THE NORDEN BOMBSIGHT WAS A TECHNOLOGICAL MARVEL OF WW2

THE NORDEN BOMBSIGHT WAS ADVANCED BUT MAY HAVE NOT LIVED UP TO ITS DESIGNER'S EXPECTIONS

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In a 1921 bombing test, U.S. Army Air Corps General Billy Mitchell's airmen sank the former German battleship *Ostfriesland.* *Although it took 65 bombs aimed at the huge*, motionless ship to accomplish the task, the test challenged the primacy of battleships as an offensive weapon. U.S. war planners were already settling on the idea of precision strategic bombing as a way to capitalize on the potential of airpower and avoid the horror of trench warfare, which had been the hallmark of *World War I* on the Western Front. This meant eliminating an enemy's ability to fight by destroying its manufacturing centers, transportation, and power infrastructure. However, strategic bombing required precision bombsights that would work from much higher altitudes and speeds than were then being designed into the next generation of bomber aircraft*. It paved the way for the development of the now famous Norden bombsight.*

WHY THE NORDEN BOMBSIGHT WAS INITIALLY FRAUGHT WITH TROUBLES

The U.S. Navy's Bureau of Ordnance (BuOrd) decided to develop such a precision bombsight, and in 1920 contracted with Carl L. Norden, a Dutch citizen and recent immigrant with a reputation as a clever designer of gyroscopically stabilized systems. Norden finished his masterpiece in 1931. Lieutenant Frederick Entwhistle, the Navy's chief of bombsight development, called it revolutionary, and its design was good enough that it would be used throughout World War II and up to the Vietnam War.

To this day, a legend surrounds the accuracy of the Norden bombsight and the device's role in the Allied victory in World War II. Mostly the result of intense self-promotion by Norden's company, the legend is just that. *The bombsight's accuracy never met planners' expectations*. Nonetheless, practically every article about the bombsight in the popular media of the day referred to the claim that with the Norden design, bombardiers could hit a pickle barrel from 20,000 feet. To help foster the notion of accuracy, Norden used a clever Latin motto, "*Cupa fiat melior muriae: per Norden obibit,*" loosely translated as, "When better pickle barrels are built, Norden will hit them, too." Actually, from that altitude, such a small object would be completely obscured by the bombsight's crosshairs, so the idea of being that accurate is absurd.

Even for larger targets, though, the Norden's accuracy never could have been as good as the strategic bombing doctrine needed it to be, considering the limited engineering and manufacturing capabilities of the time, unwise design choices, inherent errors in the mechanism itself, the complicated physics of bomb ballistics, the hazards of war operations, inadequate training, and poor reliability.

The bombsight's reputation was also tarnished and costs raised by unnecessary security precautions, unseemly interservice squabbles, and the wasteful policies of the armed services using it.

However, because of the great secrecy surrounding its specifications and performance, Washington's desire to boost public morale, and Norden's publicists wanting to promote the superiority of their monopoly product, *the truth was hidden from the public.*

Sighthead of a Norden bombsight (in the canvas bag) being taken to a Beechcraft AT-11 Kansan at an Army Airfield in Texas in 1942. The lower portion of the Norden bombsight, called the "stabilizer," was permanently installed in the nose of the aircraft. In this photo the stabilizer has a canvas cover. The guards are carrying Thompson submachine guns.

THE EARLY BOMBSIGHT

All bombsights attempt to solve the problem of when to release the bomb—usually expressed as the range angle, the angle as measured between a vertical line through the aircraft and the line of sight to the target when the bomb is to be released. When the bomb finally hits the ground in 30 seconds or so, the effect of air resistance on the bomb means that aircraft will have already passed over the target. Finding that exact point in space to release requires knowing the airplane's altitude, vectors of its speed over the ground, humidity, and the effect of air resistance on the bomb. Unpredictable factors such as local variations in gravity, air turbulence, and whether the target is moving also come into play.

All this information is difficult to determine accurately, particularly during the stress of combat, and it can change during the critical last moments of the bombing run. The pitch and roll of the aircraft and evasive maneuvers further complicate matters.

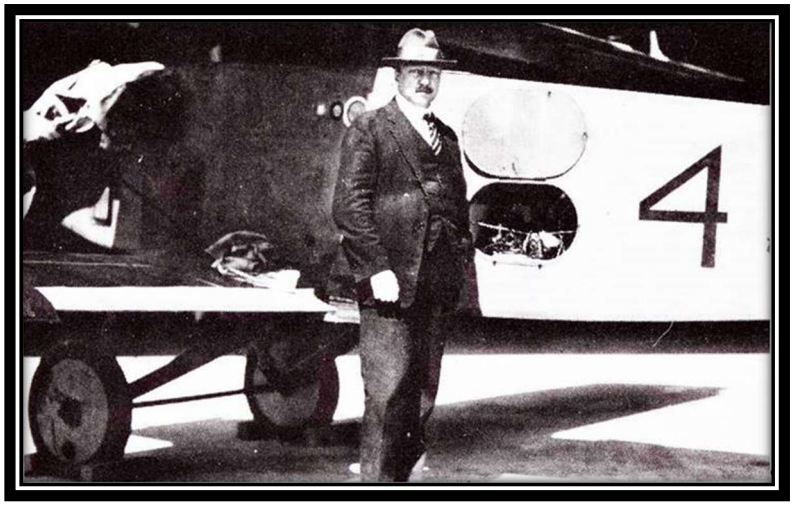
The first operational bombsights appeared during World War I. Simple affairs constructed of sticks, they were not much better than guesswork and a pilot's good eye. They were of the timing type, so called because the bombardier determined the airplane's speed over the ground using a watch. Then, using that speed, along with altitude as determined by the barometer and bomb type as data for ballistic tables, he would set key values in the bombsight.

When the target below lined up in the sight, he would release his bombs. To eliminate sideways drift, the pilot would try to fly into the wind, but this tactic exposed the bomber to ground fire for longer periods. The pitching and rolling of the aircraft, as well as inaccuracies in release time and altitude, meant that the timing method was rarely accurate.

Later bombsights such as Norden's were of the synchronous type, in which a motor in the bombsight slowly rotated a mirror in the sighting telescope's light path to cancel out the apparent motion of the ground due to the speed of the bomber. Thus, when the bombardier looked through his telescope, the ground appeared stationary. In principle then, all he had to do was keep the target in the center of his field of view and wait until the bombsight sensed that the aircraft was at the release point. Bombing runs could then be much shorter, often less than a minute. In practice, the method stretched the

technology of the time, and while it gave better results than timing sights, it still was by no means as accurate as military planners wanted.

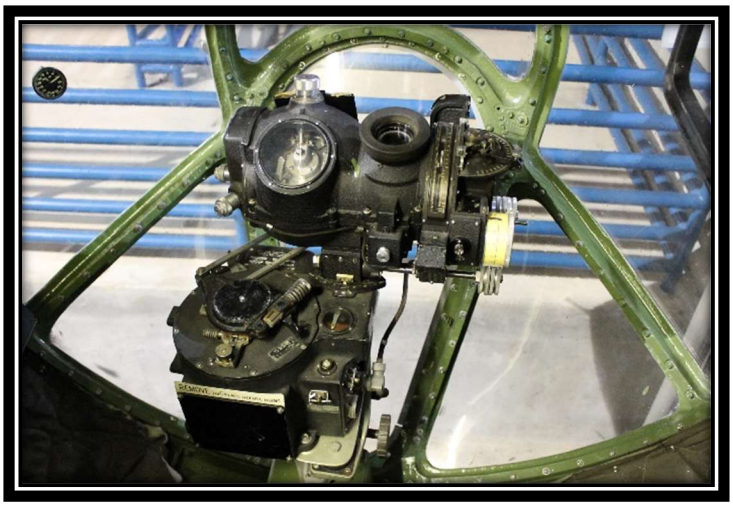
CARL LUKAS NORDEN: "OLD MAN DYNAMITE"



Carl Lucas Norden in 1930

Carl Lukas Norden was born in 1880 in Semarang, Java, and soon became known as an exacting, brave, and trustworthy youth, if not also somewhat self-centered and abrasive. He was classically trained in mechanical engineering at Switzerland's respected Federal Polytechnic Institute, where he met Nikolai Lenin, an equally self-disciplined and irascible student with other aspirations. After immigrating to the United States in 1904, Norden worked at several jobs, eventually landing at Sperry Gyroscope Co., where he worked for four years on shipboard gyroscopes. Unsurprisingly, he had personality clashes with Elmer Sperry, quit over a salary dispute, and struck out on his own as a consultant, founding the modestly named Carl L. Norden Company.

Norden, called "Old Man Dynamite" by Navy personnel, was difficult to work with. Contemporaries referred to him as "self-centered, impatient, domineering, driven, abrasive, a perfectionist … and of the highest ethical standards." He saw himself as a designer, not an inventor, believing that only God could invent. *His name did not even appear on the patent for his most advanced bombsight, even though he was clearly the inventor. Norden sought anonymity.*



A Norden bombsight in the nose of a B-29 Superfortress at the Museum of Aviation. (Museum of Aviation photo)

Early in the bombsight's development, the Navy became concerned that the project was too important to be put in the hands of one person, especially one so irascible as Norden. They recommended that he take on a partner and suggested Ted Barth, who had been in charge of gas mask production in World War I. Norden did so, eventually selling out to him but staying on as chief designer. It was a good partnership, because Barth had the important business savvy and diplomacy that Norden lacked. *Barth was also an aggressive promoter and was the source of many of the enduring legends about the Norden bombsight.*

Norden chose the synchronous method for his bombsight, but the difficulties facing him were formidable. First, tiny errors in bomb release time or plane orientation could make the difference between a hit and a miss. Success meant hitting objects that are too small to see from the planned bombing altitude of 20,000 feet. The device would necessarily be very complicated, yet had to be simple to operate and repair, highly accurate, robust under combat conditions, reliable, and need only a short bombing run from any direction relative to the wind. In addition, since an airplane in combat is an unstable platform, buffeted by air turbulence and antiaircraft fire and subject to evasive maneuvers by the pilot, the bombsight's optics needed to be gyroscopically isolated from those unpredictable motions.

Like Thomas Edison, Norden disliked alternating current (ac) and impetuously required the use of direct current (dc) motors with their dirty brushes in his precision device. Further, his aversion to the new field of electronics led him to employ mechanical devices as the basis of his bombsight's operation instead of faster, simpler, more easily manufactured, and more reliable electronic circuits. These biases unnecessarily complicated his bombsight design, introduced errors that curtailed accuracy, and resulted in maintenance headaches.

"THE GOLDEN GOOSE"

Carl Norden delivered his first production bombsight in 1939. Its performance during controlled demonstrations was excellent. In April, at Fort Benning, Georgia, four Norden bombsight-equipped Boeing B-17 Flying Fortress bombers targeted a simulated battleship 600 feet by 105 feet in size. Ten out of 12 bombs of various sizes hit the target.

On December 2, 1941, the acting chief of the Bureau of Aeronautics enthusiastically wrote to the secretary of the Navy, "The Norden bombsight is considered to be the principal single factor of superiority which the air forces of this country possess over those of potential enemy countries."

Key Point: ***Even with its faults, the Norden bombsight was a technological marvel for its day.***

A FEW COMMENTS ABOUT CARL NORDEN BY HIS SON.

The Norden bombsight was said to be the most closely guarded secret of World War II, yet more was known about the bombsight than about its designer, Carl L. Norden.

Mr. Norden was always very loyal to the Navy. "Once an Army officer came to see my father, trying to persuade him to come to work for that service. My father quoted him scripture and said, 'Man cannot work for God and the devil, and I already work for the Navy!"

Mr. Norden was deeply religious and believed everything worthwhile was divine given — the individual could take no credit. "My father would often say 'Providence (he never said the Lord) demanded that I do this." Moreover, Mr. Norden would never tackle a job if he thought someone else was capable of doing it.

Mr. Norden retired immediately after World War II and moved to Switzerland to avoid the publicity surrounding the bombsight. He remained very religiously active and supported efforts to free clerics held behind the iron curtain.

"My father was never 'proud' of the bombsight as an end product. He believed the United States was the last hope of the Western World against fascism and the bombsight was just a device to win the war. He would not have liked the fuss being made about it."

STATEMENT BY THE MUSEUM OF AVIATION FOUNDATION

The Norden Bombsight has captured the interests and imaginations of generations since the 1940s. It brought in technological advances, helped justify a separate Air Force *and gave us something to believe in to help win a terrible war.* At the same time, it satisfied our human curiosity and love of mystery. It was felicitous that it came into being at the same time as the advanced B-17 Flying Fortress bomber which, even with its technology for the time, could not have accomplished what it did in crippling the German war machine without the Norden bombsight.

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