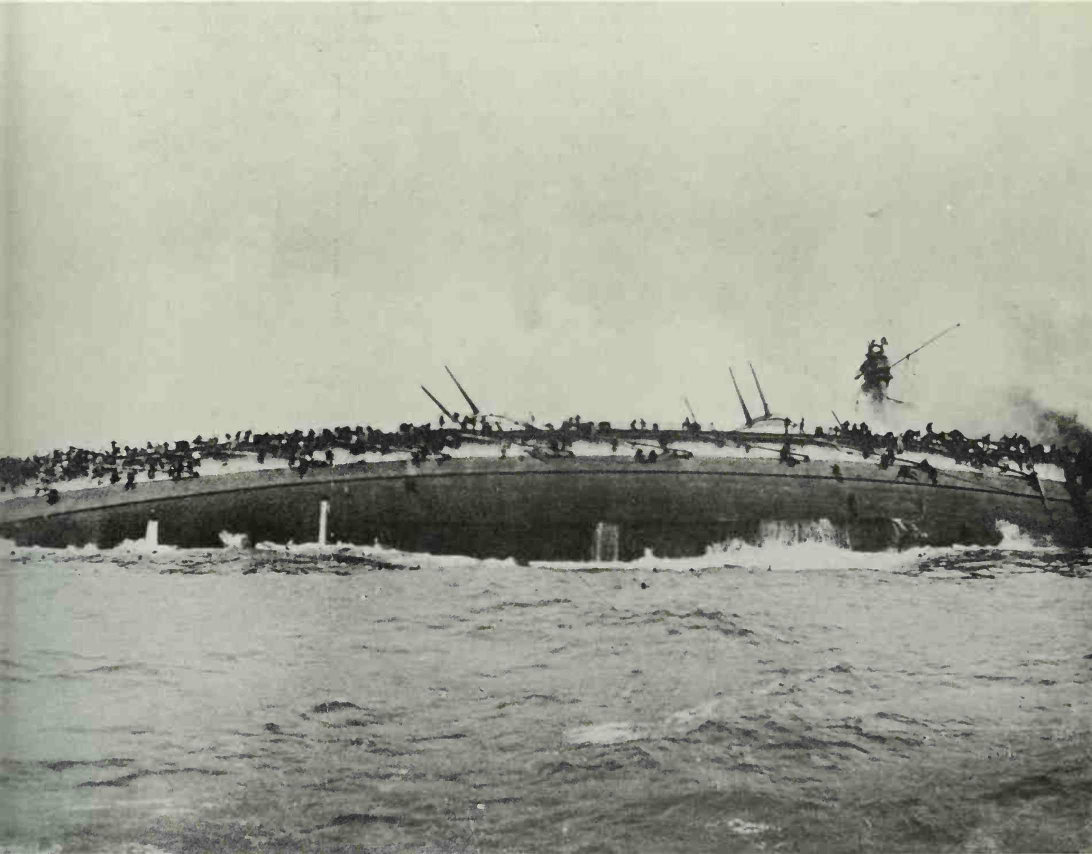
As Hipper fled toward Heligoland with his inferior force, a three-hour running battle of unprecedented speed and gun ranges ensued. Beatty, in flagship *Lion,* opened fire at 20,000 yards. As he inched closer at 27, then 28, knots, the unfortunate *Blücher* was hit constantly and forced to drop out of the German line. *Lion,* aided by newly commissioned *Tiger,* whose raw crewmen were firing erratically, also dropped three shells on *Seydlitz* which wrecked the two after turrets and killed 159 men.

But the British cruisers were not firing methodically on all four German ships. In consequence, *Lion* was disabled by at least a dozen hits from the concentrated fire of the splendid *Derfflinger* which was hit only once, and *Moltke* which was not hit at all. Now followed costly confusion in signaling that was to plague the British battle cruisers again and again. Through a misunderstanding of the flags on *Lion*'s halyards and the absence of wireless communication (because of battle damage) the remainder of Beatty's squadron dropped the opportunity to overtake Hipper's fleeing battle cruisers. They concentrated instead on finishing off *Blücher,* aflame and wallowing.

Blücher, it was estimated, "swallowed" from 40 to 100 shells and several torpedoes before she finally rolled onto her beam ends and sank. Nearly 1,000 perished on the *Blücher* and the *Seydlitz*. British losses were disproportionately low.

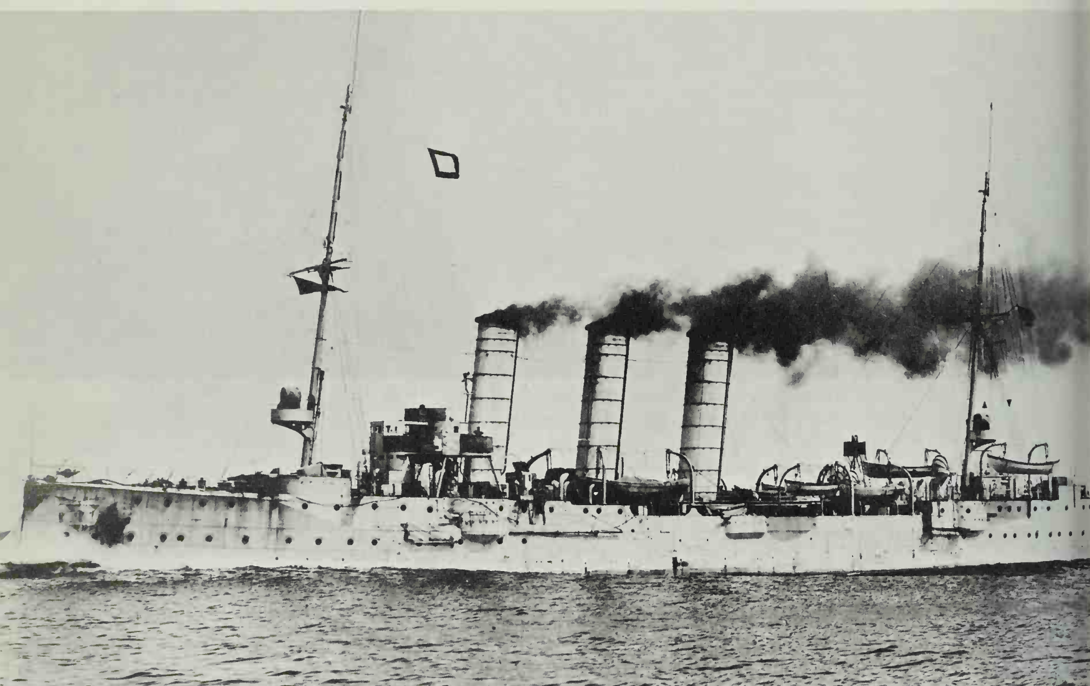
The British were jubilant even if, possibly, an opportunity to eradicate more of the Kaiser's battle cruiser fleet had been forfeited. Superiority of British guns at extreme range seemingly had been demonstrated. At the time, however, the Admiralty was unaware that no high-explosive missiles had penetrated the enemy armor. Those shells that had scored did so because of the range—they arced down from high in the air, then smashed through the relatively thin deck plates of their targets.

On the other hand, *Lion*'s thinner armor was riddled by the smaller German 11-inch shells, banging home with deadly accuracy because of excellent direction finders.



Blücher was no match for the big British battle cruisers in the Battle of Dogger Bank early in 1915. By that time almost obsolete, she was sunk with nearly 300 of her crew. The larger, newer *Seydlitz*, by comparison, was also hurt but returned home to be repaired and fight again (and be damaged again) at Jutland.

The light cruiser *Bremen*, like most classes produced by Germany up to the eve of war, featured a greatly extended ram bow. Raiders often put up a dummy fourth funnel to resemble British cruisers at a distance.



THE CRUISER CAMPAIGN

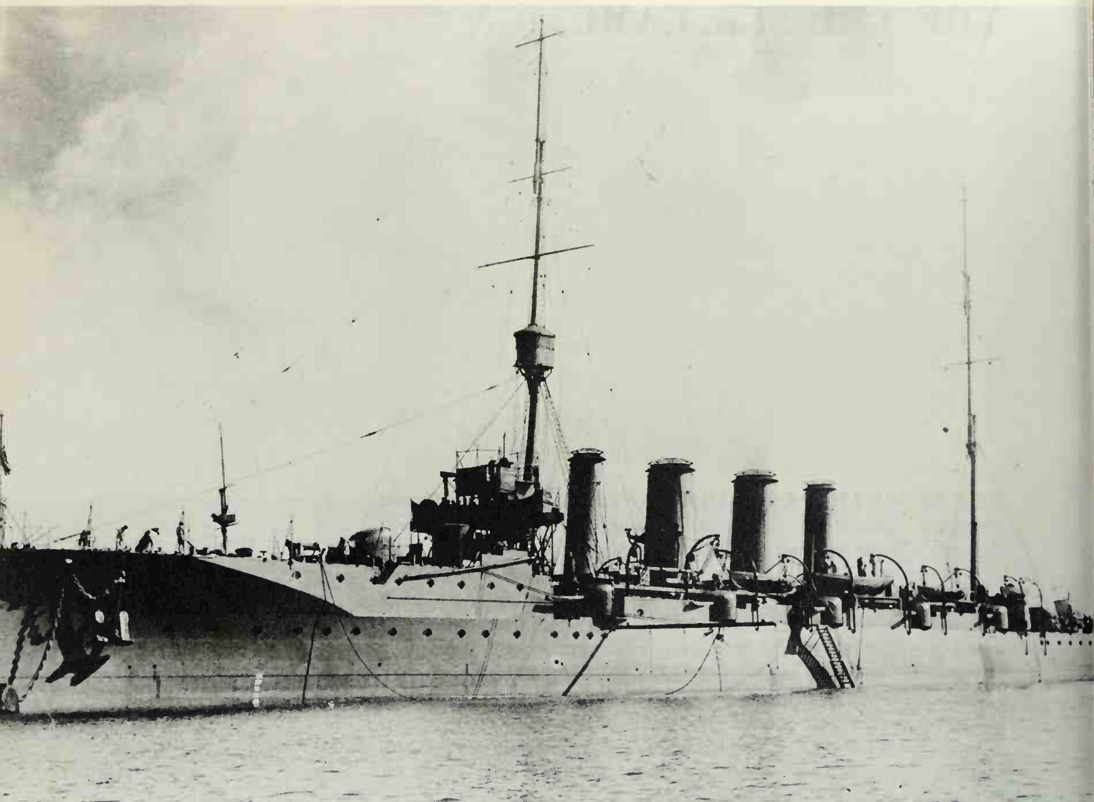
THE EVOLUTION IN CRUISING VESSELS had been so great since steel replaced wood as structural material that the word "cruiser" had only a vague meaning as a generic term in 1914.

Only the time-honored designations "frigate" and "corvette" had become passé. For a time before the war, a cruiser—as distinguished from the huge new battle cruiser—might be an "armored cruiser," a "protected cruiser" (1st, 2nd, or 3rd class), a "dispatch vessel," a "torpedo cruiser," a "sloop," or even a gunboat. Great Britain had more than 150 of these vessels on hand in 1914—dating from 1885 to 1904—and more than half were pressed into service, along with armed merchant ships, to guard her trade routes and possessions around the world. Some of these early types deserve brief description because of their significant roles in the war at sea.

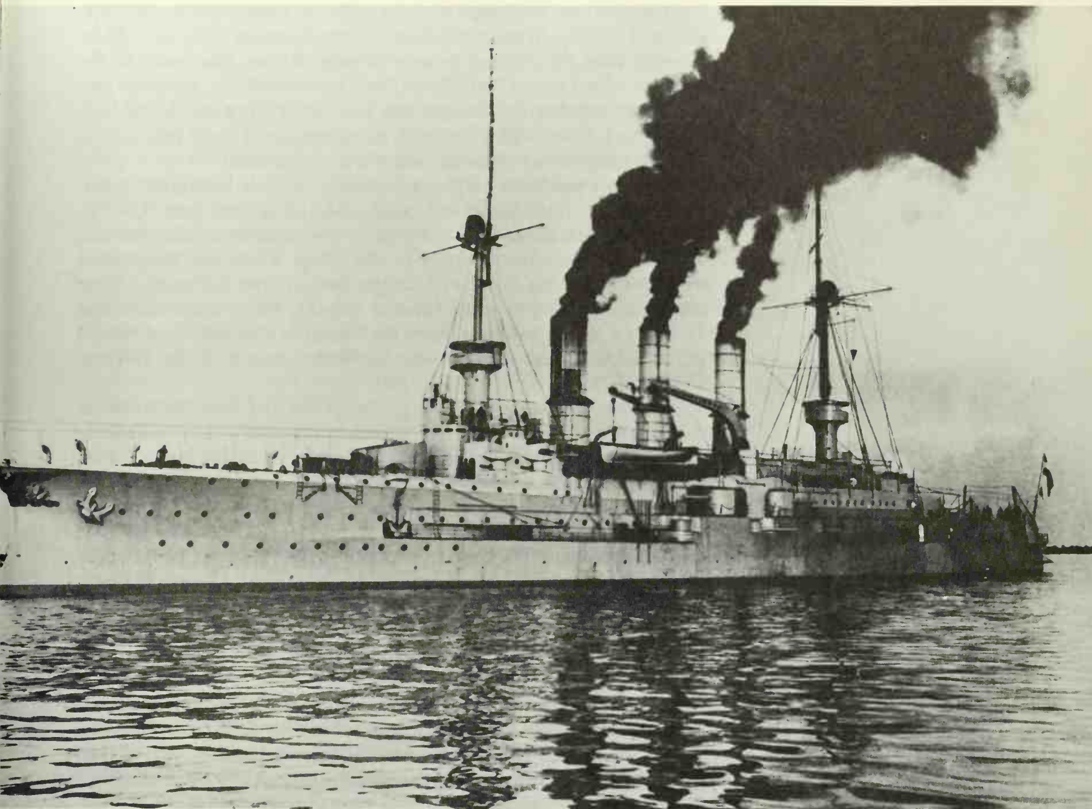
Armored Cruisers

The large armored cruiser, precursor of the battle cruiser, was a costly disappointment to both Great Britain and Germany. Too slow to keep up with the fleets and outgunned by the new battle cruisers and dreadnoughts, they accounted for an inordinate loss of life among naval vessels.

Great Britain used thirty-four armored cruisers, of which thirteen were lost to torpedoes, mines, guns, explosions, or were wrecked. These old vessels displaced from 9,000 to 15,000 tons and generally had 6-inch armor on the sides. Speed ranged from 21 to 24 knots, and most mounted 9.2-, 7.5-, and 6-inch guns firing 380-, 200-, and 100-pound shells. They carried complements of from 650 to 900 men, draining a large amount of the Royal Navy's manpower in the early war years.



H.M.S. *Glasgow* led a charmed life, escaping from Admiral Graf von Spee's powerful force at Coronel, off Chile, only to return the next month with a more powerful British squadron to destroy the German cruisers. *Glasgow* was representative of twenty-one cruisers of the "Town" classes built during 1909–1915 for long-range cruises. Average displacement was 5,000 tons, armament mostly 6-inch guns, length about 450 feet, beam 50 feet.



The "*Panzerkreuzer*" *Friedrich Karl*, launched in 1902, was typical of the German armored cruisers, nearly all of which were lost to enemy action. Length was 689 feet, beam 63 feet, speed 20.5 knots, displacement 9,000 tons. She had a coal capacity of 1,600 tons, carried 4-inch belt armor, 2-inch deck armor, and 6 inches on main turrets. Armament included four 8.2-inch, ten 5.9-inch, twelve 3.4-inch, and fourteen machine guns. She was equipped with four underwater torpedo tubes.

The first real war shock hit Britons in the second month. On September 17, 1914, in the North Sea, a lone submarine sank half of the "Cressy" class of armored cruisers—*Cressy, Hogue,* and *Aboukir*—in one hour with a loss of 1,400 lives. Next, on November 1, Admiral Graf von Spee's prowling Pacific squadron sank *Good Hope* and *Monmouth* off Coronel, Chile, with a loss of 1,440 men—not a single survivor. At Jutland, *Black Prince, Defence,* and *Warrior* were lost.

Germany had built only seven armored cruisers before the dreadnought era overtook them, and lost six. Most displaced from 9,000 to 11,600 tons and mounted 8.2-inch guns. The most spectacular loss was the *Blücher,* newest and largest of the group, which was mismatched against British battle cruisers off Dogger Bank. In the only other notable sea battle involving German armored cruisers, Spee's *Scharnhorst* and *Gneisenau,* which had outgunned the British at Coronel, were hunted down and destroyed a month later by battle cruisers off the Falkland Islands.

Standing leisurely out of range, *Invincible* and *Inflexible* required several hours to sink *Scharnhorst* and *Gneisenau,* nearly exhausting their supply of 12-inch shells. While this was seen by some as a tribute to the well-known excellence of German ship construction, others attributed it to poor gunnery and faulty ammunition. The supposedly armor-piercing British shells were reported to have burst almost upon impact, decimating the German crews long before getting to the ships' vitals. This apparently was a problem never adequately corrected until the heavy shooting at sea was over in this war.

Protected Cruisers

The "protected cruiser" was the forerunner of the modern cruiser—an oceangoing vessel with no side armor but with deck protection from 1 to 6 inches. The British ships were designated 1st, 2nd, or 3rd class according to size, which ranged anywhere from 3,000 to in excess of 10,000 tons' displacement. Gun sizes varied from 4- to 6-inch.

About half of the protected cruisers in Britain's inventory at the start of the war were pressed into service. Some, like the *Hawke* and the *Edgar,* were completed as far back as 1893. The little 3,000-ton "Gems," led by the turbine-powered *Amethyst,* were the final class constructed, in 1905. They saw extended war duty.

Germany had only seventeen small and medium-size cruisers suitable for war duty, ranging from slightly over 2,000 to 5,700 tons' displacement, with primary armament either 4.1-inch or 8.2-inch guns. Four ships were lost in action.

Light Cruisers

While the armored cruiser was being replaced by the battle cruiser, the evolving destroyer was being escalated to seagoing size with increasing firepower. This led directly to a special type of fifteen 25-knot

"Scout" cruisers, commissioned by Britain from 1905 to 1913 to operate with destroyer flotillas. They ranged from about 3,000 to 3,500 tons in displacement, were 360 to 405 feet in length, and mounted 4-inch guns.

The profusion of British cruiser types continued with production from 1905 to 1915 of twenty-one larger "Town" cruisers to deal with long-range German light cruisers. Principally these ships saw action in the dramatic 1914–1915 chases that drove German raiders from the seas. *Glasgow,* escaping from Spee's squadron at Coronel, returned with the battle cruisers to wreak vengeance off the Falklands. *Weymouth* helped hunt down the *Königsberg. Sydney* gunned the famous *Emden* into a flaming mass of scrap iron at Cocos Islands, in the Indian Ocean. *Birmingham* rammed U-15, the first U-boat to be sunk. *Chester* earned fame at Jutland. These ships displaced from 4,800 to 5,500 tons, usually carried 6-inch guns, and averaged about 25 knots.

The final evolution of British light cruisers in World War I—many of which served in World War II—began in 1914 and continued right on to the Armistice, with completion of forty ships of 3,500 to 4,700 tons, nearly all of which saw service. These 28-to-30-knot vessels were small but rugged.

The 3,750-ton *Cleopatra* rammed and sank a German destroyer. *Curaçao* and *Centaur* were mined, the latter losing both her bow and stern, yet both vessels survived.

The earlier classes mounted three or four 6-inch guns and carried a Sopwith Camel plane and a short runway over the forecastle. Armament was escalated to five, then six 6-inch guns in classes completed from late in 1915 onward. Geared turbines replaced the unwieldy direct-drive turbines, which in turn had made obsolete the slow, old-fashioned reciprocating steam engines. Some of the vessels offered a hangar under the bridge or a platform abaft the funnels for a seaplane.

Germany completed thirty-seven light cruisers in a building program starting in the early 1900s. It was halted only by the Armistice, with several powerful vessels having to be scrapped on the ways. The first thirteen averaged 3,500 tons in displacement, mounted ten 4.1-inch guns for primary armament, and could attain upwards of 25 knots. Some of the most famous exploits of the war were recorded by ships in this group—*Leipzig, Königsberg, Nürnberg, Dresden,* and *Emden.*

The "Kolberg" class, completed by 1910, led off successive classes of larger cruisers ranging up to 6,000 tons' displacement. Turbines were adopted and primary armament advanced to 5.9-inch guns. However, Germany equipped less than half a dozen cruisers with geared turbines and never standardized on the number of propellers. Two-, three-, and even four-screw ships were sometimes launched in the same class.

The German Raiders

At the outbreak of war there were only ten German cruisers at large, and they tied knots in the tail of the British lion in the early months.

Literally scores of Allied warships—British, French, and Japanese—were assigned at varying times to track them down. Five of the vessels, the armored cruisers *Scharnhorst* and *Gneisenau* and the light cruisers *Emden, Nürnberg,* and *Leipzig,* were in the Pacific. The light cruisers *Dresden* and *Karlsruhe* were stationed in the West Indies, the *Königsberg* was off East Africa, and the battle cruiser *Goeben* and light cruiser *Breslau* sailed the Mediterranean.

Admiral von Spee, with his squadron in the Far Pacific, quickly found these waters untenable as Japan declared war and the Allies took over German strongholds—Tsingtao, German New Guinea, the Bismarck Archipelago, and Samoa. Detaching the *Emden* for a lone-wolf cruise, von Spee raided French and British possessions on a 10,000-mile voyage from the South Seas to Chile, bombarding the French at Tahiti and cutting the British cable at Fanning Island in the process. His squadron of *Scharnhorst, Gneisenau,* and *Nürnberg* was joined by *Dresden* and *Leipzig* in Chilean waters, where they destroyed two of three British cruisers that stalked them.

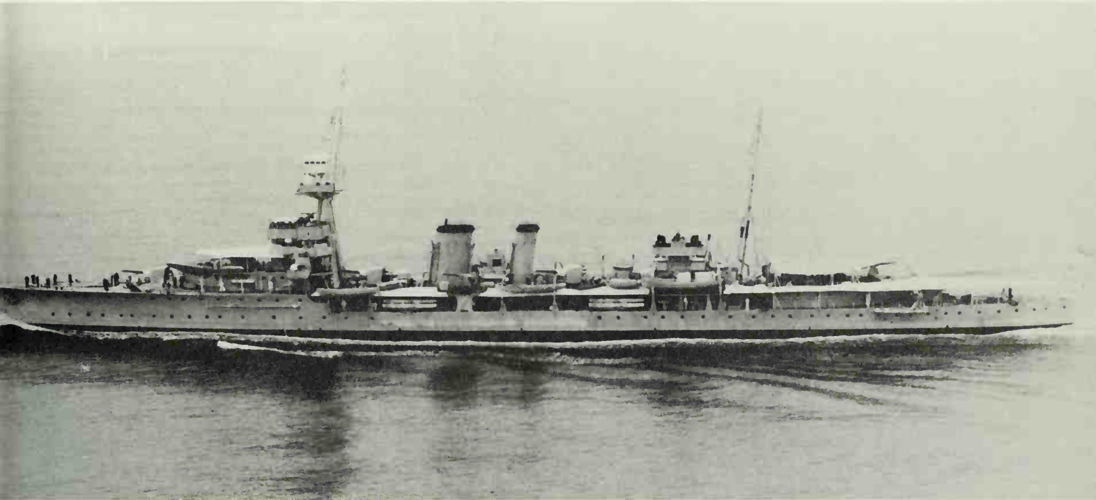
At one time some thirty Allied warships, including three battle cruisers, were spotted in powerful squadrons to guard threatened points and to prevent Spee's passage around the Horn. Except for *Dresden*, which escaped, Spee's ships finally were trapped and destroyed by an overwhelming British battle cruiser force off the Falkland Islands. *Dresden* was cornered off Chile and blown up by her own crew in March, 1915.

The *Emden*, most famous of the German raiders, began a spectacular and daring odyssey on leaving Spee's force in August, 1914. Her captain, Karl von Müller, who displayed gallantry and persuasiveness as well as courage, earned grudging admiration from foe as well as friend in his three months of action. *Emden* slipped into the Indian Ocean through Molucca Strait, evaded a British cruiser and armed merchantman, and ranged the Bay of Bengal for two weeks. Much of Indian shipping was paralyzed in the wake of *Emden*'s capture of thirteen ships. However, on departure, Müller spared the town of Madras after bombarding the huge oil tanks nearby.

He next cruised the western approaches to Ceylon for a month and captured ten more vessels, among them valuable colliers whose cargoes helped sustain *Emden*'s operations. When the scent of Allied hunters became too strong, *Emden* ran southward 1,000 miles and was received with open arms by a lone, elderly Briton on the island of Diego Garcia who had not heard about the war.

Turning eastward, Captain von Müller invaded the harbor of Penang and point-blank torpedoed the unprepared Russian light cruiser *Zhemchug*. Emerging, *Emden* sank the French destroyer *Mousquet* and released the survivors on one of the captured ships that Müller retained from time to time to remove the crews of the merchantmen that he sank. Müller's luck in arranging rendezvous with supply ships had played out, however. His consorts had been sunk off Sumatra.

In his final escapade, he determined to destroy the wireless station

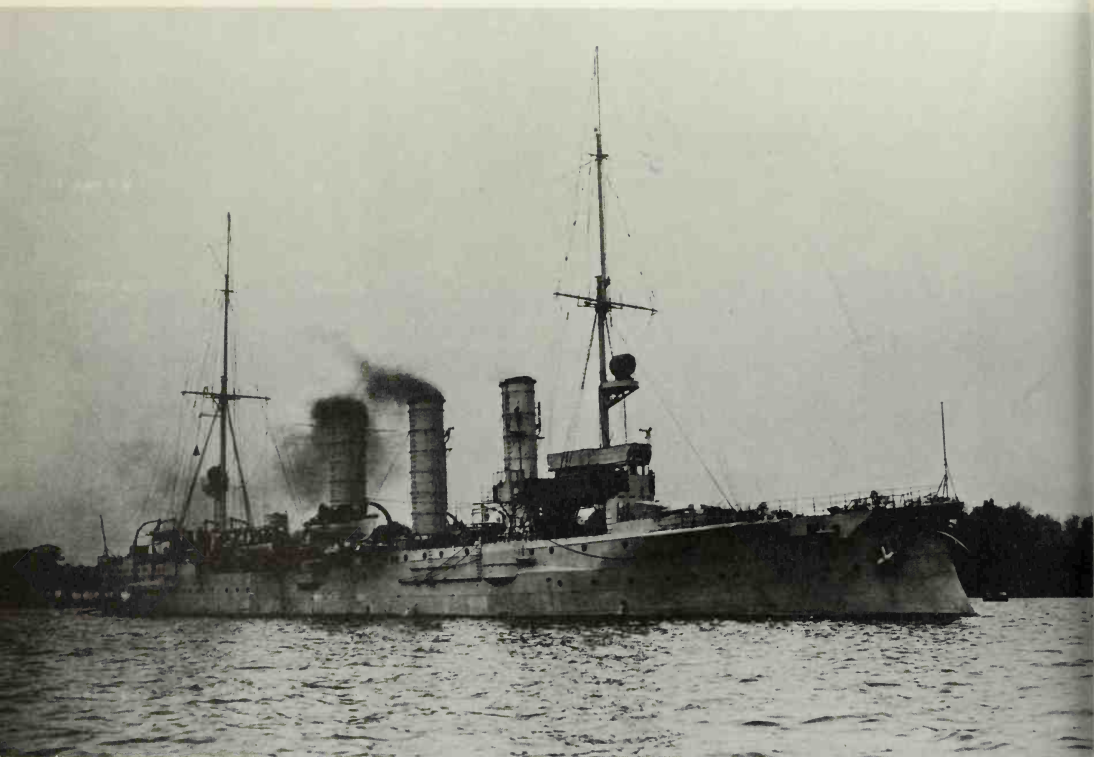


H.M.S. *Danaë* belonged to the last class of what had evolved as modern light cruisers built during the war—one of a dozen 1917–1918 ships converted to antiaircraft cruisers for duty in World War II. She displaced 4,650 tons, was capable of 29 knots on geared turbines, mounted six 6-inch and two 3-inch AA guns, and twelve 21-inch torpedo tubes as originally constructed. Length was 471 feet, beam 46 feet.

and cables at Cocos Islands, but the operators noted the crude dummy fourth funnel on *Emden* as she stood into harbor and radioed a powerful Anzac squadron for help. As the unsuspecting Germans went about their business of destruction, the Australian cruiser *Sydney* was racing toward Cocos only 2½ hours away. *Emden,* outweighed by 2,000 tons and outgunned by 6-inch rifles against 4.1-inchers, was driven onto a reef and pounded to a hulk.

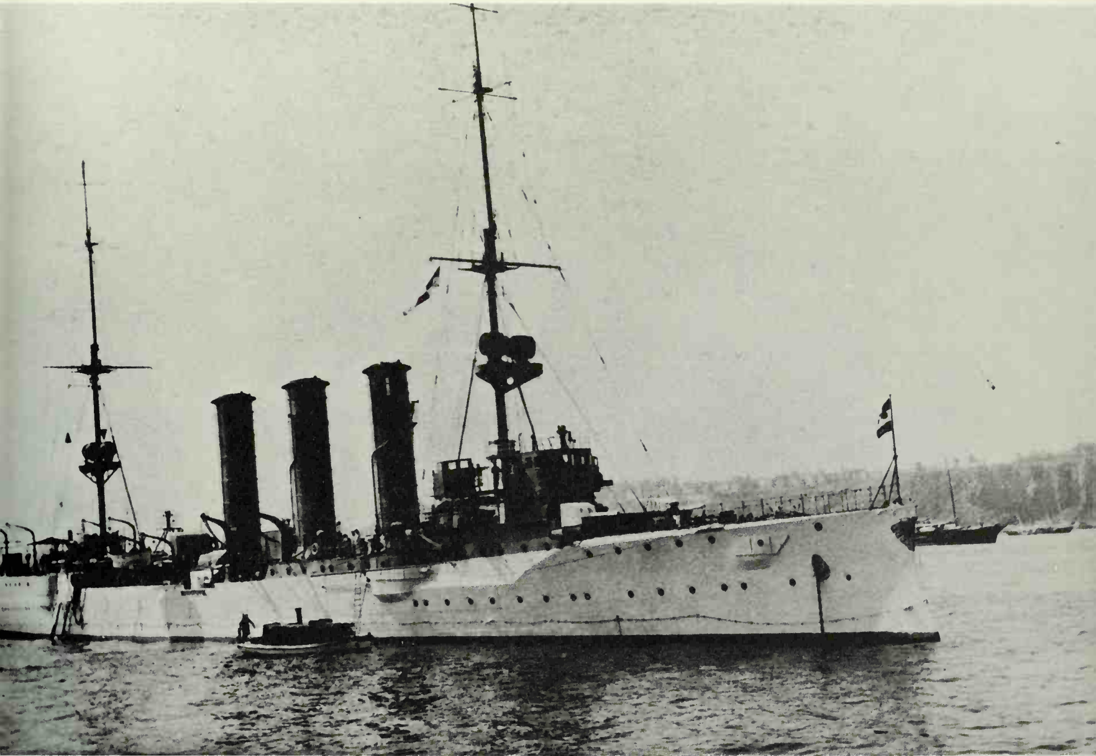
In the Atlantic the *Karlsruhe* had almost as successful, if less romantic, a career as a raider. Brought to action only briefly in a moonlight chase by two British cruisers from which she escaped, *Karlsruhe* captured seventeen merchantmen before she blew up in November, 1914. The *Königsberg* took only one prize in the Gulf of Aden and sank the *Pegasus* off Zanzibar before being blockaded in the swampy estuary of the Rufiji River in East Africa. Working her way inland to the point where seagoing vessels could not reach her, *Königsberg* occupied many ships and caused fruitless counterefforts for nearly nine months before shallow-draft monitors were brought in with 6-inch guns to destroy her with the aid of spotting seaplanes.

The fast battle cruiser *Goeben* and light cruiser *Breslau* slipped past



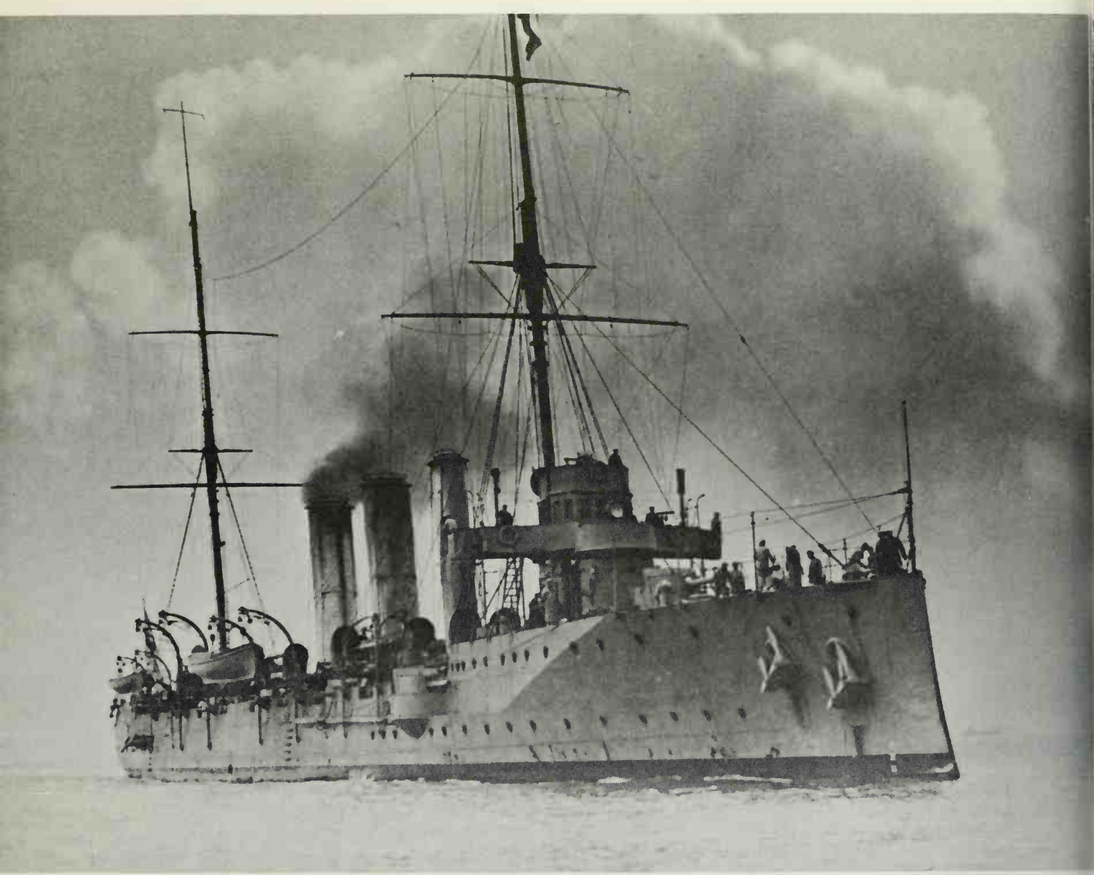
S.M.S. *Dresden* was with von Spee's squadron, along with her famous sister ship *Emden,* which was destroyed by H.M.A.S. *Sydney* at Cocos Islands. These light cruisers displaced only 3,650 tons and, like most German cruisers built before 1914, carried 4.1-inch guns. Speed was 25 knots on steam turbines and four screws.

British cruisers in the Mediterranean. Escaping to the Dardanelles, they played unique roles as Germany's most powerful weapons in pushing vacillating Turkey into the war against the Allies. *Goeben* was signed over as a Turkish warship and. with her Admiral Souchon, appointed to command the Turkish navy, raided and bombarded the Russians into



The *Königsberg*, one of Germany's handful of famous raiders. Bottled up in a swampy estuary of the Rufiji River in East Africa, she thwarted all attacks by the British for nine months before monitors with 6-inch guns were brought in with airplane spotters in July, 1915. *Königsberg* was an early light cruiser mounting 4.1-inch guns. She displaced about 3,500 tons, steamed at 25 knots.

war in the Black Sea. *Goeben* and *Breslau* made one reappearance in the Mediterranean in January, 1918, sinking two British monitors off Imbros Island. *Breslau* was mined and sunk; *Goeben* hit two mines, reached safety, and continued in the Turkish fleet as the *Yavuz* after the war.



The so-called Third Class Cruiser *Amethyst* was built for the Royal Navy in 1903, one of four 3,000 ton warships. She could "rev" up to 21 knots and although her main battery mounted but twelve 4-inch guns, she was a good patrol vessel, once giving chase to the raider *Moewe*.

The *Askold,* built in 1900, was a Russian "protected cruiser." The only one of her class, she displaced 6500 tons and mounted twelve 6-inch cannon. It is doubtful she could make her listed 23 knots.

The British *Bullfinch* was one of sixty 30-knot "turtle-backs" completed between 1896 and 1901, nearly all of which saw war service. They closely resembled the preceding class of 27-knot "torpedo boat destroyers," which also had the low turtle-back forecastles that hampered seaworthiness. *Bullfinch* was 210 feet long, had a beam of 20 feet, displaced 330 tons, achieved over 6,000 hp on triple-expansion engines. Armament consisted of one 12-pounder, five 6-pounders, and two 18-inch torpedo tubes.

DESTROYERS

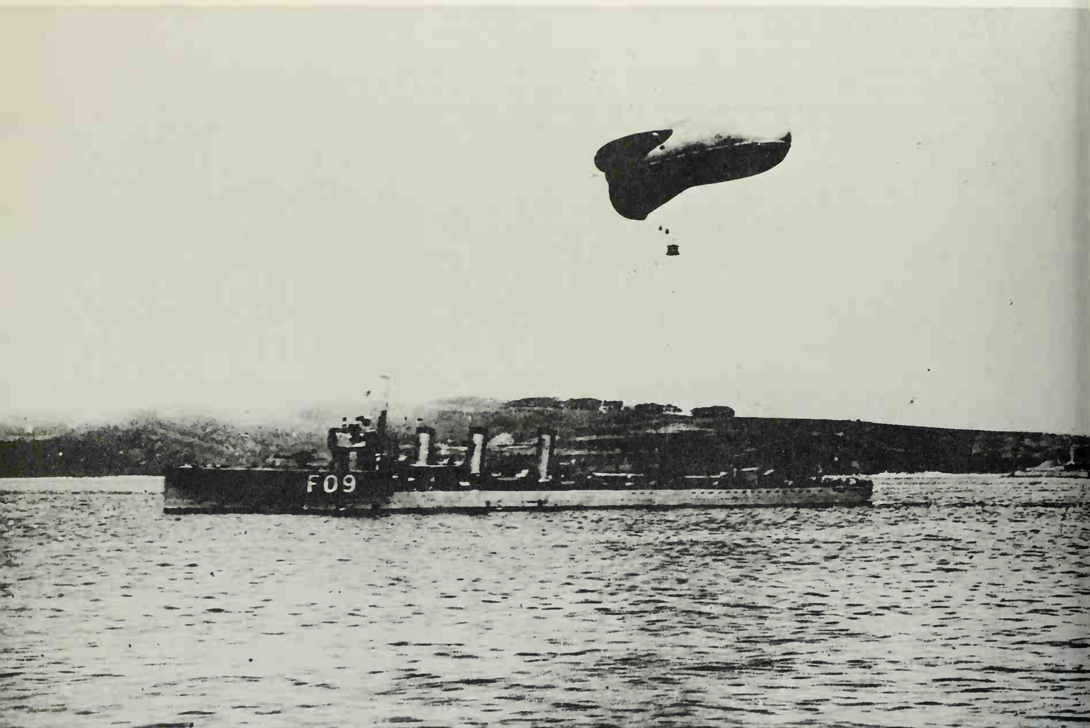
THE TORPEDO, most feared and deadly of naval weapons in World War I, had been in existence nearly three decades before any navy possessed a motor-driven submarine. The torpedo boat, ancestor of the modern destroyer, appeared in the 1870s. It was a frail craft weighing at first only a few tons, but imbued with the portent of a David in the implied challenge to the juggernauts that only the very rich nations could afford.

Goliath, however, had scant reason to fear the destroyers' granddaddies. They carried their torpedoes on spars or towed them for a quick release, close in. The next step involved more sophisticated compressed-air torpedoes, mounted in tubes, which could be launched from several hundred yards.

Soon, it was imperative for capital ships, at anchor, to spread torpedo nets from booms and play searchlights on the surrounding water. Rapid-firing guns were mounted in clusters.

Before 1890. Germany started building division leader torpedo boats of more than 200 tons, which mothered the smaller models. The unimaginative naval officers in Berlin simply called the leaders "large torpedo boats" and did so through the war, even when they were rated as high as 2,000 tons.

To the British, these husky sharks were "torpedo boat destroyers." Starting in 1892 with the little "turtle-backs" of 220 tons' displacement, Great Britain constructed the largest and most versatile line of destroyers in the world—240 in all—up to the outbreak of war. She built some 280 more of increasing speed, power, and size during the hostilities. The first 27-knot "turtle-backs," so-called because of curved forecastles, were completed from 1893 to 1895. Obviously, they were almost obsolete by 1914. The next class of 30-knot "turtle-backs" saw some of the



British destroyer *Onslow* towing observation balloon. In 1915–1917, more than 100 of this reliable "M" class were built on an emergency basis to deal with the submarine menace. Some reached 40 knots for the first time. *Onslow* displaced 1,000 tons, was 271 feet long with a beam of 27 feet. She was powered with turbines, three screws, rated at 34 knots. Armament was three 4-inch, one 2-pounder guns, and four 21-inch torpedo tubes. Complement was only 80 to 100 men.

hardest service of the war. Turbines were tried on a few of these turn-of-the-century vessels, which attained up to 35 knots but had extremely short ranges. The flimsiness of construction in order to reach high speeds on light displacements sacrificed seaworthiness, and vibration could be believed by only those who experienced it. The *Fairy,* vintage 1897, which displaced less than 300 tons, rammed and sank the 400-ton German minelayer submarine UC-75 in true destroyer fashion, but also sank herself.

The "River" group of 1903–1905, though slower at 25 knots, produced the first good seaworthy British destroyers. Featuring high forecastles, they displaced 550 tons and were armed with four 12-pounders and two torpedo tubes. The greatest stride into the modern destroyer era, however, came with the "Tribal" class of 1907–1909, which was doubled in size, equipped with turbines, and shifted entirely to oil as fuel. These ships were 250 to 270 feet long, possessed a beam of 25 feet, could steam up to 36 knots at longer ranges, and mounted five 12-pounders or two 4-inch guns.

Standardization was achieved to a great degree with the very large "M" class of 1916, followed by an improved version in the "R" group with geared turbines. The final classes being built at the end of the war, most of which also served in World War II, were the "V" and "W" types. These destroyers displaced about 1,300 tons and mounted four heavy 4-inch guns to deal with the increasing armament of the German U-boats. A number of powerful "destroyer leaders" approaching small cruiser potential appeared toward the end of the war, most averaging about 1,800 tons in displacement and mounting five 4.7-inch guns. The most remarkable British destroyer leader, however, was the *Swift,* completed in 1907.

Displacing 1,825 tons, she was 353 feet long, had a beam of 34 feet, and was reported to have exceeded 40 knots on 50,000 hp. *Swift,* which saw action in the Channel against German destroyers, originally mounted four 4-inch guns and a 2-pounder. During the middle of the war her two forecastle guns were replaced by a 6-inch gun, largest in the British destroyer navy.

England's destroyer inventory was large, but not sufficiently so as to cope with the accelerating menace from beneath the surface of the seas. Intended originally to protect the Grand Fleet and merchant shipping in home waters, the little ships also had to be sent to the Mediterranean for such duties as locking the Austrian fleet in its Adriatic ports. This spread the destroyer flotillas thin.

France counted only twenty-four small torpedo boats in 1914, and scarcely added to this modest inventory during the war. Japan did not send a great many more to sea. The best were in the 30-knot "Kaba" class, displacing 665 tons, mounting one 4.7-inch gun and four torpedo tubes. Later the Japanese copied the British "R" and "W" classes.

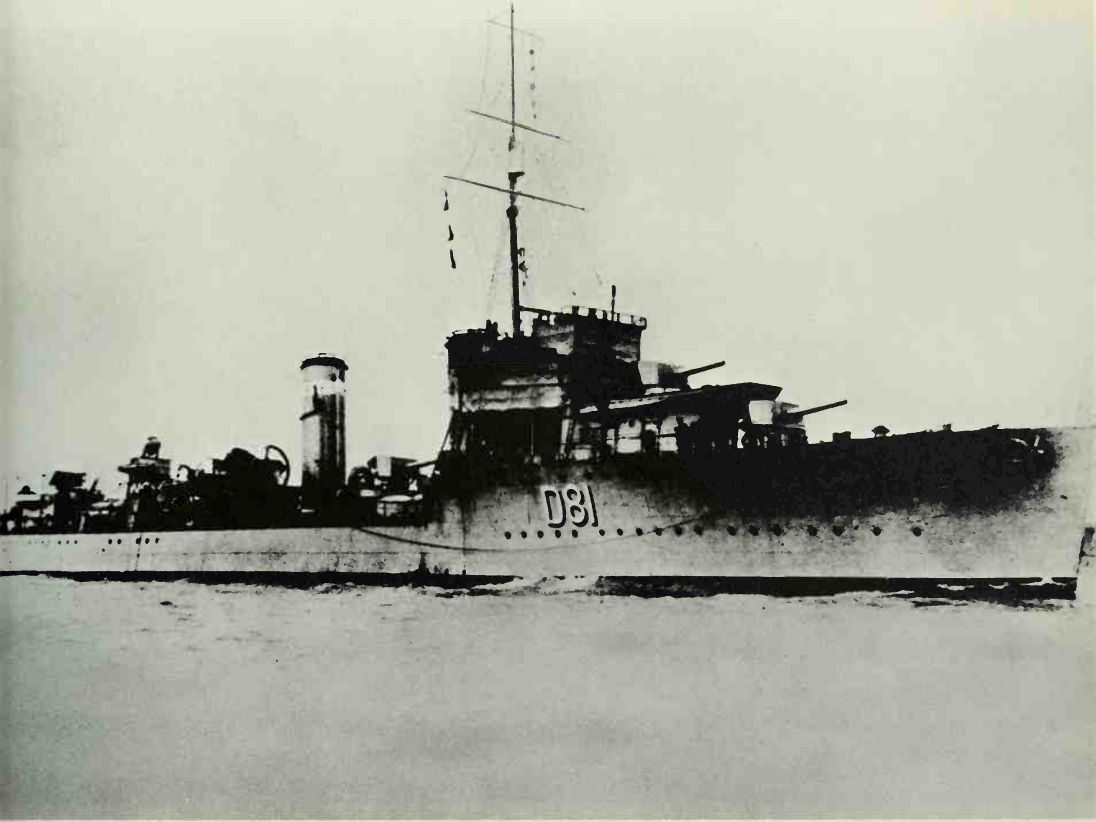
The United States Navy, up to 1916, had launched excellent large destroyers of the "Porter" and "Manley" classes. The "Porters" displaced 1,125 tons and generated 22,000 shaft hp, which gave them a speed of 32 knots. They mounted four 4-inch guns and a 3-inch AA gun, as well as twelve 21-inch torpedo tubes in triple mounts. The "Manley" class was almost identical except that the ships were slightly larger.

England needed destroyers most of all by America's entry in 1917. All that Washington could spare were rushed to Queenstown that spring. By 1918, approximately 80 destroyers flying the Stars and Stripes furrowed European waters, while others were sliding down the nation's ways in increasing numbers.

Berlin started building "large torpedo boats" in 1899—at that time displacing a little over 300 tons and capable of 26 knots. By the outbreak of war Germany had some 150 serviceable destroyers. While for the most part they were no match for the British destroyers in firepower and range, they were seaworthy. They were flush-deck, with forecastles resembling somewhat the British "turtle-backs," but their bridges were set well back to allow heavy seas to break away before hitting the chart houses. Turbines were introduced in 1908, along with the first significant armament: two 3.5-inch guns and three torpedo tubes.

In 1915 they jumped to the 1,000-ton class, with geared turbines capable of attaining 35 knots. These ships mounted either three or four 4.1-inch guns and six torpedo tubes, and carried eighteen to twenty-four mines or depth charges. After 1916, when the U-boats took over the highest priority in the German effort, only twenty-two destroyers were completed up to the end of the war. Among these, however, were two prototypes of what should have been the largest and most powerful destroyers in the world—S-113 and V-116, each mounting four 5.9-inch guns. These vessels displaced about 2,400 tons and were 337 feet long. They proved to be top-heavy, however, and slow.

Actions in which destroyer met destroyer were sporadic during the war. More than a third of the British destroyers were tied down to the Grand Fleet as a protective screen. The Germans took advantage of this and became adept at hit-and-run raids, but generally had the worst of it when brought to action. In October, 1914, when the Central Powers were harrying the exhausted Belgian army along the coast, following the fall of Antwerp, the British light cruiser *Undaunted* and four destroyers



H.M.S. *Bruce* was one of the powerful 2,000-ton Admiralty-type class leaders built in 1918, many of which saw service throughout World War II. Equipped with geared turbines and twin screws, she achieved 38 knots on 40,000 hp. Length was 332 feet, beam 32 feet; armament five 4.7-inch, one 3-inch AA, two 2-pounder guns, and six 21-inch torpedo tubes in two triple mounts.

A half flotilla of German destroyers. Germany can be credited with introducing destroyers before England, although it designated them by number without name, and called them "large torpedo boats." Consistently sound in shipbuilding, the Germans built seaworthiness into their early destroyers with high forecastles and placement of the bridge well aft.

chased and sank four German destroyers. Several raids were made throughout the war by the German flotillas in attempts to break paths for the U-boats through the mine and net barrage blocking the Straits of Dover.

Some were successful, particularly the first, in October, 1916, in which they sank two British destroyers and seven drifters at night, escaping untouched. One of the notable actions in which they were intercepted was in April, 1917, when the powerful destroyer leaders *Broke* and *Swift* confronted a raiding German flotilla. *Broke* rammed and sank the G-42, and the G-85 was torpedoed. The brawling action featured a brief hand-to-hand fight, and the two British destroyers, though heavily damaged, returned victorious.

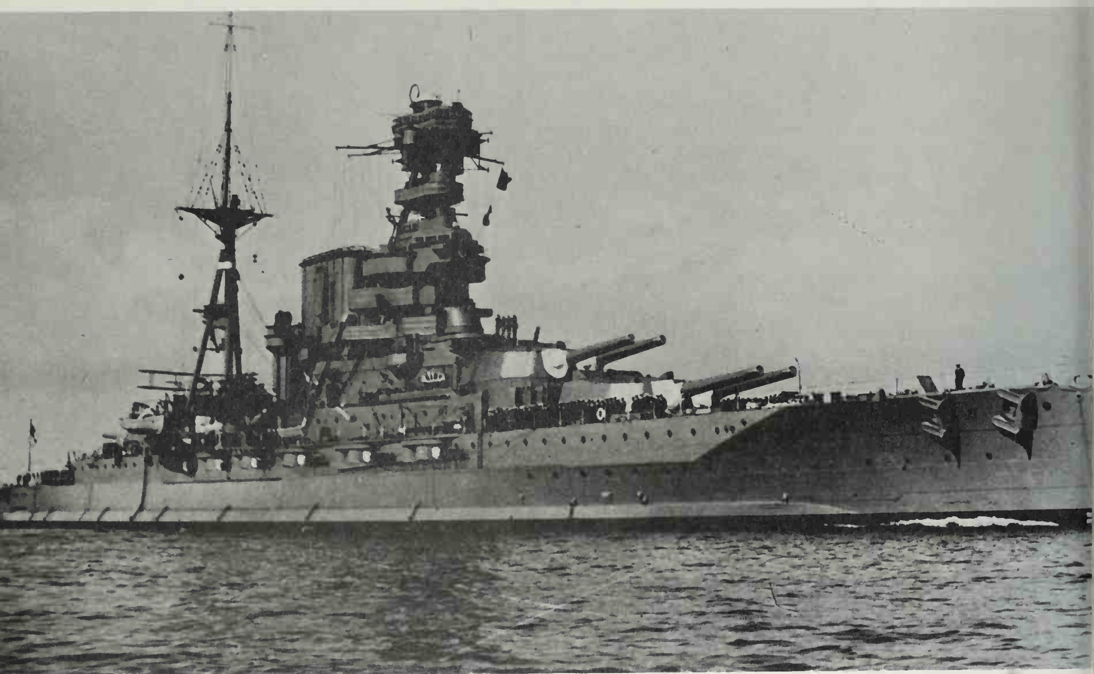
In another melee, in March, 1918, H.M.S. *Botha* rammed a German destroyer, cutting it in half. Rams, though being discarded by cruisers, were important British destroyer weapons in World War I. Made of cast or forged steel, they were fitted with double shell plating at the bows—reminiscent of the famed Civil War rams.

U.S. destroyer, DD-60, camouflaged in war paint.

TECHNICAL NOTES: U.S. destroyers in World War I were generally of the "Porter" and "Manley" classes, displacing 1,125 and 1,215 tons, respectively. Both mounted four 4-inch guns, a 3-inch AA gun, and twelve 21-inch torpedo tubes. Speed was about 32 knots.

The 4-stacker destroyer U.S.S. *Nicholson* seriously damaged the U-62 and captured the U-58. This large class of flush-deck vessels, mass-produced in American shipyards for the war, bore the brunt of Atlantic convoy. Fifty of them were lend-leased to Britain shortly after the outbreak of World War II.

The 15-inch-gunned *Barham* of the "Queen Elizabeth" class, as reconstructed after the war. She took and gave terrific punishment at Jutland, and went on to serve with distinction in World War II. Note plane abaft the mast.



THE SHOWDOWN: JUTLAND

IT WAS INEVITABLE that there should be a confrontation between the mightiest fleets that had put to sea. It occurred in the North Sea off Denmark during the afternoon of May 31, 1916, and continued sporadically through the night hours until the following dawn. The Germans called it the "Battle of the Skagerrak," the British "Jutland."

For twenty-two months since the outbreak of war the rival fleets, separated by only a few miles of water, had played hide-and-seek. The Grand Fleet, commanded by cautious Admiral John Jellicoe, had made several sweeps of the North Sea in hopes of destroying the German High Seas Fleet with overwhelming numbers and firepower. The Kaiser's sea arm could seek only to effect hit-and-run damage.

After Admiral Reinhard Scheer took command of the High Seas Fleet in January, 1916, sorties and raids were stepped up in attempts to disperse Jellicoe's monolithic forces. In late April he bombarded English towns on the east coast.

Finally, in the early morning hours of May 31, Scheer sent Admiral Franz von Hipper with his scouting force of battle cruisers northward to make a show off the coast of Norway. Perhaps he could lure elements of the Royal Navy into the massive maw of the High Seas Fleet, 50 miles southward.

The British, however, in possession of the enemy code and using early radio direction-finding equipment, knew at least that the High Seas Fleet had steamed out of Wilhelmshaven and was on a northerly course.

Not since Lord Howard's 197 ships destroyed the 130-ship Spanish Armada in 1588 had Great Britain mustered such an advantage in numbers over the enemy in a major sea battle. Under Jellicoe were 151 warships—28 battleships, 9 battle cruisers, 8 armored cruisers, 26 light cruisers, and 80 destroyers and flotilla leaders. Scheer's force of 101 vessels consisted of 22 battleships, 5 battle cruisers, 11 light cruisers, and 63 destroyers and flotilla leaders. But the British superiority on paper was much more than numerical—it was overwhelming in tonnage and guns, as well as considerable in speed.

Only three of Jellicoe's 37 capital ships were as much as eight years old, and they packed a total of 344 turret guns in 12-, 13.5-, 14-, and 15-inch sizes. Six of Scheer's 27 capital ships were slow old battleships of the pre-dreadnought era, and his biggest guns were 12-inch. Of the 244 turret guns in the German fleet, more than one-fifth were only 11-inch, but they played hob with the British.

The Battle of Jutland has been billed as the last great sea battle in which battleships took the leading role. While it is true that all strategy revolved around their protection and attempts of each side to maneuver the other into range of their powerful guns, it might more aptly be called the final great conflict of battle cruisers, for they—along with destroyers and light cruisers—endured most of the punishing brunt of that day. Admiral Beatty, daring and eager with six battle cruisers and four fast "Queen Elizabeths" in hand on initial contact, bore down on Hipper's scouting force of five battle cruisers. Hipper, never a textbook professional, was shrewd and brilliant. Displaying supreme confidence in his ships' well-practiced gunnery, he allowed the range to be closed while maneuvering the British force toward the High Seas Fleet behind the horizon. Firing commenced at 3:48 P.M. at a range of 16,000 yards.

From the start, the Germans outgunned their British foe. *Indefatigable* was the first battle cruiser lost—blowing up after a lucky hit from *Von der Tann* had fired her magazines. The *Queen Mary* also exploded under a broadside from the *Derfflinger*. More than 2,000 officers and men, most of their crews, perished with the great behemoths of the seas.

"There seems to be something wrong with our bloody ships today," Beatty observed as he saw the monstrous red fireball from the *Queen Mary* boiling heavenward.

His own flagship, *Lion*, lost her midships turret, but the heroic flooding of her magazines in that area saved the battle cruiser (and won for a dying Marine major a posthumous Victoria Cross).

Signals, again, added to both sides' confusion. The wireless was still in its pioneering stages. The smoke from funnels and gun muzzles alike obscured signal hoists and signal lights. It was surprising only that friend did not sink friend. In this battle of the scouting forces, Hipper now became the chaser, but was dealt severe punishment by the 15-inch guns of Beatty's four "Queen Elizabeth" battleships. *Lützow* was crippled, *Von der Tann*'s decks were raked into a shambles, *Derfflinger* was damaged, and *Seydlitz* was seriously hurt by a torpedo from a British destroyer.

A climactic moment came some three hours after the commencement of the battle when Jellicoe arrived with the hard core of his Grand Fleet—the magnificent battleships. Preparing for this decisive moment, Beatty, the brilliant tactician, had been leading Hipper's squadron toward the "heavies" of the Royal Navy, having reversed his own course.

Scheer realized the trap. He was unwilling to give all-out battle to the Grand Fleet, even though the *Derfflinger,* in this engagement, had sunk the third battle cruiser of the afternoon's action, the *Invincible.* Behind a smoke screen and torpedo attack delivered by his destroyers, Scheer ordered a "turn away together" to extricate his outnumbered battleships. This he did with amazing success.

Incredibly, however, after another course change, the High Seas Fleet again appeared out of the mists and smoke of evening so that—by chance—Jellicoe was in such a position that he had crossed the enemy's "T." For about eight minutes, the Grand Fleet meted out punishment of the heaviest caliber upon Scheer's leading capital ships—even though not one, on either side, was sunk.

"Charge the enemy!" was Scheer's next command to his battle cruisers. The diversionary tactic was an apparent death ride for four damaged vessels—straight into the big guns of more than thirty capital ships. Two of *Derfflinger*'s turrets were blown to bits. *Seydlitz* was left burning fiercely.

Once more, Scheer "turned together" behind a smoke screen as his gallant destroyers delivered a murderous, diversionary torpedo attack upon the van of the Grand Fleet at long range. And when the smoke cleared somewhat and the firing abated, the battle was over. Scheer this time *was* gone.

Jellicoe did not appreciate this reality. He steamed through the night thinking that he was blocking the exit of an enemy that actually was limping on his way home. There was a bedlam of searchlight play, collisions, gunfire and torpedo attacks as Scheer chopped his way through British light forces far to the rear of the main fleet. The British armored cruiser *Black Prince* and the old German battleship *Pommern* were sunk. The *Seydlitz,* burdened with 5,000 tons of water below decks, was wallowing home.

The scope of this book does not permit coverage of the spectacles of destroyer and light cruiser clashes between opposing battle cruiser lines as great salvos from the giants screamed overhead, the daring torpedo attacks into the teeth of the enemy, single-ship exploits, or the countless instances of pure heroism and self-sacrifice on both sides.

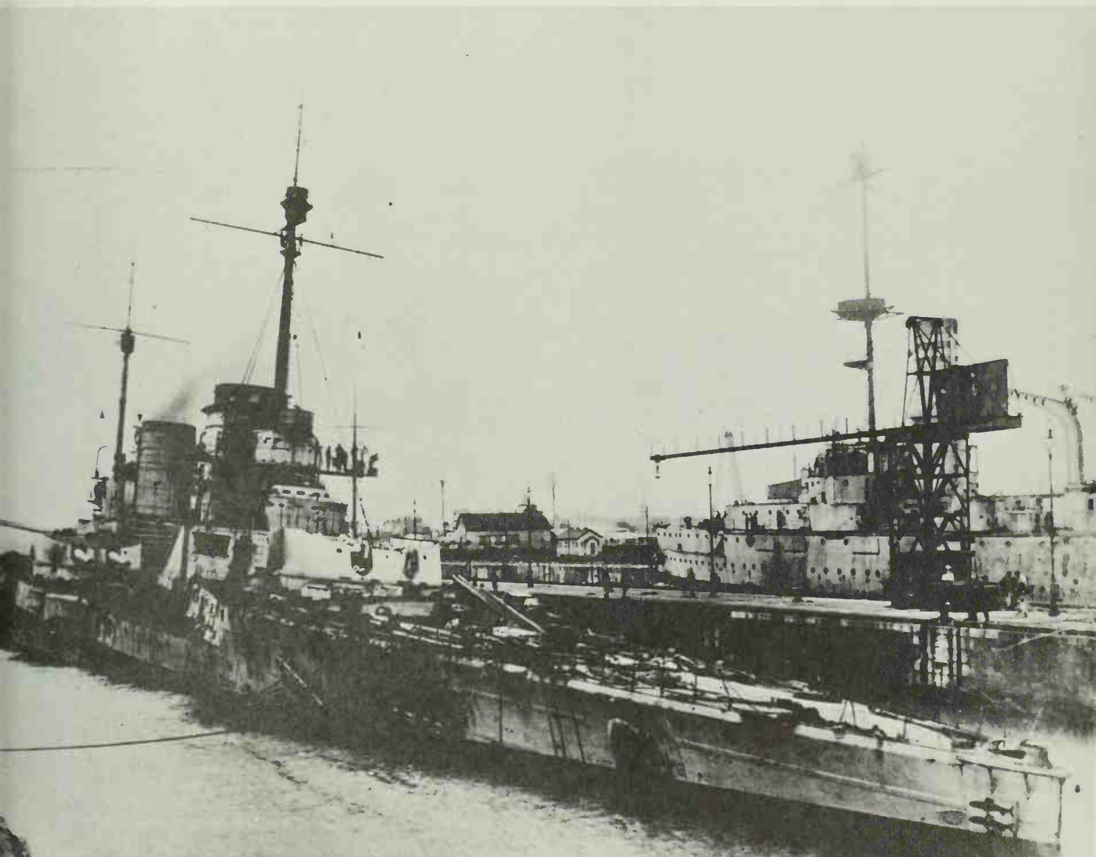
The final toll at Jutland was 6,097 Britons and 2,545 Germans killed or drowned. The British lost three great battle cruisers, three armored cruisers, and eight destroyers. Germany lost only one modern capital ship—the battle cruiser *Lützow,* which finally had to be sunk—one old pre-dreadnought battleship, four light cruisers, and five destroyers. Other damage was heavy on both sides.

In the perspective of history, Jutland was the last battle of its kind with virtually no air participation. It was the last great sea engagement revolving entirely around the battleship—and certainly was one of the most confused naval actions on record. Twenty-four admirals had flown their flags and maneuvered a total of 252 warships in a series of clashes spread over a twelve-hour period. In terms of displacement tonnage involved—more than 1,800,000, nearly two-thirds of it British—Jutland was to be exceeded only by the 2,000,000 tons involved in the Battle for Leyte Gulf in 1944. Leyte actually was a series of four engagements around the Philippines area, spread out over four days, in which American fleets of 296 vessels crushed Japanese forces of 69 ships.

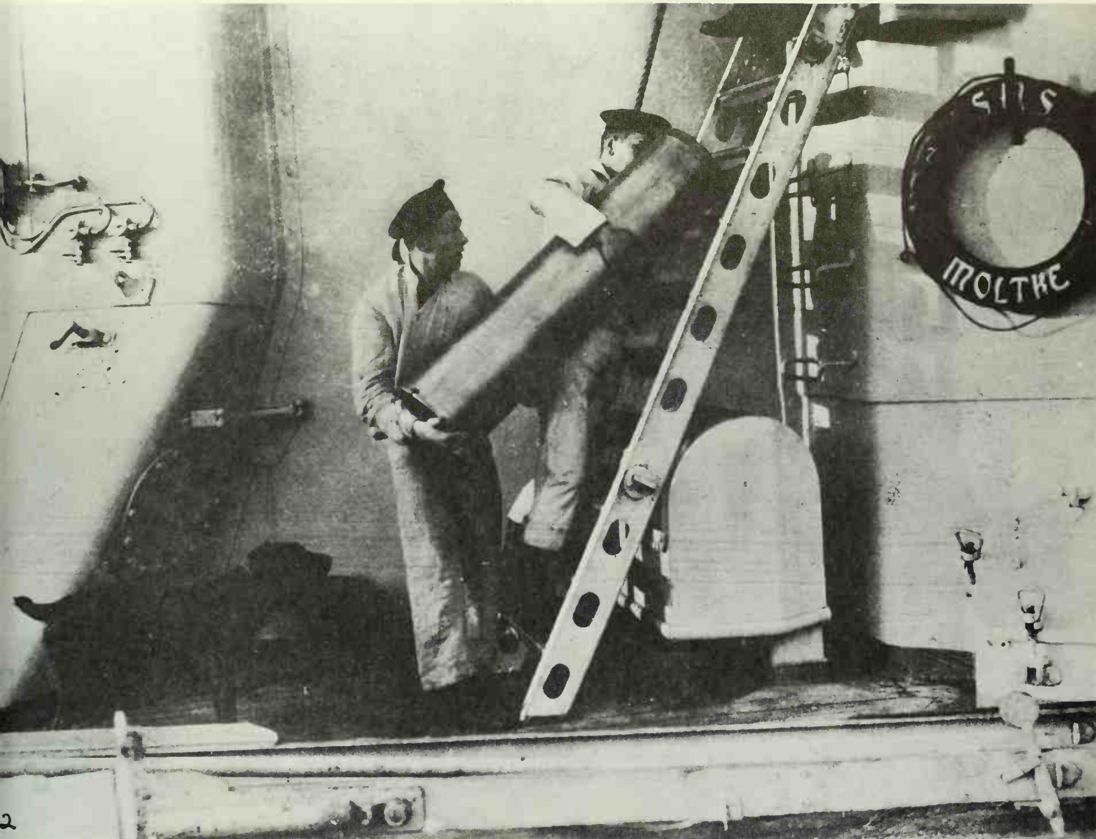
In terms of immediate effects on the war, Jutland certainly was a temporary moral tonic for the Germans and a bitter disappointment to the British. Jellicoe was heavily criticized for his caution. But, in the words of Winston Churchill, he was "the only man who could lose the war in an afternoon," and he fought Jutland to prevent a German victory more than to force a decision. The battle has become the most controversial sea engagement in history, and even today bitter charges and countercharges are being published as to the roles played by Beatty and Jellicoe in the drama, as well as Hipper and Scheer. In any case, the overall result of Jutland was to change the entire course of the war as Germany turned fully toward a submarine campaign of attrition.

Jutland's effect on naval attitudes negated the possibility of another titanic surface engagement. Even the daring Beatty, who chafed under Jellicoe's cautious mantle at Jutland, spoke out against provoking another fleet action in 1918. Improved British armor-piercing shells had not been delivered, and he considered only three battle cruisers to be capable of joining a battle line against a superior German battle cruiser fleet. As for

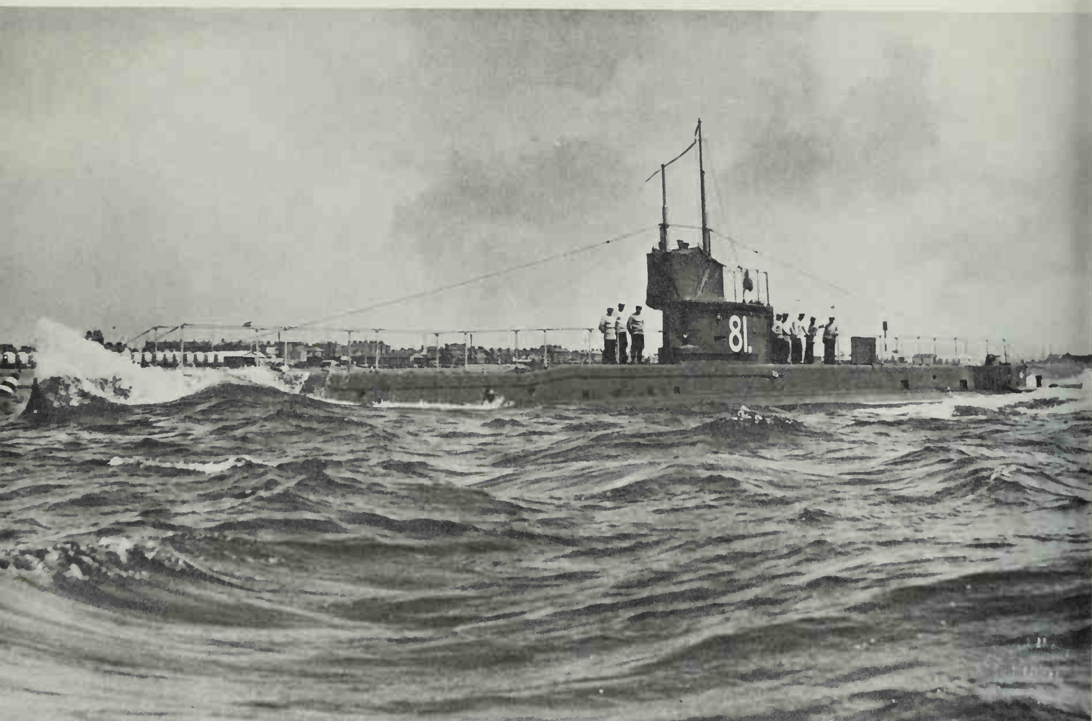
Shown heavily damaged in dock after Jutland, the crack gunnery ship *Seydlitz* symbolized the superior construction and damage control of German warships. She had two turrets destroyed and lost 159 men at Dogger Bank in 1915, but was ready for Jutland, where she took a torpedo in the bow early in the action, then had three out of four turrets knocked out, and was raked by fire, but remained seaworthy. She was Germany's fastest ship at 30 knots, had the same armament as the "Moltke" class, but was longer, had heavier armor, and displaced 24,600 tons.



Scheer, his raids and sorties became less frequent and more half-hearted as the cream of his fleet personnel was diverted to the growing flotillas of new U-boats. His final order of October 29, 1918, to put to sea for one last effort against the Grand Fleet, resulted in an open mutiny at Wilhelmshaven, which quickly infected the entire German war machine. On November 21, under terms of the Armistice, the German High Seas Fleet was surrendered and escorted to Scapa Flow for internment, where their crews, by prearranged signal, scuttled all but four vessels in June, 1919.



German crewmen carry cartridge case aboard *Moltke*—a striking example of German precautions against fire and explosion in contrast to British handling of powder in bags.



E-1 led off a class of fifty-seven submarines completed during 1913–1917 which bore the brunt of Great Britain's undersea war effort. Twenty-eight were lost. The "E" boat displacement was 700 tons, length 181 feet, beam 22½ feet. It had two screws, was powered by diesel engines with a speed of 16 knots surfaced and 10 knots submerged. Armament was five 18-inch torpedo tubes (two bow, two beam, one stern) and a 12-pounder gun. It carried 30 men.

SUBMARINES

INTRODUCTION

AMERICANS FIRST USED the submarine as an instrument of war—both in the Revolution and in the Civil War. The Confederate *Hunley,* a crude sort of halfway submersible, actually sank the federal warship *Housatonic* in Charleston harbor in 1864, although the *Hunley* itself also was blown up with all hands.

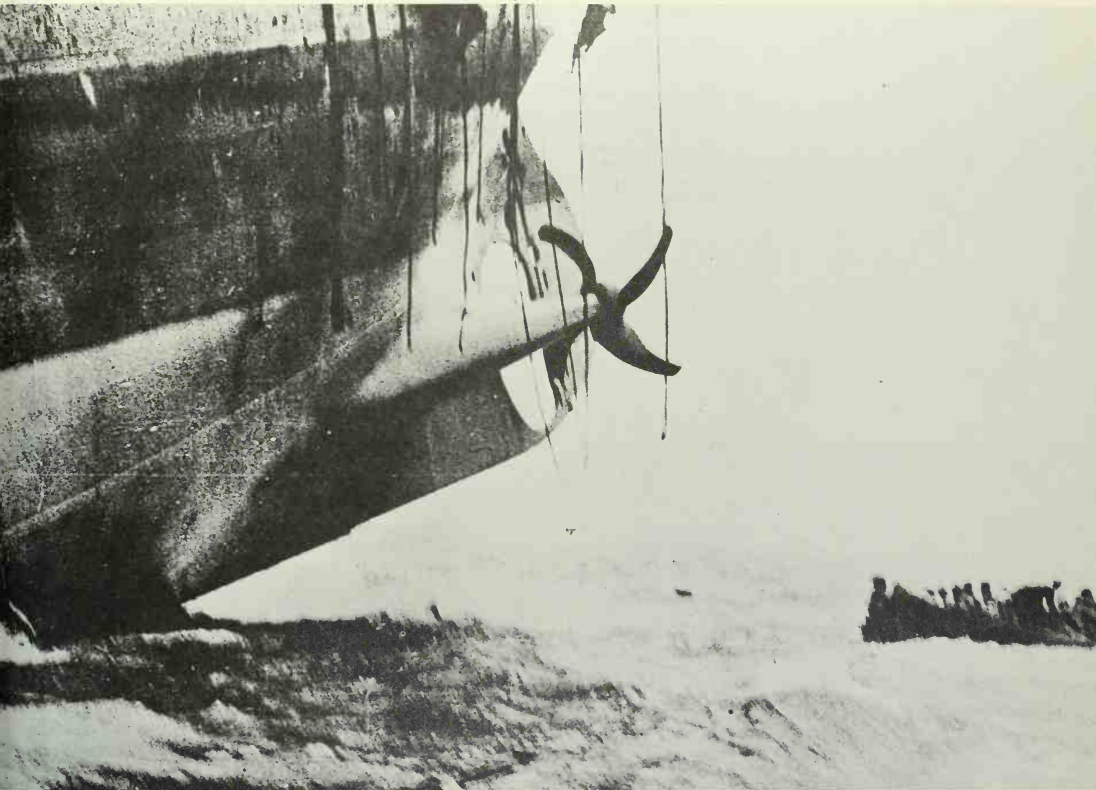
John P. Holland developed, toward the close of the last century, a motor-propelled underwater craft that was to be the true ancestor of the modern submarine. His U.S.S. *Holland* was commissioned by the Navy in 1900. She was 55 feet long, almost 11 feet in diameter, and cigar-shaped. Gasoline or storage battery fumes more often than not made duty aboard the Navy's first submarine a true hell, but at least she worked.

While Holland's Electric Boat Company began to sell his unique new craft to Germany, Italy, and Russia, as well as to the United States, another inventor, Simon Lake, developed his own submarine, which he sold to all who could afford it. The United States Navy swung to Lake's design in 1911.

The submarine was complete as a weapon with the addition of the Whitehead torpedo, developed in 1862 by Robert Whitehead, at the naval ironworks, in Austria. It was actually a small submarine in its own right, with vanes and a rudder, driven by a 40-hp compressed-air engine. The deadly missile, as used in World War I, ranged up to 20 feet in length and could carry a 500-pound warhead at 30 knots for 4 miles.

Early underseas craft had a circular conning tower with windows through which the captain had to make frequent observations. This he accomplished by "porpoising" his boat. In 1902, the periscope made navigation considerably easier, and more effective, even while the submarine was cruising 20 feet below the surface.

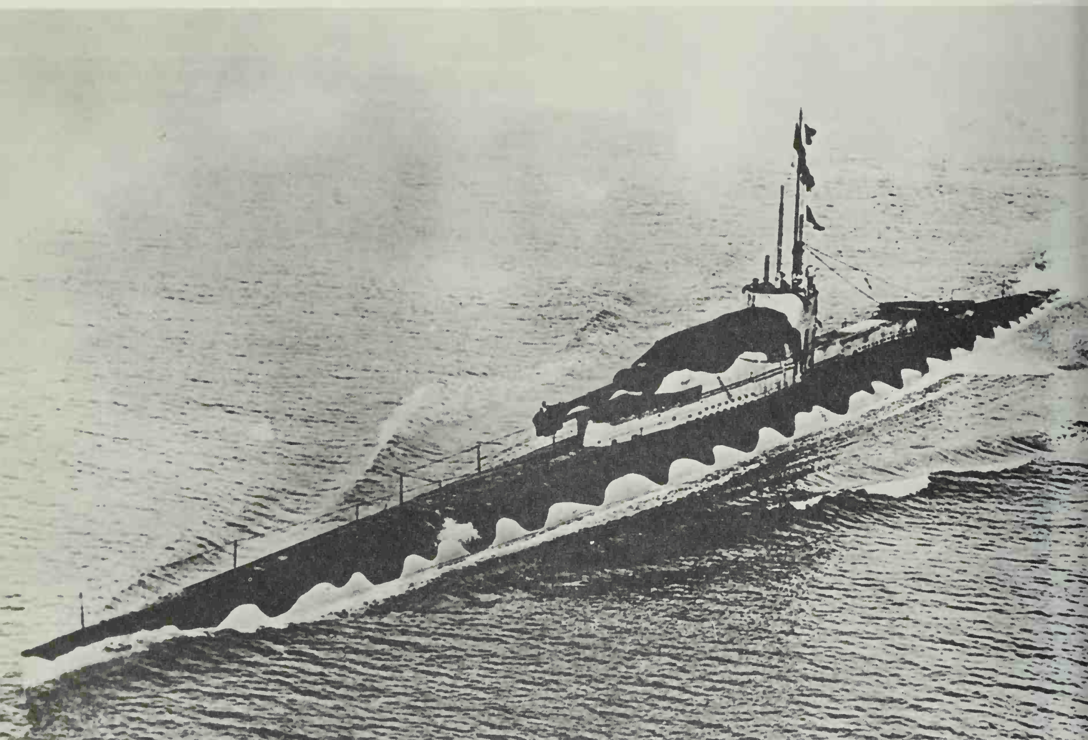
Curiously, while the terms "submarine" and "U-boat" became almost synonymous and have been strongly identified with Germany, that country showed little interest in the evolution of this craft before she felt compelled, belatedly, to plunge headlong into its construction.



Scenes such as this were repeated more than 5,000 times during Germany's unrestricted U-boat campaign. This remarkable photograph of the last moments of a torpedoed vessel shows one lifeboat astern and men still sliding down ropes as it pulls away. Splash of a man dropping into the sea can be seen in left foreground.

The British M-1 with its whopping 12-inch gun, which could be fired either from the surface or by periscope with the submarine submerged at 20 feet. The M-1 and M-2 were the only "submarine monitors" of their class.

TECHNICAL NOTES: Subs of the "M" class were 1,600 tons, powered by 2,400-hp Diesel engines, rated at 15½ knots surfaced, 9½ knots submerged. Length was 300 feet, beam 25 feet. They carried four 18-inch torpedo tubes in the bows. The pre-dreadnought Mark XI 12-inch gun fired an 850-pound shell, had to be loaded on the surface before firing. The M's carried 60 to 70 men. A third "M" sub was completed after the war, and in 1927, M-2 was modified to carry a seaplane.



BRITISH SUBMARINES

WHEN THE GERMAN SUBMARINERS were cutting their teeth on U-1, completed in 1906, the British already had behind them the experience of building twenty-four submarines, some of them experimental prototypes. By the outbreak of war, Britain had constructed some eighty submarines, a little less than half of which were in service in varying age groups. By comparison, Germany had constructed twenty-eight U-boats, of which eighteen were considered unsuited for seagoing duties.

From the little 100-ton "Hollands" of 1902, which had a single bow torpedo tube, the British progressed through the "A" class of 180 tons and two tubes, and the "B" and "C" classes of 280 tons. All of these submarines were single-screw, run by gasoline engines on the surface and battery-driven electric motors while submerged.

The breakthrough came with the "D" class of 1910–1912, which was equipped with twin screws and safer, more economical diesel engines. These 160-foot craft displaced 550 tons, made 16 knots surfaced and 9 submerged, had two bow tubes and one at the stern, and mounted a small gun in the superstructure.

The great "E" class of fifty-seven submarines constructed from 1913 through 1917 played the major role in Britain's underwater effort. Like all previous classes descended from the "Hollands," they were single-hulled, but two beam torpedo tubes were added and the hull was strengthened. They mounted a 12-pounder, carried a complement of thirty, and sometimes could reach 10 knots submerged. Exploits of the "E's" were among the most hair-raising of the war. They achieved about the only naval successes in the Gallipoli campaign, where Allied surface ships suffered tremendous losses in the restricted waters of the Dardanelles. In the swift, treacherous 27-mile-long straits—at points only a mile wide—E-boats fought U-boats, Q-ships, and destroyers, attacked troops and

Inside a British submarine.

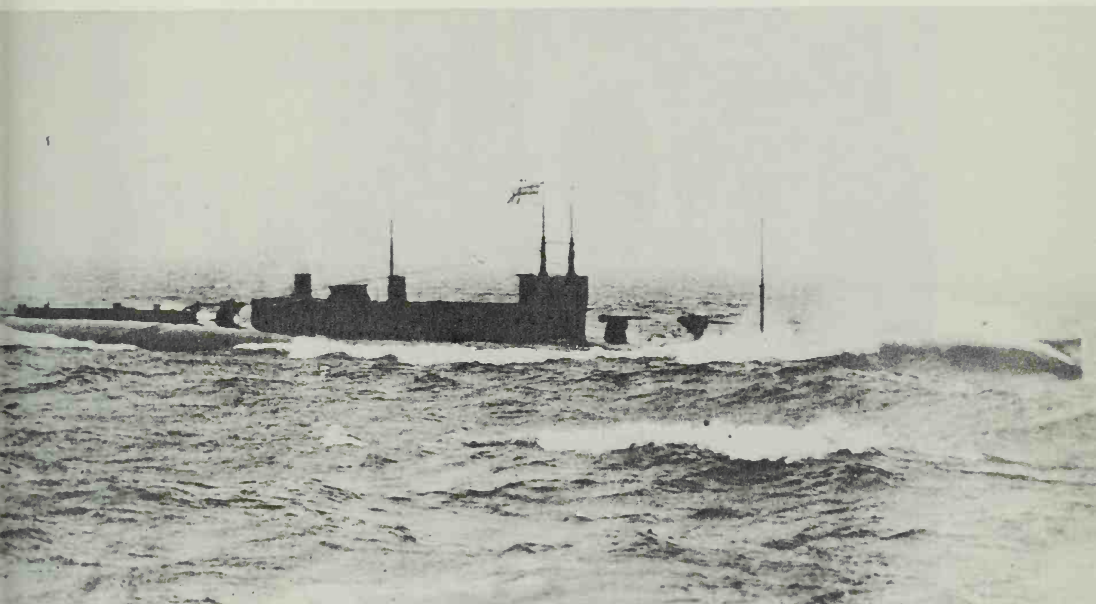
railroads, dodged mines and dove under barrage nets. The E-11 penetrated all the way to Constantinople, the first warship to do so since the Turkish conquest. There she sank Turkish warships, transports, and merchantmen, generally disrupting Turkish sea communication with Gallipoli for some time. Even the old B-11, vintage 1905, managed to dive under the minefields early in the campaign to torpedo the Turkish battleship *Messudieh*.

While the "E's" were shouldering the brunt of war duties, the Admiralty turned to an experimental program that produced the most unusual submarines of the war. Now adopting the double hull in order to streamline the outer shell for surface speed, various builders turned out classes of small vessels patterned after the Italian Laurenti style, the French Laubeuf type, and a Vickers version. The crash program even involved an order of ten new Holland-type subs from a United States shipyard, eight of which were not permitted to be delivered by the United States, zealously guarding her neutrality at the time. Suspecting that Germany was building 20-knot boats, Britain jumped to a 1,200-ton "J" class capable of 19.5 knots on the surface, making them the fastest submarines anywhere when delivered in 1916. The final product of conventional British smaller submarines was the "L" class of 900-tonners—actually an improved "E" type—several of which saw service in World War II. At war's end Britain was completing the unique "R" class of submarine hunter-killers—a 420-ton, single-screw vessel that was much faster submerged than on the surface. Conceived while Britain was in desperate straits from Germany's unrestricted submarine warfare, these hunters—capable of only 9 knots on the surface—were designed to drop to periscope depth on sighting an enemy U-boat and overtake it at the unprecedented submerged speed of 15 knots.

Britain's most remarkable undersea developments were in the large fleet and "monitor" submarine classes. Limitations in the speed capabilities of the diesel engine led to construction in 1917–1918 of eighteen large steam-driven, oceangoing submarines of the "K" class. These 1,900-ton, 338-foot fleet vessels cruised at 24 knots on geared turbines, augmented by a diesel engine for low speeds, surfacing or diving. They mounted two 4-inch and one 3-inch AA guns and were equipped with eight torpedo tubes. However, the heat that remained in the steam engines and boilers after submergence was too great to ask submariners to bear, and most of the "K's" retained after the war were used as surface patrol boats.

The mighty "M's"—submarine monitors that were among the many naval brainchildren credited to the prodigious Lord Fisher—mounted the largest guns ever put in a submarine. Two of these 1,600-ton "super-subs," each mounting a 12-inch gun from pre-dreadnought battleships, were delivered in 1918. Capable of 15 knots on the surface and over 9 knots submerged, they were designed to surface near a sizable warship and accomplish their destruction at point-blank range in the moment of surprise. These submarines were supposed to be able to fire their guns at high elevation by periscope while submerged up to 20 feet. The M-3 was not completed until after the war, and M-2 eventually was equipped with a seaplane hangar.

The K-3 was a Holland Type submarine built in 1913, 153 feet in length. Carrying eight torpedoes, she could cruise on the surface at 10 knots, submerged at 5.



On deck aboard a German submarine at sea.

THE GERMAN U-BOAT CAMPAIGN

GERMANY REPORTEDLY EXPERIMENTED with two primitive submarines as early as 1890, but her navy's light regard for these craft was indicated by the fact that three submarines were built in Germany for the Russians even before the navy accepted its first submersible, the U-1, at the end of 1906. Only twelve more were delivered over the next five years.

Despite a late beginning, however, Germany did not start at the bottom of the class, but entered the midstream of submarine evolution. Most of the early U-boats were strong, double-hulled vessels, more heavily armed than the British classes built up through 1912. The U-1 had only one torpedo tube, but the later U-boats jumped to four tubes. The early boats averaged around 500 tons' displacement, were from 150 to 200 feet long, and could travel at about 15 knots surfaced and 10 knots submerged.

Oddly, though the diesel engine was invented and perfected by Germans, their submarines built through 1912 were powered by heavy-oil "semidiesel" engines that had a short range and emitted a dense smoke. The breakthrough came in the diesel-equipped "U-19" class of 1913, whose range of some 4,000 miles caused consternation in the British fleet at Scapa Flow, but was slowly appreciated by the Germans themselves.

After vainly awaiting an attack by the Grand Fleet on the German naval haven of the Heligoland Bight during the first few weeks of the war, the German subs began sweeping the North Sea. The first British ship sunk, in September, 1914, was the light cruiser *Pathfinder*, but the heaviest single military blow by a submarine was the destruction within an hour of the armored cruisers *Cressy*, *Aboukir*, and *Hogue* by the U-9. The lesson not only underscored the folly of vessels stopping to rescue victims in submarine-infested waters, but awakened all belligerents to the power of this largely untried weapon.

Her armies failing to win the quick victory anticipated, Germany was forced to take a realistic look at the maritime situation. Her own ties with the rest of the world were effectively cut, her cruisers swept from the outer oceans, the High Seas Fleet forced to hide behind its protective minefields awaiting hit-and-run opportunities. The stranglehold of the most encompassing blockade the world had ever seen was taking its toll. In contrast, commerce in thousands of ships was flowing in practically unmolested to sustain the Allies, congesting the waters around the British Isles and France.

Germany's fateful step was announced on February 4, 1915: All waters around the British Isles were to be considered a war zone; enemy merchant ships found there would be destroyed "without its being always possible to avoid danger to the crews and passengers. . . . It is impossible to avoid attacks being made on neutral vessels in mistake for those of the enemy." Thus Germany asserted the privilege of attempting a commercial blockade without accepting the recognized responsibility of placing prize crews aboard captured vessels and sending them to port. She would not risk the surfacing of her small number of submarines to take prizes, nor did they carry enough men to leave crews with prizes.

With an attentive eye on the United States, which had issued a warning, Germany began her "sink-at-sight" campaign with about three dozen U-boats of all ages in her inventory, many of which were incapable of seagoing duty. Results were dramatic. During March, sinkings were reported from all areas of the "war zone." Two or three ships were sunk weekly in the English Channel. In May the *Lusitania* was torpedoed without warning with the loss of 1,198 men, women, and children, and the American steamers *Gulflight* and *Nebraska* were torpedoed. By August, American feeling ran so high that Germany gave orders to regard the safety of passengers on liners. The first phase of the submarine campaign came to an end in September after the U-boats had claimed a total of more than 450 ships bearing the flags of Great Britain, France, Belgium, Norway, Sweden, Denmark, the United States, Holland, and Spain. This toll did not include sharp losses from a new source—the submarine minelayers.

Concurrently with a steady output of her standard seagoing U-boats, Germany had launched mass production of two classes of relatively inexpensive submarines—the "UC's" and "UB's." The first thirty-five of these little 130-to-170-ton boats, powered by heavy-oil engines, were delivered throughout 1915. With crews of fourteen or fifteen, they could attain only about 6.5 knots on the surface and 5 knots submerged. The unarmed UC's job was to sow mines around lightships and buoys by night. The UB, while not as efficient as her seagoing sisters, had two torpedo tubes and played havoc with shipping and fishing fleets along the Belgian coast.

The submarine campaign was revived in February, 1916, on the premise that while passenger ships would be spared, defensively armed merchant ships would be sunk without warning. The torpedoing of a French passenger ship at the end of March brought a thinly veiled ulti-

Four German U-boats with mother ship in November, 1917. These early submarines were successful, but had a high mortality rate. Of those shown, U-6 and U-7 were torpedoed, U-10 was mined, and U-12 was rammed by a British ship. It was U-9 of this class that sank three British cruisers within an hour in the North Sea in September, 1914, inflicting a loss of 1,400 men.

TECHNICAL NOTES: The U-5 class, like other early German U-boats numbered through 18, were powered by heavy-oil engines that emitted a dense smoke. U-5's were 188 feet long with 18¼-foot beam, displaced 500 to 600 tons. They had four 17.7-inch torpedo tubes (two bow and two stern) and one 2-inch gun. Complement was 28.

matum from President Woodrow Wilson. Germany again relented, but turned her attention to the Mediterranean, which became a happy hunting ground for U-boats until early 1917. The UB's and UC's were coming off the assembly line in quantity, and several of these small vessels were shipped in sections by rail to the Austrians at Pola for reassembly.

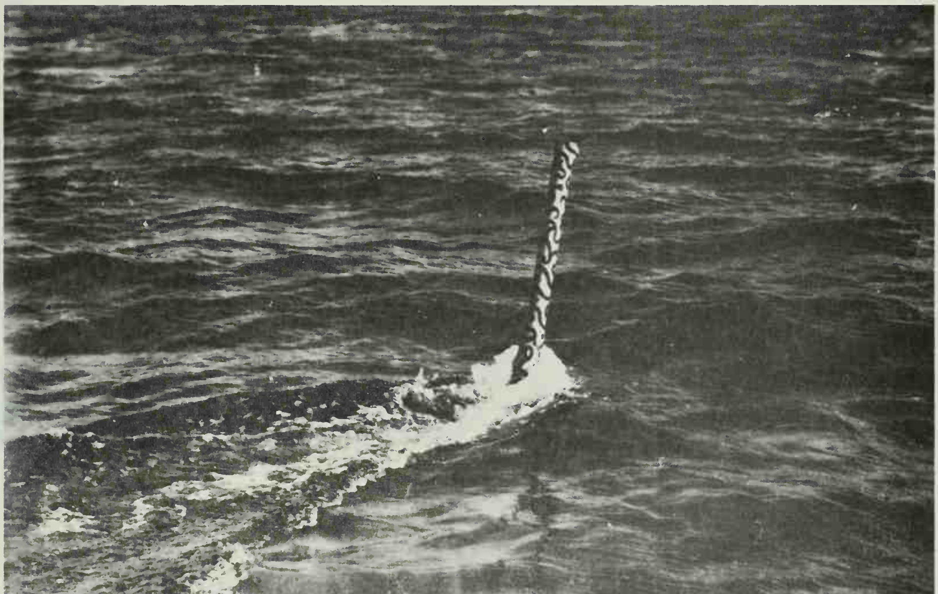
By the summer of 1916, after Jutland, Admiral Scheer had to agree that submarines were the sole key to winning the war.

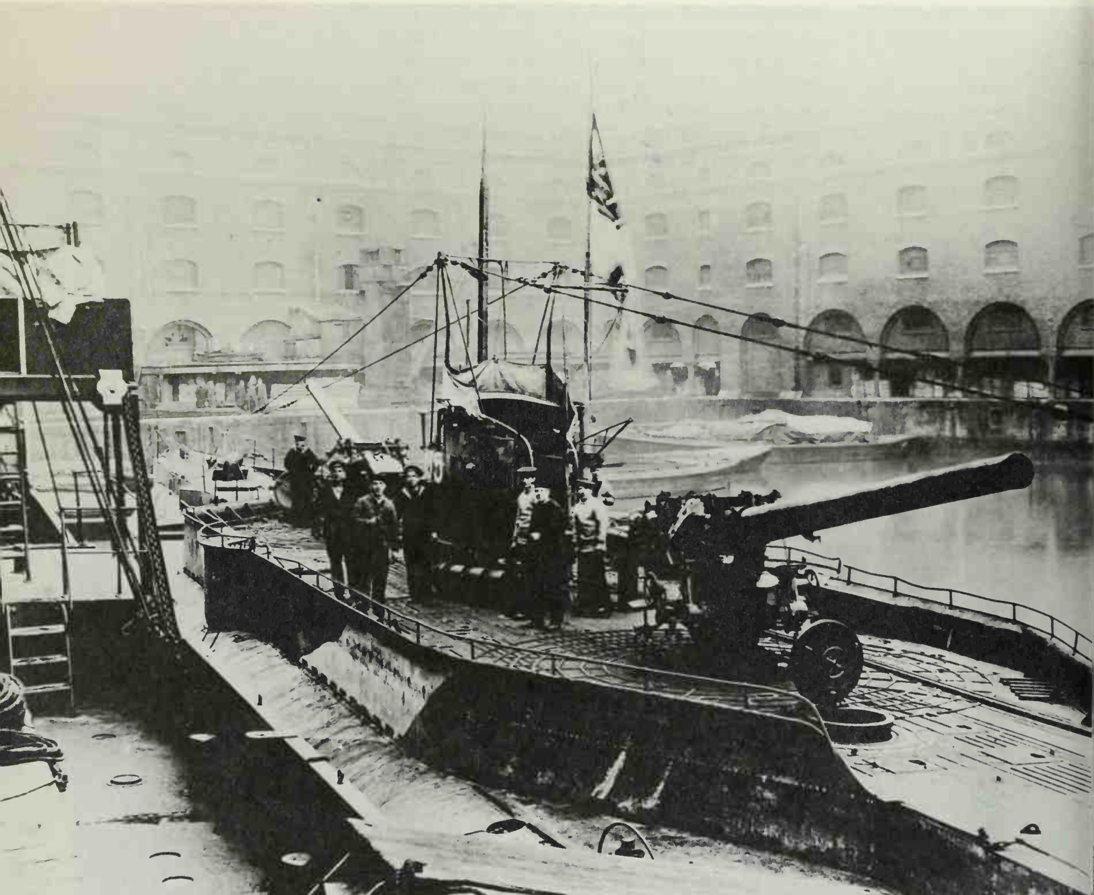
At the beginning of 1917, more than 100 seagoing submarines were in commission. The "U" classes were bigger, and mounted 3.4-, 4.1-, and even 5.9-inch guns on the largest sizes. Long-range minelaying submarines were developed. A new flow of UB's and UC's only faintly resembled their predecessors of 1915. The UB now displaced 500 tons, was powered by diesels, mounted a 4.1-inch gun, and was equipped with five torpedo tubes. The UC minelayer also was larger and carried torpedoes, a gun, and eighteen mines.

On February 1, 1917, Germany began her final, desperate bid to bring Britain to her knees with the single instrument of the submarine. French waters and the Mediterranean were added to the "war zone," followed by the Portuguese Atlantic islands and the Archangel area. Ships of any type, flying any flag, were to be sunk.

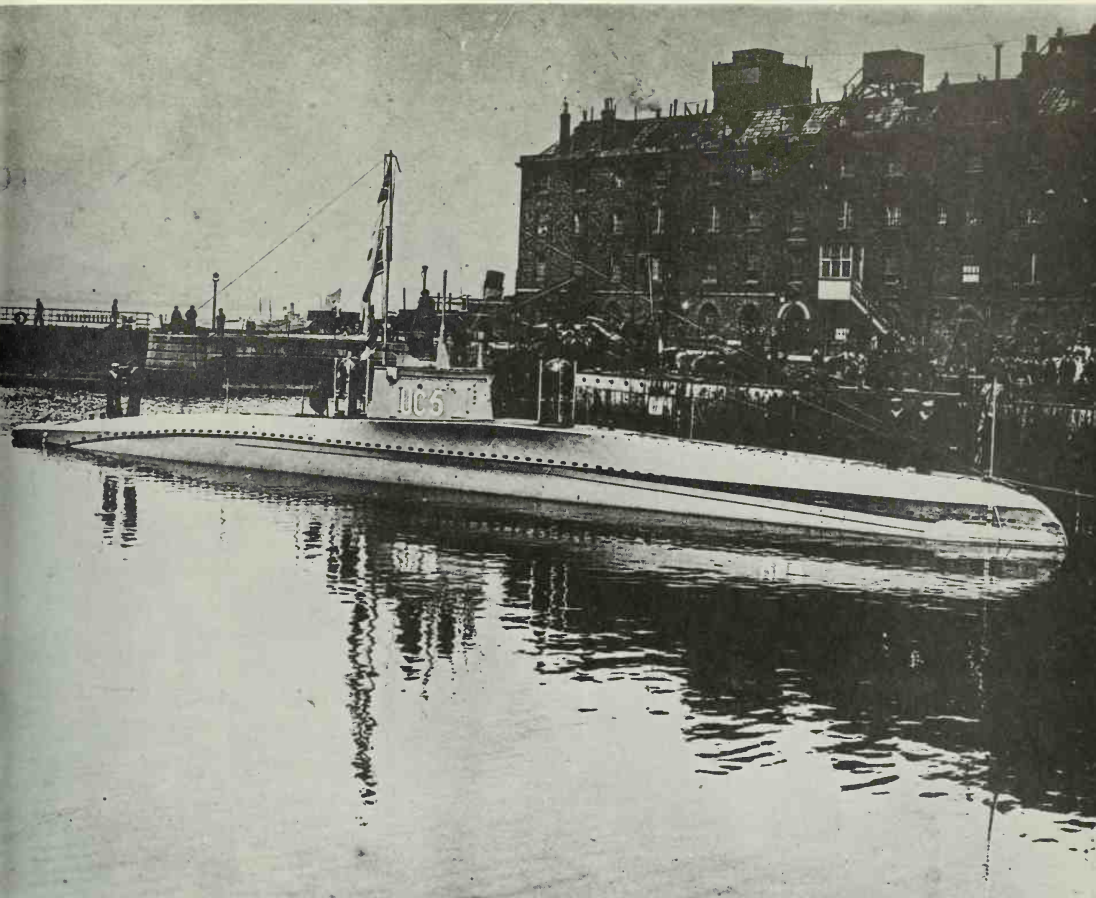
The toll of merchant ships and fishing vessels rose from 293,000 tons in January to 468,000 tons in February and over 500,000 tons in March. In the month of April, when the United States entered the war, the U-boat sinkings reached a peak of 395 Allied and neutral merchant and fishing vessels, representing 840,000 tons of shipping. In this dark month, when one of every four vessels leaving Great Britain was destined never to return, Admiral Jellicoe bluntly told U.S. Admiral W. S. Sims that it would be impossible to go on with the war if losses of such magnitude continued.

Camouflaged periscope of an Austrian submarine slides through the surface of the Mediterranean.



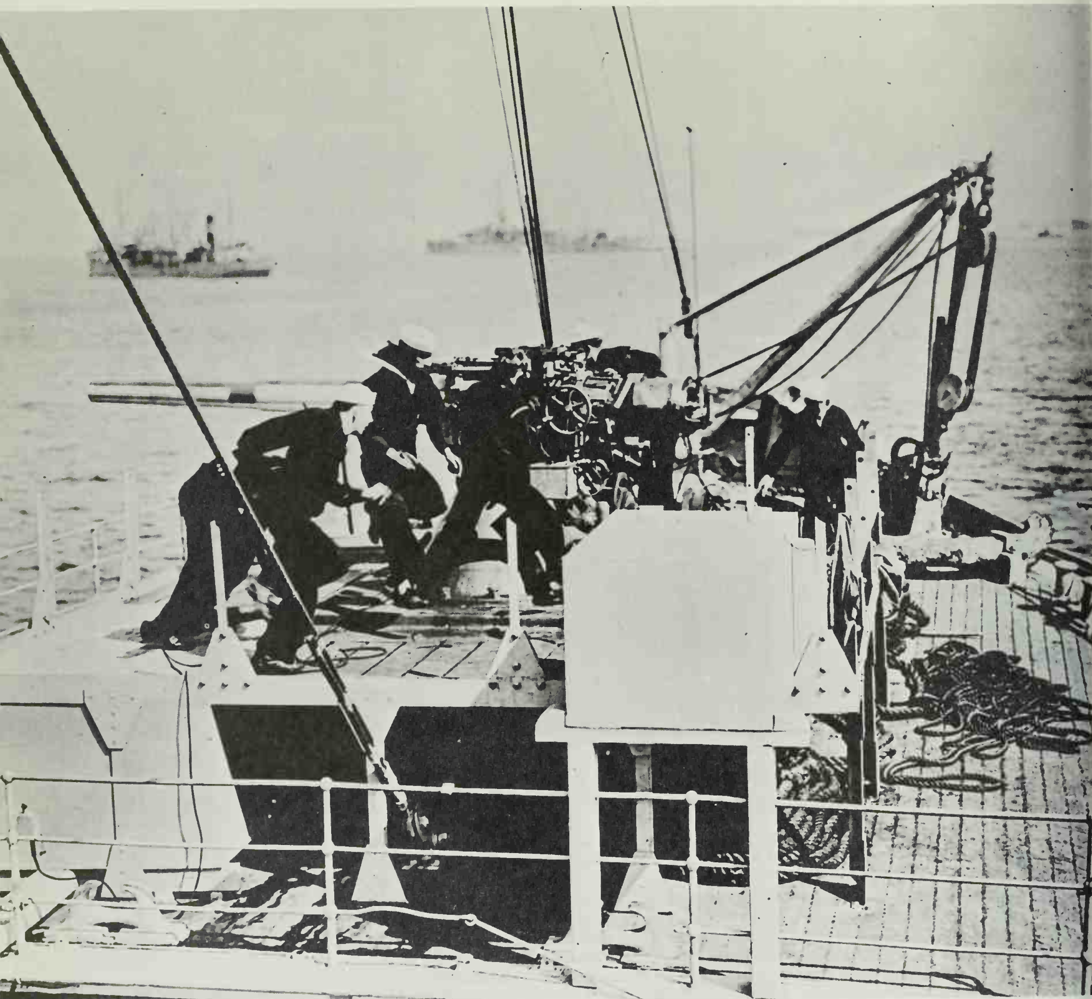


The surrendered U-155, converted from the merchant submarine *Deutschland* which made two trips to the United States in 1916 for propaganda and trade purposes, had range of 13,000 miles. Seven vessels in this series had displacement of 1,500 tons, length 213 feet, beam 29 feet, surface speed of 12½ knots on 800-hp diesel engines. On conversion they were armed with two 5.9-inch or 4.1-inch guns and two 19.7-inch bow torpedo tubes. A class of even larger long-range subs was begun after American entry in the war to lay mines and operate off the U.S. coast, but many never reached completion. Fastest submerged speed was about 8 knots.



Minelaying German submarine UC-5 displaced 170 tons. Length was 112 feet, beam only 10 feet. Note mines in top of two exposed vertical tubes, of which the vessel had six. These vessels had only one screw and could sail at 6½ knots on the surface, slightly less submerged, on heavy-oil engines. All fifteen of the class were either sunk or captured. The next class of submarine minelayers were much larger, faster, and armed.

Merchant ships were armed with deck guns for self-protection, but many went down without ever seeing the submarine that torpedoed them.



THE ANTISUBMARINE CAMPAIGN

TYPICALLY, THE SUBMARINE OF WORLD WAR I, when submerged, could cruise for about thirty hours at 2 to 3 knots before having to surface and recharge its batteries. The battery power required varied with the cube of the speed, however, and at full speed of 7 to 10 knots the current was exhausted in less than two hours. Such limitations would have made the subs sitting ducks for destroyers equipped with the modern electronic and sonar gear of World War II. But no such happy circumstances existed for the Allied destroyers of World War I, although hydrophone listening equipment was developed and they had sufficient speed, firepower, and depth charges. More important, the destroyer forces were thinly spread in attempting to protect their fleets and shipping from the British Isles westward across the Atlantic, and southward throughout the Mediterranean.

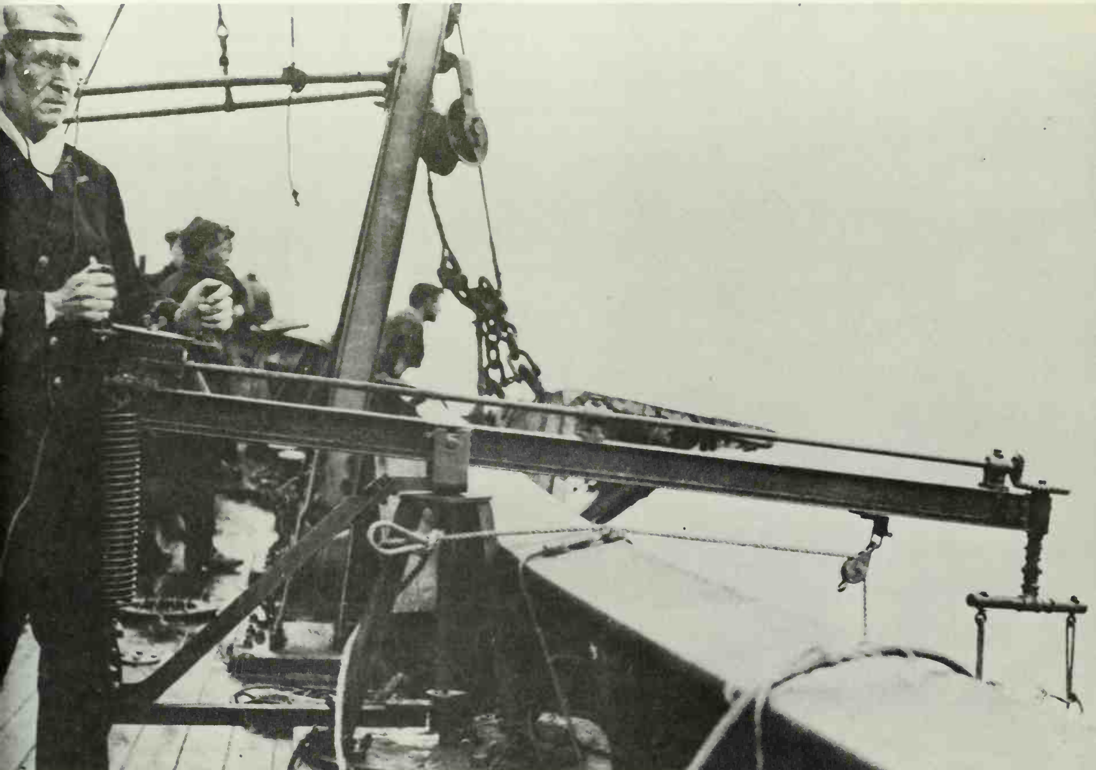
Before the convoy system was devised to counter the all-out U-boat campaign of 1917, all conceivable methods of combating the subs and their mines had been tried. Each was a comparative failure in itself, but contributed to an overall system that achieved a modicum of success in U-boat attrition. Barrages of mines and nets, tended by "drifters," were strung across key passages. The first, and most important, was the effort to close the Straits of Dover, the most convenient passage of U-boats to the Channel, the Irish Sea, and the Atlantic. An ambitious Franco-Italian barrier eventually was completed across the Otranto Strait to block the Austrian navy. Countermining of exits from submarine bases was tried, and the U-boat commanders were said to have laughed at the ineffective British mines. A spectacular attempt was made by the British in the spring of 1918 to block the key submarine bases at Zeebrugge and Ostend, which they had failed to take by land. The operation was more notable for courage than effectiveness, the gutty British sinking several blockships directly under the withering fire of shore batteries. Other efforts involved hundreds of yachts, trawlers, and other small craft, manned by volunteers, which continually searched for submarines. "Q ships"—decoys camouflaged to resemble helpless merchantmen, but actually carrying heavy guns behind screens to blast the unwary submariner when he surfaced to sink his prey by gunfire—appeared in large numbers. Finally, merchantmen themselves were armed with heavy deck guns, and the paravane, towed at a wide angle from ships' bows, was perfected to cut the moorings of mines.

Together, antisubmarine measures brought about the destruction of twenty-four U-boats in 1914 and 1915 and twenty-five more in 1916. It was not enough. They were being built faster than they were being sunk. U-boats in commission in 1917 rose from 111 in February to 127 in April, and finally to the high-water mark of 140 in October. Some sixty U-boats were known to be at sea at one time during the summer. They were manned by the cream of the German navy, chosen from the immobile High Seas Fleet. Tactics changed. No longer did U-boats risk surfacing to sink merchantmen by gunfire and save their torpedoes. Scores of Allied vessels were sunk without ever having seen a submarine.

Such was the situation when Admiral Sims of the United States Navy arrived in London. A controversy was in progress in the Admiralty, which finally was resolved by adoption of the convoy system. Its success, while not striking, was immediate and inexorable. Huge aggregations of merchant ships, escorted by destroyers, did not turn out to be the lucrative, unmanageable targets that opponents of the convoy system had feared. Rather, they proved to be elusive will-o'-the-wisps for the U-boats. Slowly, the toll of Allied and neutral sinkings subsided—from a peak of 840,000 tons in April, to 550,000 tons in May, and 260,000 tons in November. At the same time, U-boat destruction increased.

The entry of America into the war added great impetus to the antisubmarine campaign. Her destroyers became immediately available and were a big factor in making the convoy system possible. Germany sent long-range U-boats across the Atlantic which knocked off some sixty ships, but none that carried troops toward France. More than 2,000,000 American troops were escorted safely to France—largely by U.S. naval vessels. Thirty-six 110-foot wooden subchasers—the "splinter fleet" that also became familiar to U.S. sailors in World War II—were sent to the Mediterranean to help guard the net barrage across the Otranto Strait. The U.S. Navy also operated dirigibles, kite ballons, and some 400 planes in the United States, France, Britain, and the Mediterranean.

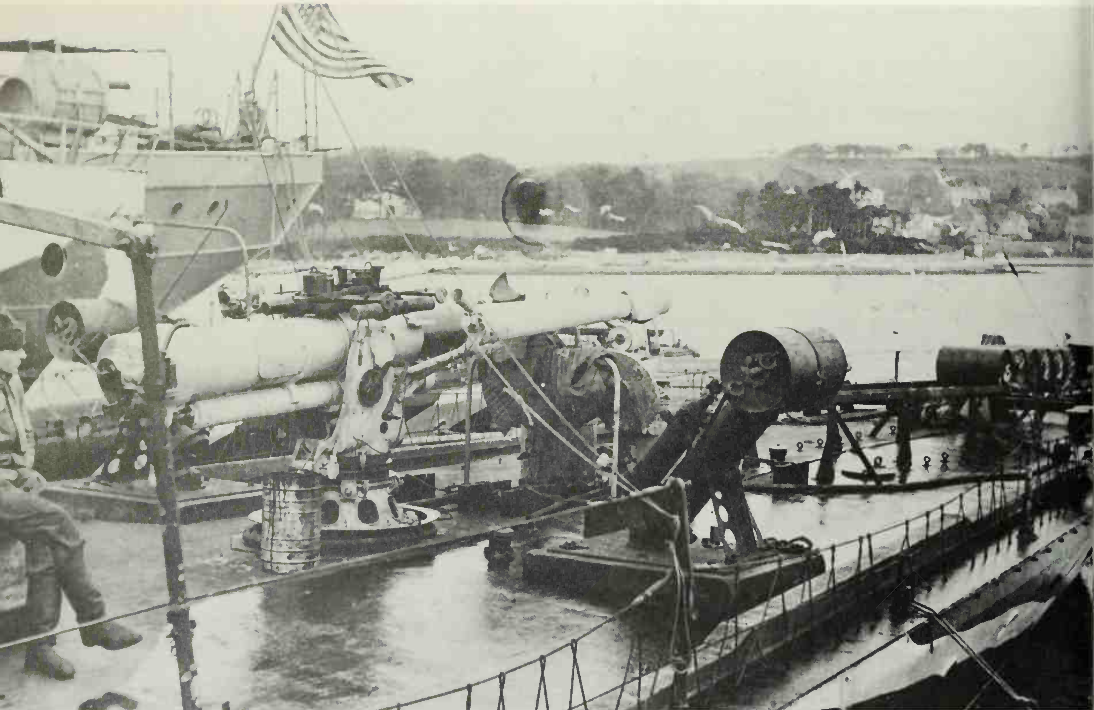
The Northern Barrage, the greatest minelaying project ever attempted, now was possible with American participation. Employing a deadly new U.S. mine that stretched sensitive antennae out 35 feet in all directions, the Americans and British sought to block submarine egress from the North Sea. It involved the massive job of mining a 250-mile stretch between the Orkneys and the Norwegian coast. Throughout the summer and early autumn of 1918, a zone of mines from 15 to 35 miles deep was laid. It required more than 70,000 mines, of which nearly



British officer listening for submarine with a hydrophone aboard an armed trawler in the North Sea. Some 3,000 Allied vessels, from destroyers on down, eventually were equipped with this new sound gear toward war's end.

57,000 were planted by United States naval forces. Its value as a psychological deterrent to jittery U-boat commanders was probably greater than its success in trapping submarines. The number sunk in the barrage could not be established with certainty.

Toward the end of 1917, the handwriting on the wall became clearer to Germany. New Allied shipbuilding overtook the rate of losses, and the

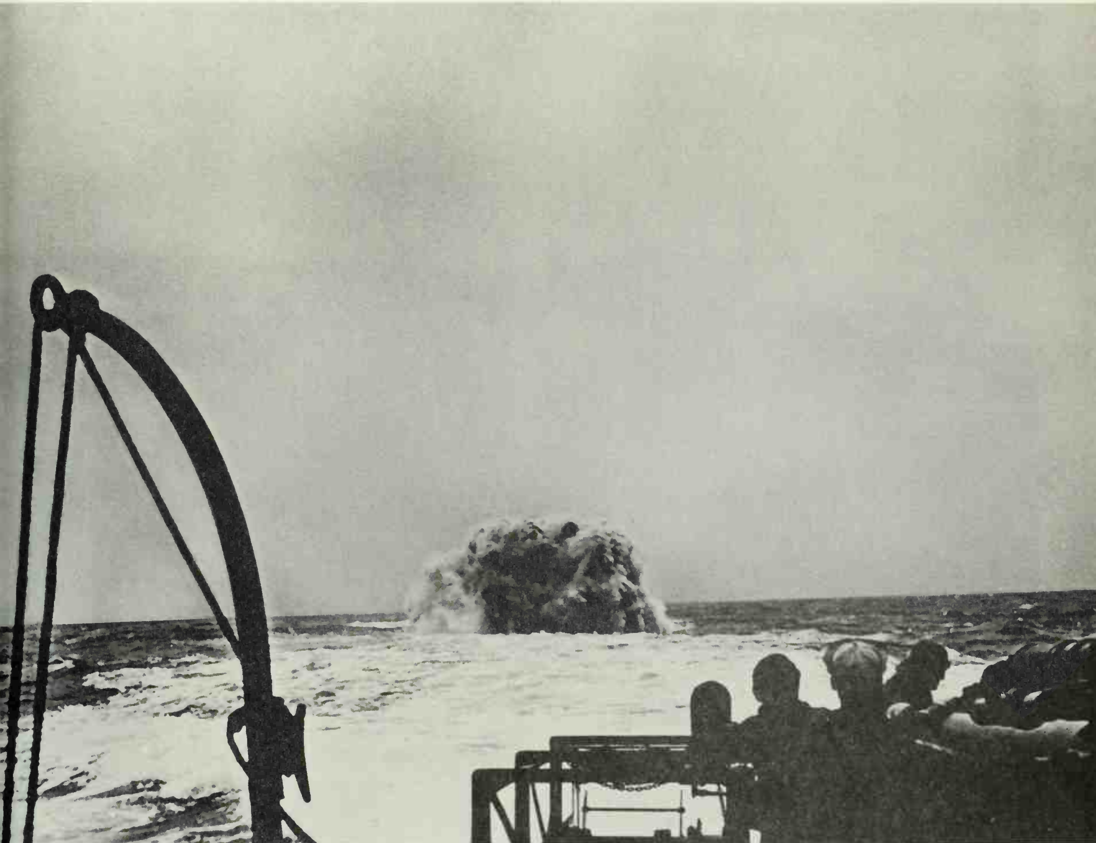


Detail of fantail of a U.S. ship, showing depth charges on ramp, an "I" gun for launching charges, and deck gun.

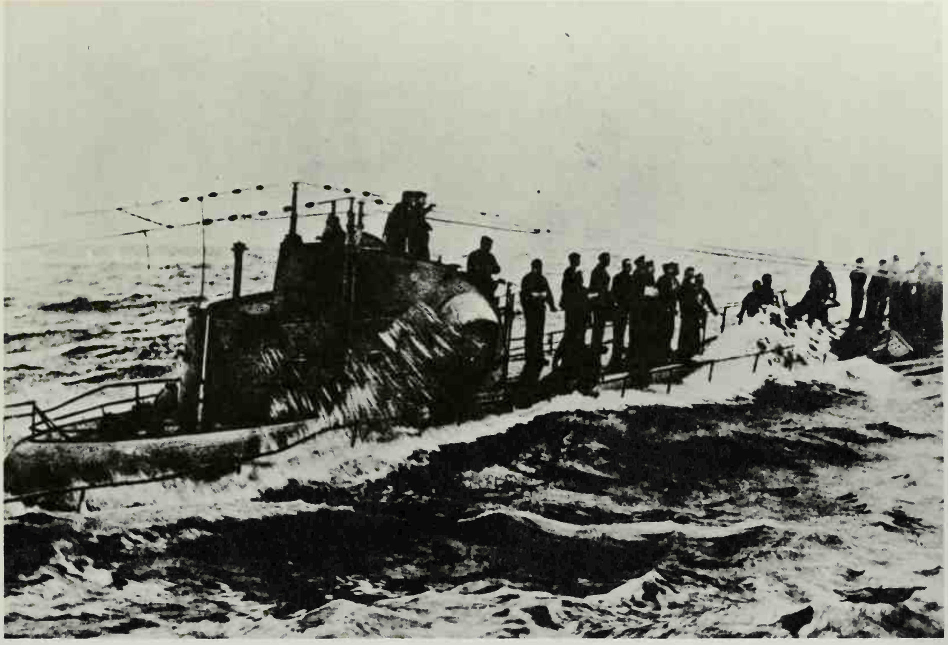
rate of U-boat destruction was slowly approaching their rate of construction. Sixty-six German submarines were destroyed during the year—twenty-four in the final quarter alone, which practically equaled the Allied bag for the entire year of 1916. In the final ten months of 1918, eighty-eight U-boats were sunk. After the Armistice Germany handed over her remaining fleet of 138.

For World War I, Germany had built and used close to 400 submarines, and more than half were destroyed. Their toll of Allied and neutral merchant shipping had been astounding—5,408 vessels, representing a gross tonnage of 11,189,000, half of which were sent to the bottom in the climactic year of 1917.

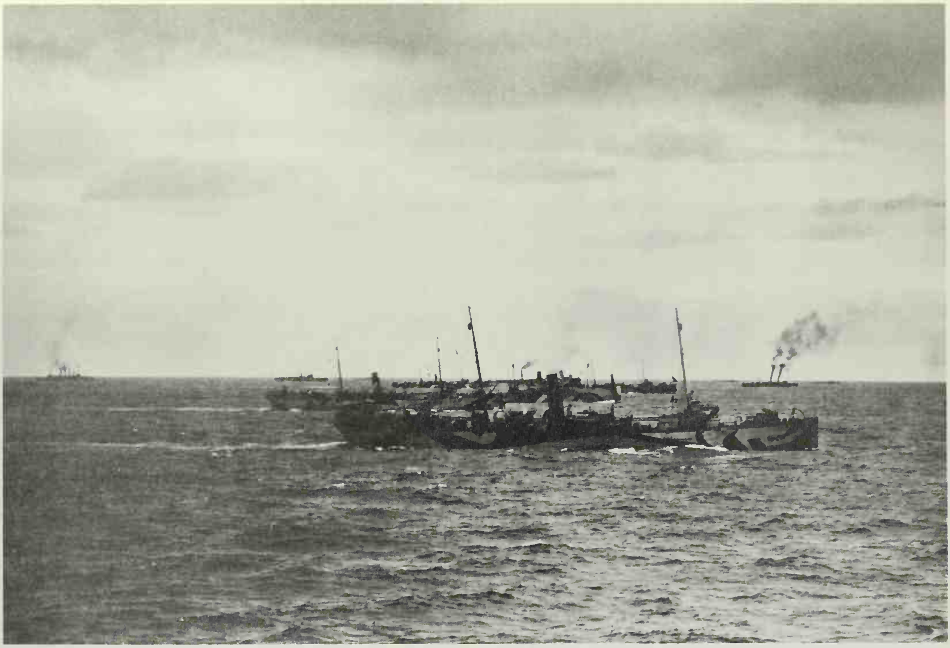
Sailors adjust timing mechanisms on "ash cans" before firing from a "Y" gun launcher.



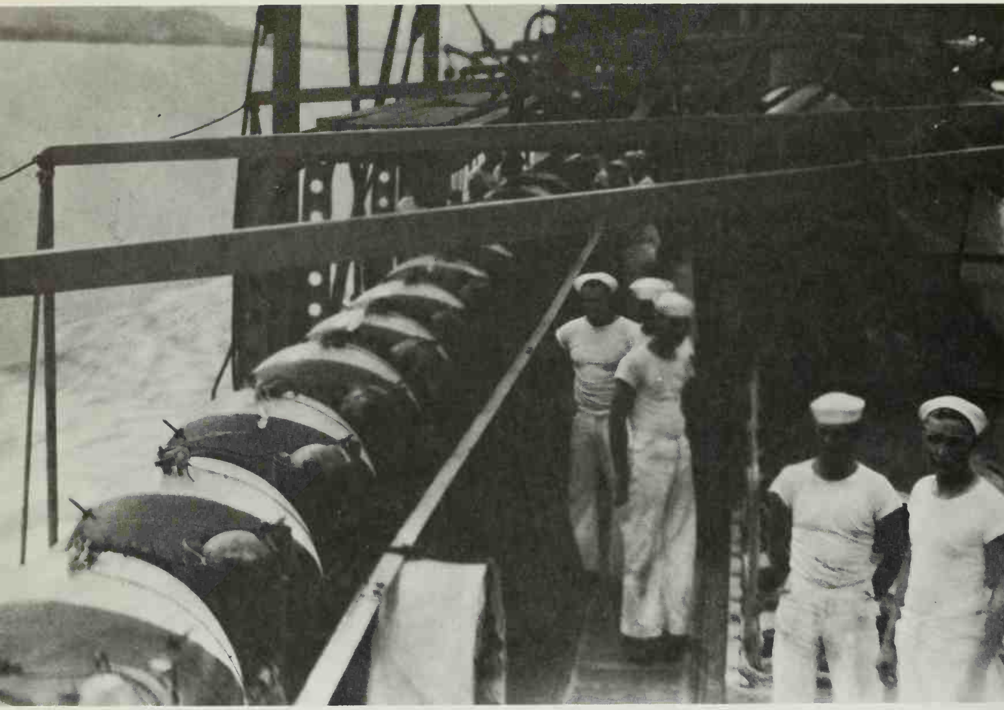
A depth charge dropped from U.S. destroyer explodes off French coast.



The U-58 being captured by the American destroyers *Fanning* and *Nicholson*, which sank it off the coast of Ireland. This later class of U-boat displaced 800 tons and had four 19.7-inch torpedo tubes and a 4.1-inch gun. Complement was 39.



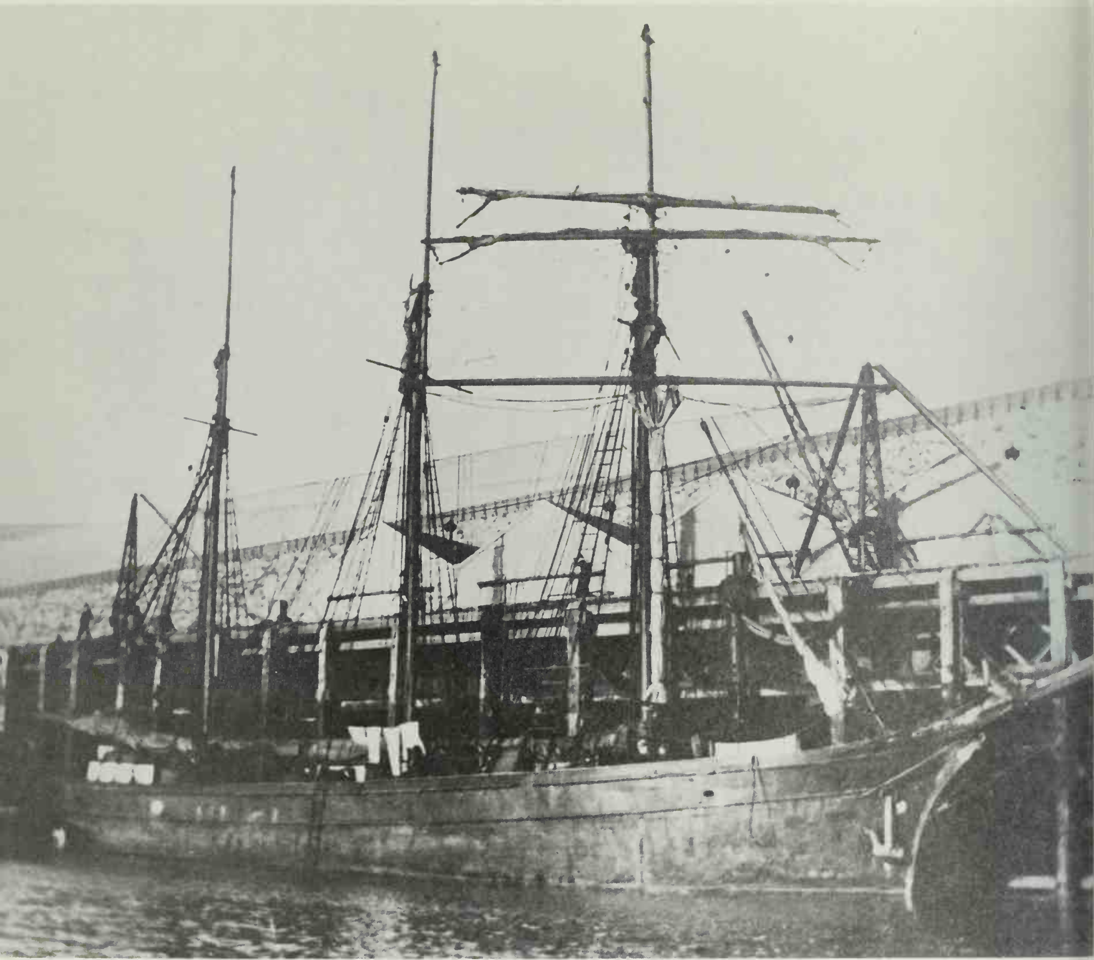
U.S. mine squadron, eight ships abreast, laying the gigantic Northern Barrage, the largest such undertaking in history. Five or six lines of mines were planted at a time at 12 knots, for distances of 46 to 55 miles. The minelayers maintained a distance of 500 yards apart in this operation.



Close-up of track aboard U.S. minelayer as mine is being laid. Nearly 57,000 of the 70,000 mines in the Northern Barrage were planted by U.S. ships.

A mine about to be planted from a British vessel.

One of the many types of Q-ships sent out by the British to lure German submarines to destruction. They saw moderate success early in the war when U-boats surfaced to sink apparently unarmed vessels with gunfire in order to conserve torpedoes. Naval personnel, disguised as merchant seamen, pretended to abandon ship on appearance of the submarine. When the U-boat was lured within range, guns concealed by boats or dummy deckhouses were suddenly revealed and opened fire on the enemy.



MISCELLANEOUS VESSELS

INTRODUCTION

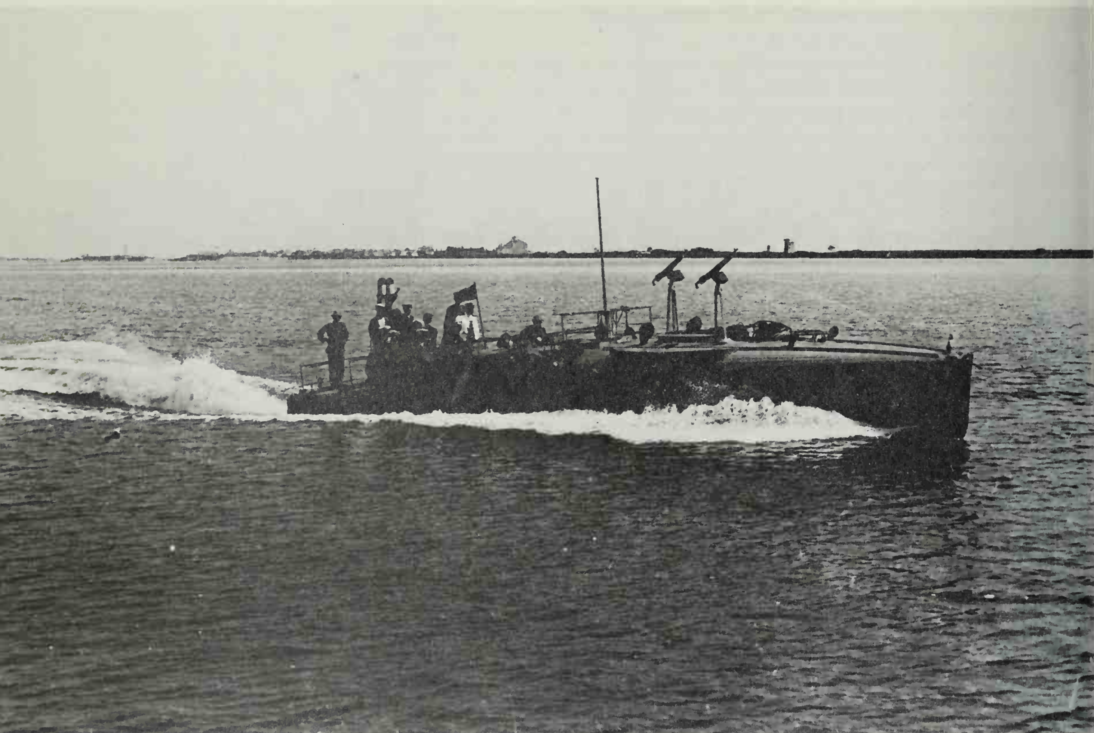
IT IS NOT POSSIBLE to cover the profusion of fleet auxiliary vessels brought into being by the rapid naval developments of World War I, though mention should be made of some classes.

The shortage of British destroyers forced use of many varied ships, both sail and steam-driven. There were trawlers, minelayers, converted yachts, and small 22-knot patrol craft. In addition to the Q-ships, manned by naval personnel disguised as merchant seamen, there were convoy sloops carrying concealed guns, others equipped with hydrogen plants to serve as kite balloon ships, and whaler types with hidden guns to travel with convoys. Some large merchant ships were armed with 11-inch howitzers, depth charges, 6-inch and smaller guns to chase down German merchant cruisers, and others were converted to "armed boarding vessels" to help relieve the destroyers of this chore.

The German merchant raiders provided some of the more romantic sea tales of the war, if only because they were the hunted—by overwhelming numbers—and were forced to the ultimates of cleverness to survive. The *Möwe*, armed with four 5.9-inch guns and four torpedo tubes, sneaked past the British armada from Hamburg for two successful South Atlantic cruises, returning safely each time. She sank fourteen Allied ships in 1915–1916 and twenty in 1916–1917, capturing a British prize along the way, which was then converted to a German raider, the *Leopard*. The *Leopard* was sunk on her first trip. Other well-known German auxiliary cruisers, onetime merchant ships, were the *Kronprinz Wilhelm* and the *Wolf*, which departed from Kiel in December, 1916, laid nearly 500 mines around the Cape of Good Hope, cruised the Indian Ocean for a year, sinking twelve vessels, and returned safely in 1918.

The most unusual German merchant raider was the sailing vessel *Seeadler*, equipped with concealed auxiliary diesels. Masquerading as a Norwegian ship, and carrying a Norwegian-speaking crew, she was at large for nine months before being wrecked in the Fijis in August, 1917. Her captain was the legendary Count Felix von Luckner.

An Italian "M.A.S." motor torpedo boat of the type used by Commander Luigi Rizzo when he darted between two escorting destroyers in the Adriatic Sea, launched two torpedoes from 650 yards, and sent the Austrian dreadnought *Szent Istvan* to the bottom. Rizzo escaped.



COASTAL MOTOR TORPEDO BOATS

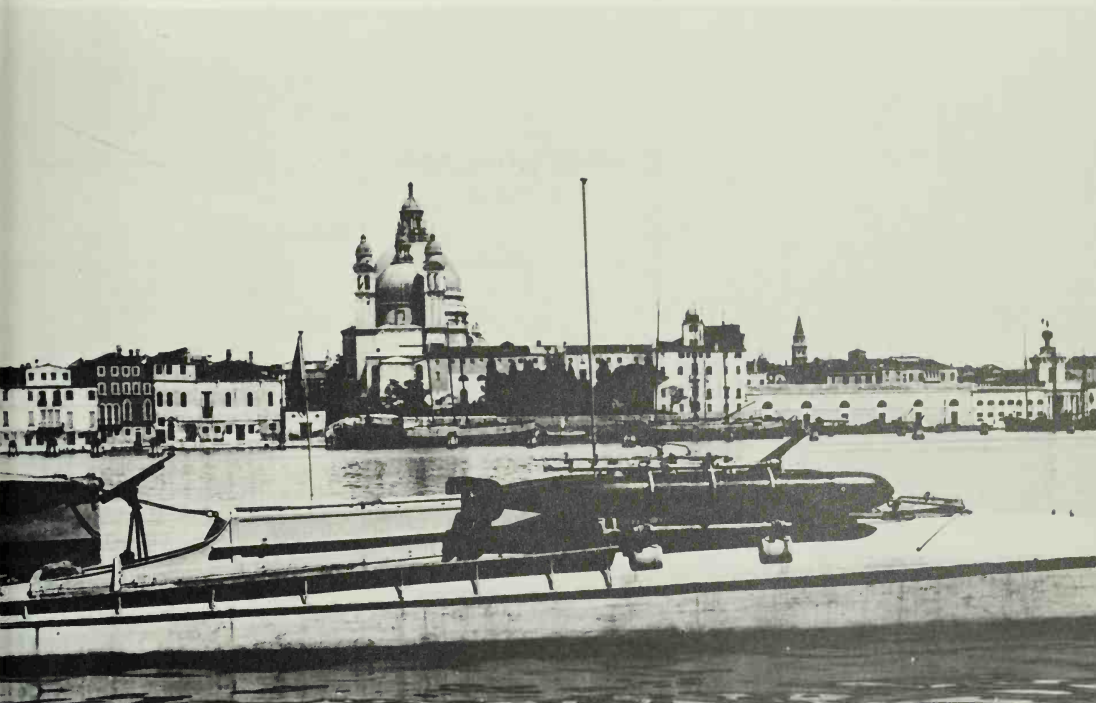
EARLY IN THE WAR both Great Britain and Italy produced a number of coastal motor boats. Pioneers of the motor torpedo boats whose daring exploits became famous in World War II, they made life miserable for the enemy along the Belgian and Austro-Hungarian coasts.

The motor torpedo boats first roared into prominence in 1916. These early models, weighing only a few tons, ranged from 40 to 70 feet long, and their stepped hydroplane hulls and powerful gasoline engines gave speeds of from 30 to 40 knots. No tubes were installed for the one or two torpedoes; they were launched over the stern by ramp, the boat quickly turning away. Complements ranged from two to six men, and aircraft-type machine guns were mounted on some boats. Larger ships in the British navy occasionally carried two to four boats on davits, and one special motor torpedo boat carrier was constructed. The British boats attacked U-boats and generally harried German vessels and coast defenses along the Channel, often taking terrific punishment from German aircraft.

The honors in the mosquito fleet actions, however, went to the Italians. In the dark morning hours of June 10, 1918, a formidable task force of battleships, cruisers, and destroyers from the Austrian bases at Pola and Cattaro was well on its way for a desperate attempt to break through the barrage of mines and nets across the Strait of Otranto. Commander Luigi Rizzo, who already had sunk an Austrian ship at anchor at Trieste, met the powerful fleet units with his "M.A.S." boat in the upper Adriatic. Powering his tiny craft through the center of the formation, he launched two torpedoes into the modern dreadnought *Szent Istvan* and sank her. Thus Rizzo, with the smallest kind of naval weapon afloat, accomplished what the mightiest fleet ever assembled could not do at Jutland. The task force was thrown into confusion and headed for port and an ignoble fate of mutiny and surrender, never again to emerge under the Austrian flag.

A few days before the Armistice, the Italians pressed home their attack into the heart of the dying Austrian navy. By coincidence, on the same night that the Austrian crews had mutinied and turned their ships over to the Yugoslavs, two Italian officers made their way into heavily defended Pola harbor. Using a specially modified torpedo to assist in transportation, these original "frogmen" swam and wrestled their craft for hours through icy waters—over barriers and around booms, past sentries and in the shadows of shore batteries, until they reached their target. There, in the center of Pola harbor, just before the light of dawn led to their capture, they attached a time bomb to the Austrian flagship *Viribus Unitis* and sent her to the bottom.

Italian M.A.S. 9, showing torpedoes mounted toward the bow.



THE UNSUNG MONITORS

THE UNGAINLY BRITISH MONITORS were probably in more day-to-day action than any other class of vessel during World War I. Taking their name from the American *Monitor* of the Civil War, first ship to demonstrate the revolving turret in action, the monitors were much more than barges mounting guns.

Heavy losses in old battleships and cruisers in the narrow, mine-infested waters of the Dardanelles highlighted the need for monitor-type vessels to substitute for fleet units in restricted waters. Even the splendid *Queen Elizabeth's* 15-inch guns, along with the more vulnerable battle cruisers, were risked during the naval nightmare of the Dardanelles in frustrating bombardments of the effective Turkish shore batteries.

Forty monitors were completed during the war, nearly all in 1914 and 1915, of which sixteen were in the heavy class, ranging from 6,000 to 8,000 tons. Powered either by steam or diesel engines, these 6-to-12-knot gun carriers saw rugged service in the Dardanelles, the eastern Mediterranean, the Adriatic, and even stood off the coast of Belgium to bombard the German lines in Flanders. The war's biggest ordnance pieces—18-inch guns removed from the former light battle cruiser *Furious*—were installed on three monitors of the "Lord Clive" class to supplement their original 12-inch guns taken from "Majestic" class pre-dreadnoughts. American-made 14-inch guns originally ordered for a

Greek battle cruiser under construction in Germany were acquired to arm four vessels of the "Abercrombie" class. Four others mounted twin 15-inch guns, and all had secondary armament of 4- or 6-inch guns, plus an assortment of smaller antiaircraft weapons.

Only one of the large monitors was lost due to enemy action—the *Raglan,* surprised by the battle cruiser *Goeben*. Protected by antitorpedo bulges, their immunity was remarkable. The 8,000-ton *Terror* was hit forward by three torpedoes in rapid succession off the Belgian coast, but made it back to Portsmouth for repairs. *Erebus*, a sister vessel, was hit amidships by a boat filled with a powerful charge of explosives, then steamed home at 12 knots for a two-week overhaul. These two monitors were retained for World War II service, the *Terror* being lost in an aircraft attack off Libya in 1941.

The most spectacular monitor duty was reserved for the *Mersey* and *Severn*, Brazilian river monitors building in Britain that were taken over. These 1,260-ton vessels, each armed with three 6-inch guns and two 4.7-inch howitzers, were sent to the Rufiji delta in East Africa in July, 1915, to destroy the cornered German cruiser *Königsberg* with the aid of navy spotting planes.

Nineteen smaller monitors of 540 tons were turned out in 1915, mounting 9.2-, 7.5-, and 6-inch cruiser guns.

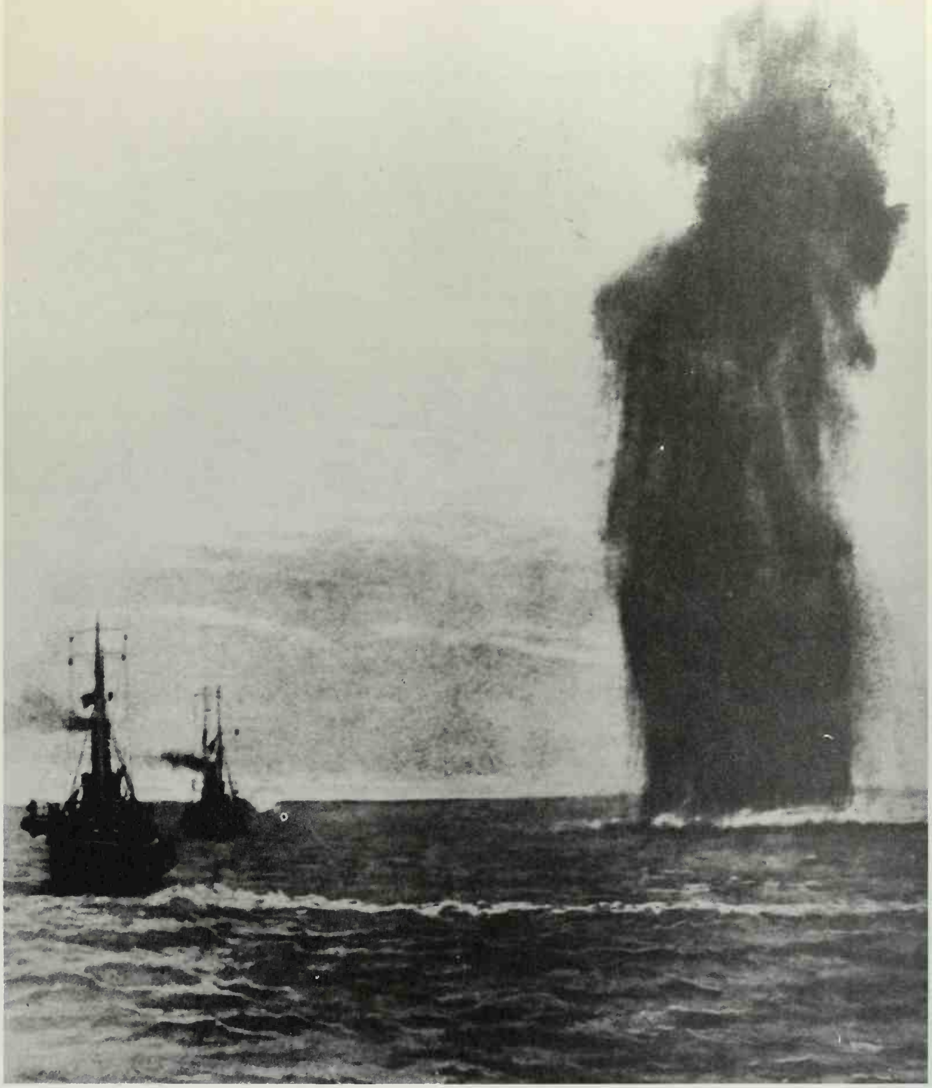
A U.S. minesweeper meets heavy weather in the North Sea.

MINESWEEPING OPERATIONS

THE MOST TREACHEROUS SEA DUTY of the war fell to the minesweepers. During the first two months of hostilities the British lost a sweeper for every two mines swept up. German mining went hand in hand with the stepped-up submarine campaign, and at the peak, in April, 1917, the British lost a minesweeper each day. Even at the end of the war in 1918, when thousands of mines were being swept with improved techniques, a sweeper was blown up for every eighty mines cleared.

The British first used trawlers that could sweep at a speed of about 6 knots. Old torpedo boats were converted for 12-knot sweeps ahead of fleet movements. Vessels of every description were fitted for sweeping during the 1917 crisis, and 100 special sweepers displacing 750 tons were built. The British method employed a serrated wire stretched 400 to 500 yards between pairs of sweepers. The French used a pair of torpedo-shaped "otters"—much like the British paravanes—towed by single ships at an angle from each side at 6 to 7 knots. A series of mechanical and explosive wire cutters was fitted along the sweep wires to break the mine moorings. This method was adapted by the U.S. Navy during the war. The Germans towed a light sweep patterned after the British system at the very high speed of 20 knots to clear a path for their fleet. When an obstruction was detected, a marker was dropped as a signal for the slower sweepers to clear the area.

Minesweeping was a daily ritual throughout the war. In excess of 1,000 miles of British and Irish coastline were being swept each day by the end of 1917. During that worst year for the Allies, some 4,000 German mines were swept up around Britain; their toll was 170 Allied and neutral vessels sunk and many damaged. At war's end, the stupendous task of sweeping all remaining mines from the seas began.



Allied minesweepers had a grueling, daily task during the war, and worked for a year clearing the seas after the war. Here a mine has been exploded after being cut from its mooring.

It required one year to clear British home waters and the Mediterranean. The job of sweeping 70,000 Allied mines laid in the great Northern Barrage from the Orkneys to Norway fell to American minesweepers. The Germans did not complete the clearance of the Heligoland Bight and the Baltic until 1923.

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INDEX

C

G

U

V

W

Y

Z

(continued from front flap)

and submarines. The illustrations are many and authentic. Their quality inevitably varies — because many are action photographs, necessarily primitive — but they are essential for preserving authentic atmosphere, a feeling of where and in what circumstances the weapons were used. This is the raw material of history, presented not just as a listing but as a partial inventory of the bloodlines of the weapons of today.

This is a companion volume to Walker's successful GREAT WEAPONS OF WORLD WAR II and was prepared with the assistance of the Army Times Publishing Company.

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GREAT WEAPONS OF WORLD WAR II

BY JOHN KIRK AND ROBERT YOUNG, JR.

INTRODUCTION BY HANSON BALDWIN

The second world war produced a profusion of formidable weapons that left their mark on the history of the Twentieth Century. Some, like the Supermarine Spitfire, saved nations; others, like the atomic bomb, undid them. There were weapons like Italy's human torpedoes, which were associated with exploits of almost unbelievable daring; there were weapons like the German "88," which spectacularly altered the course of campaigns; and there were weapons like the Garand rifle, which, through sheer ubiquity, left a diffuse but, in sum, massive impress on the contours of the war.

GREAT WEAPONS OF WORLD WAR II describes the most famous of these weapons in terms of the historic roles they played. Over 300 planes, ships, tanks, small arms and artillery weapons are illustrated in this handsome edition and nearly 100 are discussed in detail. The volume was compiled by the Editors with the assistance and cooperation of the U.S. Army, Navy and Air Force. Laymen and weapons buffs alike will find GREAT WEAPONS an indispensable addition to their libraries and a valuable companion to any of the major war-time histories and memoirs.