SOME OBSERVATIONS ON ANTI-AIRCRAFT ARTILLERY IN PANAMA

The wartime air defences of the Canal Zone, and later of Panama as a whole, involved not just the anti-aircraft guns, but also radar[1] (which had replaced the pre-war sound locaters), barrage balloons, the aircraft warning system, camouflage, smokescreens, the "killer curtain"[2], and, of course, the defending fighters.

When the original defences of the Canal were being planned and built, before and during the years of World War 1, the main threat was seen as being from the sea. Aircraft were still in their infancy, and the idea of the Canal – so remote from any potential belligerent - being put in danger from the air was thought almost fanciful. At the start of the war, powered flight was limited to a few slow-moving airships and aircraft were few and made mostly of wood and canvas. However, by 1918, air power had grown to be force to be reckoned with, though still not an immediate threat to such a large and distant target as the Canal – but with the potential to become such.[3]

In 1913, Congressman James Hay of the House Committee on Military Affairs raised the question of the need for dedicated anti-aircraft guns during a discussion of the Panama Canal defences. The Army's witness, Brigadier General George Scriven, Chief of the Signal Corps (which, at the time, was responsible for the Army's few aircraft)[4], dismissed the need for a gun to shoot at aeroplanes, preferring instead to champion the use of aircraft to defeat any attack. When Hay asked about a gun capable of shooting at aeroplanes, Scriven responded that the "*Ordnance Department had been experimenting, but I do not know that they have yet devised a gun*". Indeed, both the Ordnance Department, which would build such guns, and the Coast Artillery Corps, which would man them, were unimpressed with

[1] For the incomplete story of radar being introduced into the Canal Zone, which actually occurred before the Pearl Harbor attack, but struggled with assorted problems with equipment, trained personnel and the terrain of Panama, see: https://raytodd.blog/2024/06/30/panama-in-world-war-2-the-introduction-of-radar/

[2] See the boxed text about Cerro Paraiso below.

[3] http://www.ftmac.org/AntiAircraftBatterys.htm

[4] For more on the Corps, see https://raytodd.blog/2024/08/20/panama-in-world-war-2-the-coastal-artillery-and-its-guns/

the aeroplane as a weapon of war at the time and focused their efforts instead on shooting down much the slower and less manoeuvrable balloons and powered dirigibles.[5]

It would be Spring 1917, as the US entered World War 1, that the Army decided to assign the anti-aircraft mission to its Coast Artillery Corps. Reinforcing the Army's decision was the acknowledged ability of seacoast artillerymen to fire at ships moving in two dimensions. By logical extension, it was thought that this ability made them the most appropriate candidates to attempt to fire at aeroplanes moving in three dimensions.[6]

After World War 1, much of the manpower and equipment of the wartime anti-aircraft artillery branch of the Coast Artillery Corps were lost, with the branch itself spending the following 20 years in a struggle for more modern equipment and to even survive, in an era framed by tight military budgets and the Great Depression.[7]

There were continued advances in general aviation, military, naval and commercial aviation, as well as with lighter-than-air aviation, between the wars and, added to the lessons learned during the war, this caused the US Army to once more look at ways to defend against aircraft. The process remained slow, because the aircraft was still seen as only a limited threat due to the range of aircraft at the time (long-range flights by aircraft carrying useful offensive loads only became a realistic threat in the late 1930s) and the fact that the US was well insulated from Europe and Asia (where any adversary might be expected to come from) by the Atlantic and Pacific Oceans.[8]

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[5] *Defending the AEF: Combat Adaptation and Jointness in the Skies over France* by Bryon Greenwald (National Defense University, July 2018).
According to Airships.net, the terms "airship" and "dirigible" are synonyms; a dirigible is any lighter-than-air craft that is powered and steerable, as opposed to free floating like a balloon. Contrary to common belief, the latter term, derived from French, refers not to a rigid structure, but rather is derived from the verb *dirigier* ("to steer").

[6] *Defending the AEF: Combat Adaptation and Jointness in the Skies over France* by Bryon Greenwald (National Defense University, July 2018):
https://www.researchgate.net/publication/326449656_Defending_the_AEF_Combat_Adaptation_and_Jointness_in_the_Skies_over_France

[7] *Learning to Fight From the Ground Up: American Antiaircraft Artillery in World War II* by Bryon Greenwald (On Point, Vol 24 No 1, Army Historical Foundation, Summer 2018).

[8] http://www.ftmac.org/AntiAircraftBatterys.htm

On 1 August 1921, the War Department ruled that the Coast Artillery Corps would furnish all artillery necessary for land and coast fortifications, as well as all anti-aircraft, railway, and trench mortar artillery for use either with fortifications or with the armies in the field.

As the overseas and insular possessions[9] required garrisons strong enough to withstand attack until relief could arrive. The Canal Zone, having among the largest coast artillery garrisons, became one of the principal training locations for all of the Corps' assigned missions: seacoast artillery, anti-aircraft artillery, and mobile railway and tractor-drawn artillery.[10]

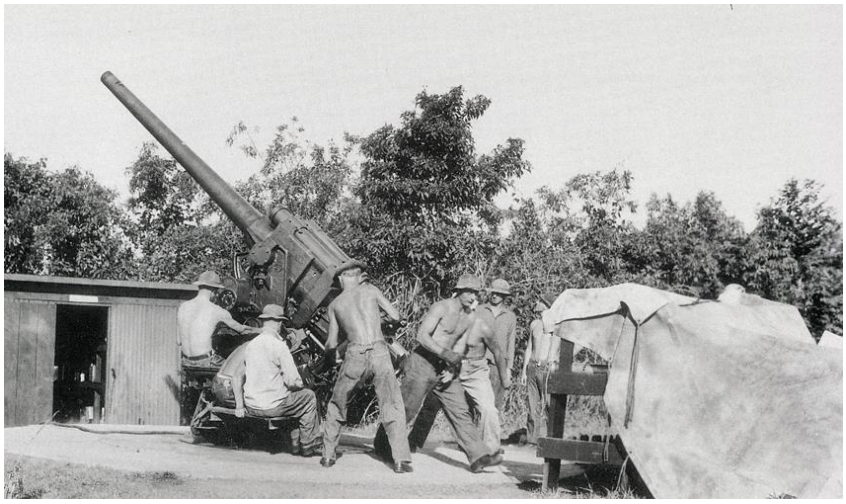
As early as 1923, the War Department had determined that either a larger naval fleet or a much larger number of aircraft would provide better coastal defence, but that the cheapest option was continued reliance on guns and submarine mines – which, inevitably, was the option chosen. As a result, the General Staff concluded that permanent seacoast fortifications were still essential. However, it recommended abandoning those defences which were no longer of military value, and to improve the ones being retained – especially with new, long-range guns and anti-aircraft protection. It also called for additional air forces.

World War 1-vintage M1918 3-inch mobile anti-aircraft gun of the Coast Artillery Corps seen in 1926

[9] Insular possessions comprise US territory that is not part of a state or the District of Columbia; at the time, this would have applied to Hawaii and the Philippines, as well as such places as the US Virgin islands, Guam, Wake Island and American Samoa.

[10] By June 1924, only 144 of the Corps' coastal artillery companies were active.

Whilst military budgets between the wars were parsimonious, in 1927, competition between the Coast Artillery Corps and field artillery saw changes made which, while they were seen as threatening the Corps' role in any future war, did at least simplify training, allowing the Corps to focus its meagre resources on its seacoast and anti-aircraft defence roles.



3-inch gun AA battery. The standard anti-aircraft gun would be upgraded from the M3 3-inch gun to the M1 90mm gun[11]

Between the wars there was disagreement at the bureaucratic level between the Army, the Coast Artillery Corps, the US Army Air Service (USAAS, after 1926 it became a Corps as the USAAC), and anti-aircraft artillery, especially as the economy felt the effect of the Great Depression in the 1930s. Some of this internecine bickering about the value of airpower and how best to defend against it continued into the early stages of World War 2, such as with the continued discussion over responsibilities over barrage balloons.[12]

The Italian Abyssinian campaign and the Spanish Civil War of the mid- to late 1930s had amply confirmed the importance of defence against aerial bombing attacks and focused attention of the Coast Artillery Corps and the Ordnance Department on the need of long-range, accurate, powerful anti-aircraft guns.[13] As a result, in 1937-39, the purchase of anti-

[11] https://www.wikiwand.com/en/United_States_Army_Coast_Artillery_Corps

[12] *Defending the AEF: Combat Adaptation and Jointness in the Skies over France* by Bryon Greenwald (National Defense University, July 2018): https://www.researchgate.net/publication/326449656_Defending_the_AEF_Combat_Adaptation_and_Jointness_in_the_Skies_over_France
For more on barrage balloons in Panama, see https://raytodd.blog/2024/06/30/panama-in-world-war-2-wartime-air-defences/

[13] http://tothosewhoserved.org/usa/ts/usatso01/chapter14.html

aircraft artillery became a War Department priority, although the shortfall in equipment and trained manpower would take much time and resources to overcome.[14]

> "*The actual anti-aircraft defenses were very weak due to demands for guns in the European conflict. Only eight 3-inch guns were mounted by 1918. Seven of these guns were in fixed mounts around the seacoast defenses and one gun was mounted on a railway car. Four more guns were received in late 1918 and were emplaced around the Gatun Dam. In April 1920, 36 3-inch guns were allocated to the Canal Zone. By 1931, the US Army had emplaced the 3-inch anti-aircraft in 15 3-gun batteries on fixed mounts (throughout the Canal Zone) and one 3-inch battery on railway cars. Supporting these anti-aircraft guns were 29 mobile 60-inch searchlights and 16 0.50-calibre machine guns*."[15]
>
> *The American Defenses of the Panama Canal* by Terrance McGovern (1999)

Since World War 1, a 3-inch (76.2 mm) gun had been the standard US Army anti-aircraft gun. However, 1n 1938, aware of the shortcomings of the current the 3-inch gun M3,[16] the Coast Artillery Corps had requested a larger-calibre gun, with a higher muzzle velocity, capable of firing a 21 lb (9.5 kg) projectile to a greater height. A Coast Artillery Board report of 1939 had predicted bombers flying at 250 miles (402 km) per hour at an altitude of 32,000 feet (9,750 metres), and warned of even faster aircraft under design which could operate at a ceiling of nearly eight miles (42,000 feet or 12.9 km). As a result, 1939 saw the start of work on a longer-range gun calculated to be able to reach aircraft at heights of 56,000 feet (17,069 metres).

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[14] *Learning to Fight From the Ground Up: American Antiaircraft Artillery in World War II* by Bryon Greenwald (On Point, Vol 24 No 1, Army Historical Foundation, Summer 2018).

[15] *The American Defenses of the Panama Canal* by Terrance McGovern (1999) via http://www.czimages.com/CZMemories/Photos/photoof854.htm

[16] It had a relative low ceiling range of around 15,0000 feet (around 4,500 metres), a muzzle velocity of only 2,600 feet (792.5 metres) per second and a relatively light 12.8 lb (5.8 kg) projectile.

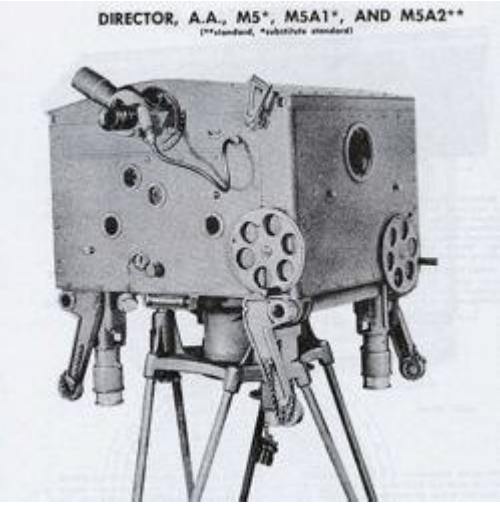
A fixed mount 3-inch gun. Guns such as this were sited at Fort Grant (Amador), Fort Sherman, along the coast towards San Lorenzo, and at Fort DeLesseps

Meanwhile, a 1938 project for a 90 mm anti-aircraft gun, was rushed to completion in 1940. However, the Ordnance Department had also been convinced that an even more powerful anti-aircraft weapon would be needed before too long, and by 1939 developments in radar and electronics held out hopes of effectively reaching targets at greater altitudes.

This picture of a 3-inch M1917 anti-aircraft gun was taken at Fort Amador near the Panama Canal in the 1920's. No photographs of the M1917 guns at Fort MacArthur have yet been found.

The 90 mm gun was the US Army's primary heavy anti-aircraft gun from just prior to the opening of World War 2 until 1946. In March 1940, the 90 mm design was standardised as the initial 90 mm M1, and entered production later that year. In anti-aircraft use, they were normally operated in groups of four, controlled by a gun director or a Kerrison predictor, with radar direction first introduced from 1941. For night-time use, a searchlight was slaved to the radar with a beam-width set so that the target would be somewhere in the beam when it was turned on.

The gun was also used by the Coast Artillery Command in its Anti-Motor Torpedo Boat (AMTB) batteries, from 1943 replacing the 3-inch gun, with its mount designed for both anti-surface and anti-aircraft fire.[17]



A modified version of the British-design Kerrison predictor, with the addition of a stereoscopic range finder, an altitude converter, and an electric mechanism for setting slant range into the director's multiplying mechanism produced the model as the M5A2 director

A project was initiated in 1939, and this was to eventually produce what became in 1944 as the 120 mm AA gun M1.[18] 15 of the new 120 mm gun would eventually be sent to the Canal Zone, but by then any potential air threat had long since passed. In the end, only about 550 M1 were produced, seeing some use in the later Korean War, but by then the advent of faster, jet-powered aircraft had made such large anti-aircraft guns like the M1 obsolete[19].[20]

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[17] The selection of the 90 mm calibre had been determined by the weight of a shell that could be hand loaded; anything more than 40 lb (18.1 kg) for a complete round would be too heavy for men to handle for more than a few minutes at a stretch, and mechanical loading systems until then had not been reliable.

[18] http://tothosewhoserved.org/usa/ts/usatso01/chapter14.html

[19] https://www.militaryfactory.com/armor/detail.php?armor_id=446
With the 50 lb (22.6 kg) projectile and separate 51 lb (23.1 kg) sealed powder case being too heavy for hand-loading, the M1 120 mm gun utilised a power-operated ammunition tray and rammer.

[20] The MIM-3 Nike Ajax surface-to-air missile entered service in 1954. By January 1960, all remaining National Guard units with M1 guns had been converted to use the MIM-3 or deactivated.

M1 120 mm gun at the US Army Ordnance Museum

The Coast Artillery Corps controlled all the fixed artillery, and all anti-aircraft artillery in the Canal Zone, and on the outbreak of war in September 1939 the only anti-aircraft regiment there was activated, the 73rd Coast Artillery Regiment.[21]

Vista de un cañón M1 AA de 120 milímetros. Quince de estas armas fueron enviadas a la Zona del Canal durante la Segunda Guerra Mundial. Hasta 1960, varias baterías en Fuerte Grant todavía estaban armadas con este tipo de cañones.

M1 120 mm gun at Battery Warren on Flamenco Island (at the end of the Amador Causeway – where the HAWK missiles, seen in the photo at the end of this article, were later located

As tensions continued to increase, in 1939, there were complaints of other Army elements in the Canal Zone making too many demands on the USAAC, resulting in a disruption of training and a severe strain on equipment, caused by missions involved included target-towing for artillery tracking, searchlight practice, and anti-aircraft practice. The USAAC

[21] *Security and Defense of the Panama Canal, 1903-2000* by Charles Morris (Panama Canal Commission).

commander estimated that only 10% of such flying could be regarded as training for the air units involved.[22]

Prior to October 1939, the Antiaircraft Defense Board of the Panama Canal Department made all decisions on anti-aircraft defences.[23] As a result of an emphasis on air defence, a reorganisation of military forces took place on 16 October 1939. All anti-aircraft units were amalgamated into one command – the Panama Provisional Coast Artillery Brigade. This was one of the five commands into which the Panama Canal Department was divided.[24].

Despite the Chief of Coast Artillery having warned of the lack of adequate protection from aerial attack, in 1940, the War Department's view was that the shortage of anti-aircraft guns was so severe that no mobile, and no more fixed, weapons could be spared for harbour defences. So, for the time being, the defences would have to make do with what they had.

Prior to the outbreak of World War 2 in 1939, anti-aircraft defences in the Canal Zone remained limited, and the standard anti-aircraft artillery were the 12 3-inch (76.2 mm) gun batteries[25], supported by 0.50-inch machine guns as the only automatic weapons for air defence[26] (37 mm cannon would later be added from November 1939, although this too

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[22] *Air Defense of the Panama Canal, 1 January 1939 – 7 December 1941* (Army Air Forces Historical Office), January 1946: https://www.afhra.af.mil/Portals/16/documents/Studies/1-50/AFD-090602-096.pdf

[23] *Security and Defense of the Panama Canal 1903-2000* by Charles Morris, Panama Canal Commission: https://original-ufdc.uflib.ufl.edu/AA00047733/00001/6j

[24] *Air Defense of the Panama Canal, 1 January 1939 – 7 December 1941* (Army Air Forces Historical Office), January 1946: https://www.afhra.af.mil/Portals/16/documents/Studies/1-50/AFD-090602-096.pdf

[25] The 3-inch gun had had limited effectiveness against high-speed, high-altitude aircraft and thus were clustered close to targets, for use against low-altitude targets, such as torpedo and dive bombers. The M3 had been the standard US Army anti-aircraft gun from 1927, and had been effective then. However, it had neither the range to be effective against planes flying at the heights attainable by the time of World War 2 (the M3 3-inch anti-aircraft gun had a slant range of 15,000 feet or 4,572 metres), nor the fire control mechanisms needed to track accurately those flying at the greater speeds.

[26] In the 1930s, the Coast Artillery Corps preferred the water-cooled version of the 0.50-inch, the basic M2 model equipped with an outer water-filled jacket and a water pump for cooling the barrel. The M2 heavy machine gun remains in production, and in US Army use, to this day. However, while large numbers of water-cooled M2 remained the US Navy's standard short-range anti-aircraft weapon until 1942, when it was realised that they lacked hitting power at typical naval engagement rages; they were gradually replaced by 20 mm Oerlikon cannon.

The tall tripod mount adopted for use with the M2 in the 1930s had been designed for a different tactical use than that which changes in air warfare demanded in 1940. By then, the Chief of Coast Artillery had labelled the existing mounts too heavy, too hard to transport, and having insufficient elevation to be suited to close-in defence against low-flying, high-speed targets.

would suffer from a shortage of ammunition, but by March 1941, those assigned were in place)[27], and searchlights (of which a 1940 review also found a shortage, as there was with most things, including of ammunition as late as December 1941[28]).

The equipment was to be upgraded as the war progressed, with automatic cannon and additional heavy weapons added.[29] There was also an expansion of gun and searchlight positions during the war, along with more and improved weapons. There would be mobile 3-inch mobile guns, alongside fixed 3-inch and 105 mm guns, forming an interior defence ring around defended areas. A study in February 1942 called for a considerable increase in the numbers of automatic weapons available. By December 1942, all the 37 mm guns had been replaced by new 40 mm Bofors guns.[30]

An M1 37 mm gun in the Solomon Islands during the war

[27] Colt had first produced the 37 mm gun in 1927, but it was only 1938 that the gun, with a carriage and sighting system, coupled with a so-called control equipment set, were put into production. It could fire up to 90 rounds per minute, to a range of 10,500 feet (3,200 metres). It was adopted in 1939 as the US Army's main anti-aircraft gun for the first years of World War 2, being replaced from 1943 by the 40 mm Bofors. It was also deployed in the coastal defence role in anti-torpedo batteries alongside 90 mm guns harbour defence batteries.
In 1940, a superior British remote-control system, originally designed for use with 40 mm Bofors, was recommended by the Ordnance Technical Committee for all new 37 mm units. This was the Kerrison predictor, a mechanical director linked with gears on the gun that automatically elevated and traversed the gun as the director transmitted its computations. Later a stereoscopic range finder, an altitude converter, and an electric mechanism for setting slant range were added to the director's mechanism.

[28] This, of course, hampered training and practice firing.

[29] In 1929, there had been only one searchlight position, on Venado Island (in Panama Bay, roughly midway between Balboa and Taboga island), although others were constructed in the late 1930s.

[30] *Security and Defense of the Panama Canal 1903-2000* by Charles Morris, Panama Canal Commission:
https://original-ufdc.uflib.ufl.edu/AA00047733/00001/6j
http://tothosewhoserved.org/usa/ts/usatso01/chapter14.html
For more on the Bofors gun in World War 2, see: https://www.usni.org/magazines/naval-history-magazine/2019/december/gun-fought-all-sides

However, there were continued problems during the war with shortages, including of trained radar operators and maintenance crews, which hampered the build-up of anti-aircraft defences in Panama; and in spite of more and better equipment and more expert, scientific placing of the radar sets themselves.[31]

Even the number of searchlights were initially limited, and a choice had to be made for the best deployment of those available. It was also recommended that during daylight hours they should be concealed. On Panama Bay, a lack of available positions led to a closer grouping along the shoreline, and sometimes the terrain had meant that the sound locator, control station, searchlight and power plant had been placed closer together than normal or safe.

On 1 October 1939, on the Atlantic end of the Canal there were 12 fixed 3-inch gun batteries and a few anti-aircraft searchlights, with 15 0.3-inch machine guns as the only automatic weapons (replaced by November by the more suitable and effective 0.5-inch).[32] By the beginning of 1940, the Pacific end had 11 gun batteries and 32 searchlight positions.

M2 water-cooled 0.50-inch heavy machine gun
(This photo from Sicily in 1943)

[31] https://www.ibiblio.org/hyperwar/USN/ref/Radar/Radar-6.html
[32] The 0.3-inch M1917 machine gun had been in use with the Army since the end of World War 1, but its biggest drawback in the anti-aircraft role was its short effective range.

On 20 November 1940, the Panama Coast Artillery Command was formed, comprising the Corps' two Harbor Defense units and its two anti-aircraft brigades – the 75th and 76th Antiaircraft Artillery Brigades –

- the 75th AAA Brigade[33] – provided air defence for the Canal areas on the Pacific side, including the Pedro Miguel Locks, Miraflores Locks, Spillway and power plant, Madden Dam, Albrook Field, Howard Field, and the Navy facilities of the Balboa Dry Dock and tank farm;
- the 76th AAA Brigade[34] – provided air defence on the Atlantic side, at Gatun Locks, Dam and Spillway, Mount Hope Filtration Plant, France Field and Coco Solo.[35]

The 105 mm Anti Aircraft Gun, M1927 was developed in the 1920s, and was said to have had the longest gun barrel length-to-calibre ratio of any gun in the US armed forces inventory at the time of its adoption in 1928. It replaced the 4.7-inch (119 mm) gun as the largest anti-aircraft gun of the US Army and had a reasonable performance. It was not mass-produced, remaining a "rare" weapon, and there were only about 13 guns available to the Army in 30 June 1940, and those were all in the Canal Zone, having been redesignated in the 1930s as the 105 mm Anti Aircraft Gun M3. It was said to have a maximum ceiling range of up to 12,800 metres, firing at a rate of 15 rounds per minute.[36]

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For more on the Bofors gun in World War 2, see: https://www.usni.org/magazines/naval-history-magazine/2019/december/gun-fought-all-sides

[33] The 75th Antiaircraft Artillery Brigade comprised the 72nd, 82nd and 88th Coast Artillery Antiaircraft Artillery.
[34] The 76th Antiaircraft Artillery Brigade comprised the 73rd and 83rd Coast Artillery Regiments.
[35] *Security and Defense of the Panama Canal, 1903-2000* by Charles Morris (Panama Canal Commission).
[36] https://www.secretprojects.co.uk/threads/us-4-7-inch-105-mm-anti-aircraft-gun-mobile-gun-1920s.37656/

provided air defence on the Atlantic side, at Gatun Locks, Dam and Spillway, Mount Hope Filtration Plant, France Field and Coco Solo.[37]

Before radar was introduced, the Army had to rely on patrolling aircraft, the eyeball mark one, and sound locaters. The sound locaters were sound-ranging devices, using huge horns which picked up, concentrated, and located the sounds of approaching aircraft and - with instantaneous adjustments for travel-time of sound and for force and direction of known wind currents – were said to be able to furnish accurate data to the anti-aircraft guns. In the 1930s, "*It has been said that in some armies are capable of locating targets accurately even if 50 miles away*". Sound locators had to be located more than 500 yards from a main road, as being any closer was said to lessen their efficiency, as any extraneous noise could interfere with their effectiveness, such as it was.[38]

Coast Artillery Corps, Antiaircraft Sound Locator with Searchlight and Transport. 1932

The two years prior to 7 December 1941 were spent in preparation for production rather than in the actual production of war materiel. A procurement goal was set at achieving supply for a US force of 1.2 million men by 31 December 1941. For example, only 504 out of 835 of the planned 37 mm anti-aircraft guns had been delivered. Ammunition production was begun, but only negligible quantities were available to meet the requirements of what would be a two-front war. The same was true of gas masks, 60-inch searchlights, assault

[37] *Security and Defense of the Panama Canal, 1903-2000* by Charles Morris (Panama Canal Commission).
[38] Ibid.

boats, and quartermaster and medical supplies.[39] Moreover, the rush to deploy forces. particularly anti-aircraft formations. cut into unit training time, spread the number of trained officers and non-commissioned officers too thin, and ensured that the quality of the training was minimal.[40]

Prior to the Pearl Harbor attack in December 1941, anti-aircraft outposts in the Canal Zone were few, and were mostly used as jungle training sites, occupied by only for three days at a time, and otherwise only maintained on a caretaking basis. Access to them, in any case, was generally difficult – with no, or few and poor roads, and the Canal itself used as a communications route (as mentioned in the boxed text below). It was not until 1941 that such outposts were permanently manned.

Anti-aircraft guns in the Canal Zone, date unknown
(US Army Center of Military History)[41]

By 1940, there were 11 gun batteries and 32 searchlight positions in the Pacific sector and, as of 1 October 1939, there were 12 fixed anti-aircraft batteries and a "few" searchlights in the Atlantic sector.[42]

[39] *Logistics in World War ll: Final Report of the Army Service Forces* - A Report to the Under Secretary of War and the Chief of Staff by the Director of the Service, Supply, and Procurement Division, War Department General Staff (Center of Military History US Army, Washington DC , 1993): https://history.army.mil/html/books/070/70-29/CMH_Pub_70-29.pdf

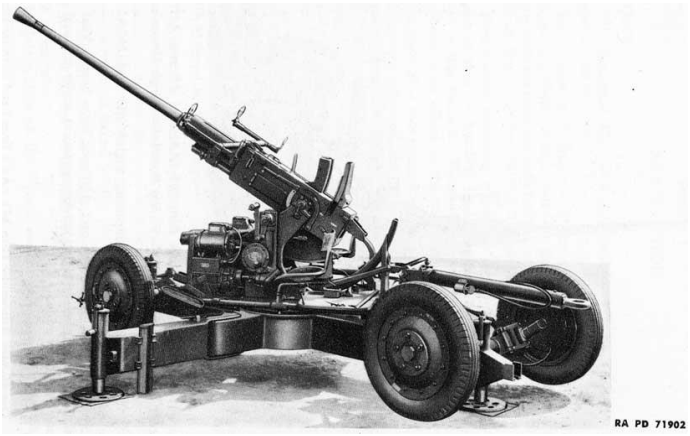
[40] *Learning to Fight From the Ground Up* by Bryon Greenwold (*On Point: The Journal of Army History,* Vol 24, No1, Summer 2018).

[41] https://ww2db.com/image.php?image_id=15117

[42] From 1941, a plan was put in place which allowed te gun batteries to provide supporting fire to the Mobile Force, as well as a secondary harbour defence role in the Atlantic sector.

In May 1941, Time Magazine published an article saying that, on Gatun Lake, there were "a little fleet of motorboats", the supply boats of one of the finest, least-known outfits in the US Army: the Panama Coast Artillery Command. Each day, from docks along the lakeside, the boats shuttled men and supplies for the listening posts, anti-aircraft gun batteries, and searchlight positions around the lake. In the jungle, supply boats, trucks or pack mules call once a day, unless something happened— each station kept a 30-day supply of canned food on hand. It said that any foreign sailor, passing through the Canal on a freighter, would be able to see occasional clusters of tents or barracks in the hills, and could even see the barrels of guns against the sky.[43]

More than half a billion dollars was expended in the immediate pre-war and wartime periods in the Caribbean Defense Command area, which included Panama and the Canal Zone, with $234 million under the direct supervision of the Panama Canal Department (the US Army command in the Canal Zone). Facilities built throughout Panama and the Canal Zone included nine airbases and aerodromes, 30 aircraft warning stations, and 634 searchlight and anti-aircraft gun positions.



Bofors 40-mm Automatic Gun M1 (AA) and 40-mm Antiaircraft Gun Carriage M2 – in the firing position

Additional benefits were derived from reciprocal aid agreements made with Britain, Australia, and New Zealand in September 1941. Transfers were made to the US forces of British anti-aircraft and coast defence weapons for the defence of the Panama Canal, including British-designed radar and Bofors guns.[44] Negotiations to acquire 72 Bofors 40mm

[43] https://time.com/archive/6764990/national-defense-jarmans-junglemen/

[44] *Logistics in World War ll: Final Report of the Army Service Forces* - A Report to the Under Secretary of War and the Chief of Staff by the Director of the Service, Supply, and Procurement Division, War Department

anti-aircraft guns from the British allowed for all the 37 mm guns to be replaced by the Bofors by the end of December 1942.[45]

From mid-Summer 1941, the Aircraft Warning Stations and anti-aircraft defences were on continuous alert.[46] In June 1941, the first Army barrage balloon unit arrived, followed by a US Marine detachment in December. The Rio Hato Gunnery Camp was established, in the Republic, 75 miles (121 km) from the Canal Zone, for practice firing (including night practice) of anti-aircraft guns in 1941.[47] Alongside the PT Boat training base on Taboga there were, as well as searchlights, anti-aircraft guns and bunkers.

At the time of Pearl Harbor on 7 December 1941, Army forces then in Panama and the Canal Zone included the following[48] –

- 1st Coastal Artillery (Harbour Defence) Regiment
- 4th Coastal Artillery (Harbour Defence) Regiment
- 72nd Coastal Artillery (Anti-Aircraft) Regiment
- 73rd Coastal Artillery (Anti-Aircraft) Regiment
- 82nd Coastal Artillery (Anti-Aircraft) Regiment
- 83rd Coastal Artillery (Anti-Aircraft) Regiment

The attack on Pearl Harbor appeared to show that the Coast Artillery and its anti-aircraft guns was ineffective against a mass air attack, and that pre-war anti-aircraft planning had

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General Staff (Center of Military History US Army, Washington DC , 1993): https://history.army.mil/html/books/070/70-29/CMH_Pub_70-29.pdf
US forces also received a number of installations and quantities of supplies from the British when the US occupied bases in Iceland and the Caribbean in the same year

[45] *"Radar Contact!": The Beginnings of Army Air Forces Radar and Fighter Control* by Randall DeGering (Air University Press, 2018): https://www.jstor.org/stable/resrep19549
The prototype Bofors gun had been first developed in Sweden in 1931, entering service with the Swedish Navy in 1934. The first land-based version was ordered by Belgium in 1935, and the British had adopted the weapon after testing Polish-built examples in 1937. The US Army acquired its first examples only in December 1940. It was formally adopted as the 40 mm, automatic anti-aircraft gun M1 in April 1941.

[46] https://www.ibiblio.org/hyperwar/USA/USA-WH-Guard/USA-WH-Guard-13.html

[47] However, Heavy supplies had to be transported by sea and offloaded onto the beach at Rio Hato until, in 1942, the US built a highway from Chorrera to Rio Hato.

[48] http://navsource.org/Naval/usaaf.htm
Following Pearl Harbor new regiments were formed, one being the 36th Coast Artillery, originally assigned to Puerto Rico, then later to the Canal Zone.

been very inadequate.[49] What might have happened in Panama in 1941 is illustrated by how the anti-aircraft forces at Pearl Harbor and Clark Field in the Philippines were both woefully under-equipped and poorly prepared to face determined attacks by better-trained and -equipped Japanese pilots.[50]

Because the Canal seemed likely to be one of the objectives of the Japanese, Commanding General Andrews', in command 1941-42, saw his requests on behalf of the Panama Canal Department fare better than most of those pleading for reinforcement. On 12 December 1941, Army GHQ noted that two infantry regiments, two barrage balloon units, a field artillery battalion, and two hospital units were to be sent to Panama in addition to some 1,800 coast artillery replacement personnel. Shortly after, arrangements were also made to further reinforce the air component.

Among General Andrews' opinion of the shortcomings in the defences of the Canal Zone, he contended that the commandant of the naval district did not have enough aircraft or vessels under his control to conduct an adequate reconnaissance. The Aircraft Warning Service was totally inadequate in personnel to supervise the installation of detectors (radar) on hand as well as to man the equipment when installed. Only two detectors were installed and in operation in the Panama Canal Department at the time. The harbour defences' anti-aircraft artillery had insufficient personnel to man the armament being installed in the Canal Zone and only enough ammunition for one minute of fire per gun for the 37-mm. guns. There were no barrage balloons, and the Caribbean Air Force, based in the Canal Zone, was totally lacking in fighters for night operation and in VHF radio equipment with which to direct interception.[51]

The construction and use of anti-aircraft defence sites after the Pearl Harbor attack had, given the nature of the Japanese attack and the Canal being an obvious target, the highest priority, but there was little time for training – and a shortage of ammunition limited target

[49] https://www.wikiwand.com/en/United_States_Army_Coast_Artillery_Corps
[50] *Learning to Fight From the Ground Up* by Bryon Greenwold (*On Point: The Journal of Army History,* Vol 24, No1, Summer 2018).
[51] https://history.army.mil/books/wwii/guard-us/ch13.htm

practice.[52] Local terrain and weather conditions are said to have proved the greatest obstacle to the building of new positions.

Nevertheless, from 7 December 1941, the defence alert status required a third of gun batteries to be on "A" status (supposedly ready for immediate firing), a third on "B" status (ready to fire within 10 minutes) and a third on "C" status (resting).

On 9 January 1942, General Order 381[53] from the Panama Interceptor Command (responsible for fighter defence) provided a summary of the expected form an air attack would take. This, it said, was likely to be by low-flying (in fact, very low flying, as little as 10 feet or 3 metres) using torpedoes and/or dive-bombing, likely launched "lengthwise" against the locks and Madden Dam, and from the Gatun Lake side of the Canal. It was predicted that fighters would find it difficult to combat the attackers, and the best defence would be from anti-aircraft ground fire and barrage balloons.[54]

In addition to the headquarters bunker at Quarry Heights, other underground command posts were built in the isthmus, including one for anti-aircraft defence in the Balboa area. Another was an Emergency Joint Command Post at Gordo Hill, between Gamboa and Paraiso.

[52] The rapid expansion of anti-aircraft defences meant that industry could not provide enough guns, enough ammunition, or even enough towed targets for training. It would take until mid-1943 for the shortfalls to end: *Learning to Fight From the Ground Up: American Antiaircraft Artillery in World War II* by Bryon Greenwald (On Point, Vol 24 No 1, Army Historical Foundation, Summer 2018).

[53] Antiaircraft Defense Against Low Flying and Dive-Bombing Aviation.

[54] *P-38 in Latin America* by Dan Hagedorn (Aviation Art & History, 2022).

Cerro Paraiso	Aka Paraiso Hill; on the west bank of Canal. The "Killer Curtain" was suspended between here and Cerro Paraiso near Pedro Miguel Locks, and designed to prevent low-level attacks on the locks.[55] An inclined railway was built to allow the engineers to build an anti-aircraft weapon position on the top of the hill, as this was considered a strategic position.[56] In 2007, the hill was levelled as part of the Canal expansion project.

Fort San Lorenzo	Despite having been designated as a National Monument since 1908, the area around Fort San Lorenzo, completed by the Spanish in 1601 (and now a UNESCO World Heritage Site) was originally incorporated into the Fort Sherman Military Reservation, in 1911 and, during World War 1, a radio listening post was set up there. During World War 2, in 1942, a searchlight and 3-inch anti-aircraft guns were placed there (remaining until 1946) to prevent German U-boats from sending raiding parties up the Chagres towards the Gatun Dam. The Army also built a pontoon bridge across the adjacent Chagres just above its mouth. The bridge and gun position were dismantled after the war and Fort San Lorenzo returned to be a sight-seeing area and a picnic ground.[57]

Margarita Island	On the north-eastern tip of this island near Colón on the Caribbean end of the Canal were two firing positions for Battery No.1 of Fort Randolph, the 14-inch (355 mm) railway gun.[58] The Island was connected to the mainland by a railway causeway, so that the eastern breakwater of Limon Bay could be built. It was also home to three x 3-inch guns of anti-aircraft Battery 5.

[55] Its only victim was a USAAF aircraft which crashed into an electricity generation building after striking the curtain. Ironically, the aircraft had been involved in assisting the calibration of anti-aircraft batteries around the locks. Use of the curtain was discontinued.
Security and Defense of the Panama Canal 1903-2000 by Charles Morris, Panama Canal Commission.

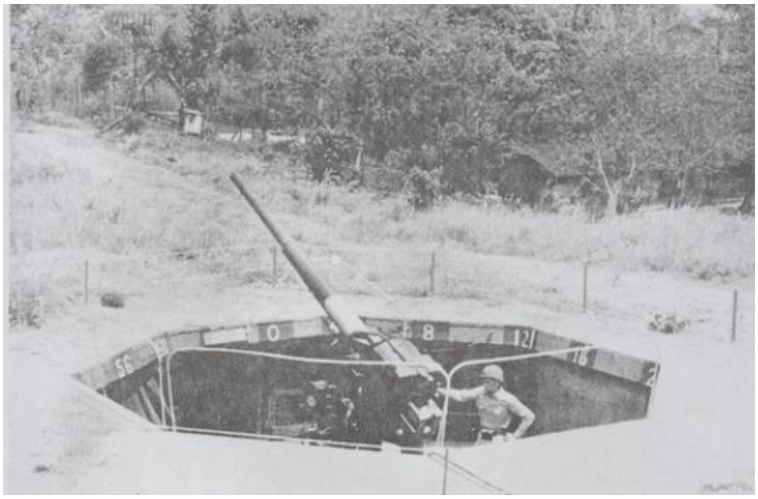
[56] However, the railway was not considered safe for personnel to use, and they had to walk up the hill.
Security and Defense of the Panama Canal, 1903-2000 by Charles Morris (Panama Canal Commission).

[57] http://www.czimages.com/CZMemories/VAP/Sherman/fspage2.htm

[58] The guns could be used on either side of the isthmus (and known as Battery No.8 at Fort Grant), using the 5-feet (1.5 meter) gauge track of the Panama Railroad. However, it was planned to keep one gun on either side: https://si.maps.arcgis.com/apps/Cascade/index.html?appid=e65d5058a32a4b939965915b61aab678

Hotel Washington	During World War 2, the Hotel Washington in Colón was described as an eerie place. Signs in the corridors and the elevator advised guests of the whereabouts of air raid shelters. The roof, a vantage spot for sightseers, was off-limits. An anti-aircraft battery was located next door, on the swimming pool side, and from time-to-time guests were notified, in advance, that there would be firing practice. They could then find urgent business elsewhere or stuff their ears with cotton. None of the halls were lighted, except by low-burning lanterns set on the floor, and blackout restrictions were stringently enforced.

The US had asked in the lead up to World War 2 for 999-year leases on areas outside the Canal Zone to build what were regarded as being essential additional defences, including airfields, anti-aircraft batteries and warning stations, but the negotiations dragged on for two years, with the Arias Madrid administration seeking to extract various improvements and concessions in return.[59] While the number of sites would eventually reach over 130, on 11 October 1940, the US had originally requested just 12 additional sites in the Republic for landing fields and auxiliary airbases, three for coastal defence, seven for air alarm stations, 46 for searchlights, two for transit roads to those sites, and just a single site for anti-aircraft guns.[60]



3-inch AA gun emplacement in the vicinity of the Canal locks

[59] The nationalist Arias Madrid was elected President in 1940, but was deposed in a bloodless coup in October 1941, being replaced by a more accommodating President and administration. For more on the fascinating Arias Madrid story, see https://raytodd.blog/2024/06/30/panama-in-world-war-2-the-wartime-presidents/

[60] https://salacela.net/es/wp-content/uploads/2017/10/Contenido-151.pdf

Of course, the new airfields established in the Republic would also be accompanied by the necessary defences, including anti-aircraft guns and positions to defend against attacks on the ground. This was in addition to anti-aircraft gun, searchlights and automatic weapon defences proliferating around the Canal and surrounding installations. Due to their limited value against high-speed, high-altitude bombers, the 3-inch guns were clustered close to the most valuable targets for greater concentration of fire against low-altitude attackers.

During the war the US was to construct in the Canal Zone and elsewhere in the country nine new airbases and aerodromes, 10 bases for ground forces, 30 aircraft warning stations, 634 searchlight and anti-aircraft positions, and various other facilities, including the Coco Solo Naval Hospital to the south-east of the Naval Air Station – at a total cost, in 1940 dollars, of $1.36 billion.[61]

In February 1942, instructions were issued to establish a system of barrage fire for the 3-inch guns, the first involving a fixed barrage at 500 feet (152 metres) above the Pedro Miguel and Miraflores Locks. The barrage was seen as an alternative until the development of a radar-controlled barrage, and stayed in place until such a method became available. Against low-flying craft, the use of guns with rapid cyclic rates would increase the chances of a strike through the sheer volume of fire.

[61] For more on the 1942 agreement for the bases in the Republic, and the wrangle that saw them all hurriedly vacated after the war, see https://raytodd.blog/2024/06/30/panama-and-world-war-2-operating-outside-the-zone-the-1942-agreement-and-the-1947-row/

A BASEBALL STAR IN THE ANTI-AIRCRAFT ARTILLERY IN PANAMA

In October 1941, Major League Baseball player Mickey Harris was called up and, after anti-aircraft training in Virginia, was sent to the Canal Zone in early 1942. It has been said that he was, perhaps, to play more baseball while in service than any other major league player, pitching for the Balboa Brewers in the highly competitive Canal Zone League.

However, baseball did not occupy all his time, Private Harris still had military duties that involved manning anti-aircraft guns. In July 1942, Harris was recalled from the Canal Zone to play for an All-Service team against an American League all-star squad at Cleveland's Municipal Stadium, but then returned to the Canal Zone, marrying there in August 1944 at St Mary's Church in Balboa.

As now Corporal Harris, he finally left Panama in October 1945, having been overseas for almost four years.[62]

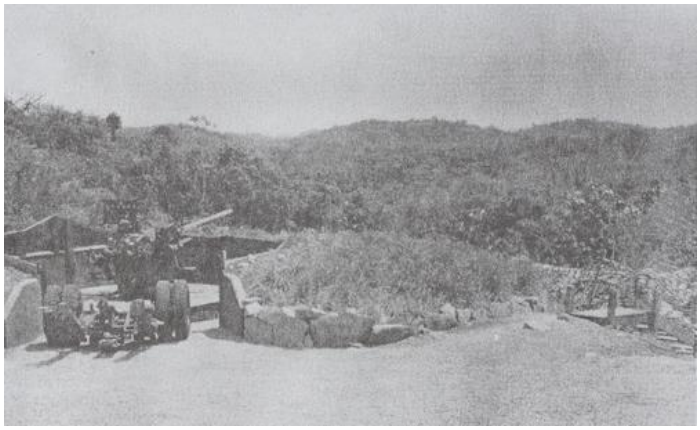
MLB player Mickey Harris

In June 1942, plans were made for automatic weapons defence of Albrook Field, Howard Field and Panama Air Depot (also located at Albrook), with priority given to the hangars of

[62] https://www.baseballinwartime.com/player_biographies/harris_mickey.htm

the latter, and integrated with the defences of Albrook Field. However, these would then be disestablished during the September 1943 reduction of defences.

In September 1942, a firing range was established at the Atlantic end of the Canal, at Galeta, near Colón, on the site of a Navy Range. It would be moved later, as shipping interfered with gunnery practice, including fishing boats ignoring notices. After being relocated to Chagres, four 3-inch mobile guns were installed on a hill near the Chagres River to conduct target practice. In addition, on the Pacific, a practice firing point was established at Venado Beach, near Fort Kobbe, with another at Paitilla Point for automatic weapons.



Mobile anti-aircraft gun emplacement

In October 1942, the Coastal Artillery Command reported that all armament was well placed for defence of the Canal Zone against torpedo boats, as well as against low-flying torpedo-launching or mine laying aircraft.[63]

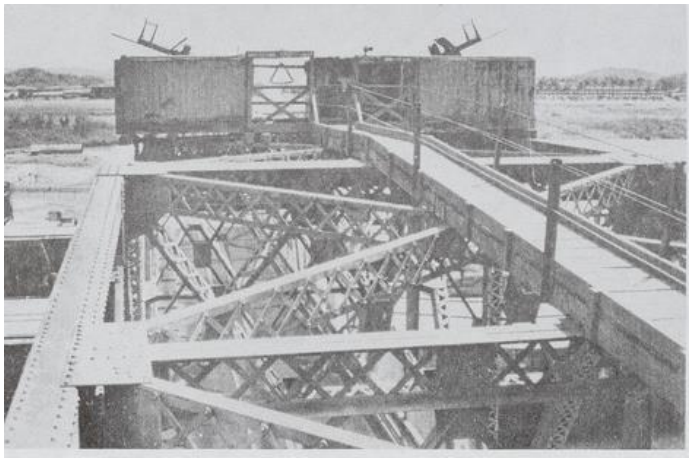
In November 1942, a study was carried out to determine the effectiveness of each gun battery, with assessments were based on 45-second bombing runs to the "bomb release line".

Until September 1943, searchlight defences on the Pacific side consisted of 85 positions, later reduced to four searchlight batteries, each with 12 lights, for Pacific Searchlight Defense, with 0.50-inch machine guns used for local protection.[64] However, at the same time, in common with many other defence arrangements, anti-aircraft gun defences began

[63] *Security and Defense of the Panama Canal 1903-2000* by Charles Morris, Panama Canal Commission: https://original-ufdc.uflib.ufl.edu/AA00047733/00001/6j

[64] *Security and Defense of the Panama Canal, 1903-2000* by Charles Morris (Panama Canal Commission).

to be reduced, as the threat was seen to diminish. It was also at this time that the Coast Artillery Command had set up certain standards for training of gun crews.



Miraflores Locks swingbridge, with two 0.50-inch machine gun installations

During the war, gun batteries found that they had problems making visual contact with targets due to local climatic conditions. It became apparent that the gunsight needed to counter low-flying strafing aircraft was below the minimum limits of the M-4 and M-7 directors in use. The Luczak Sight[65] in use was therefore improved upon and, with testing, proved to provide a solution.

Due the regions terrain, the radar installed in the Canal Zone suffered from ground clutter to a greater or lesser degree.[66] Due to the problems, the M-1 Height Finder was used to determine the range of low-flying aircraft.[67] In addition, by 1944, daily tracking missions formed part of the training required to improve and maintain the efficiency of the crews of the radar sets. The Panama Air Warning System (PAWS) of ground observers was also tasked for tracking targets below 1,000 feet (305 metres), but it too suffered from difficulties in the use of its equipment over the same terrain.[68] In May 1944, the early radar

[65] Invented by an Engineer officer, Bernard Richard Luczak, in 1943, a former engineer with Westinghouse Electric before the war. It was a direct-fire gunsight for the 90 mm anti-aircraft artillery. The name, in Polish, means “bow-maker” or “archer”.

[66] In 1940, the SCR-268 was the US Army's first radar that was designed to direct searchlights and anti-aircraft guns, and continued in use with the Army in spite of problems with the accuracy of its elevation data due to ground reflections (ground clutter). However, it was widely utilised by both Army and Marines air defence and early warning units during the war.

[67] This was an optical range-finder, the slant range from the battery site was combined with the angle of sight, using a mechanical computing device, to determine altitude.

[68] *Security and Defense of the Panama Canal, 1903-2000* by Charles Morris (Panama Canal Commission). https://original-ufdc.uflib.ufl.edu/AA00047733/00001/6j`

sets were moved from anti-aircraft gun sites to searchlight positions, as a new, more capable, type arrived.[69]

35th scale model of a M1 Height Finder

In July 1944, the Coastal Artillery Command ordered surveys for possible sites for 120 mm guns, with Camp Chiva, Albrook Field, Empire and Cocoli found to be suitable, as well as being excellent sites for the accompanying radar. By December 1944, Battery 80 at Camp Chiva and Battery 81 near the Empire Range had been approved (the others had been rejected, with alternatives sought).[70]

During 1943-45, all Coast Artillery regiments were broken up into separate battalions. Where new battalions were formed, these were generally created as anti-aircraft artillery units.[71]

At the end of the war, except for some 6-inch (152 mm) pedestal mount coastal artillery and 3-inch anti-aircraft guns, the Endicott- and Taft-period guns[72] were scrapped and the Coast Artillery Corps drawn down in size. When the war ended it was decided that few (and soon

[69] *Security and Defense of the Panama Canal, 1903-2000* by Charles Morris (Panama Canal Commission). For a 120 mm gun site, there needed to be enough space for four 120 mm guns, a minimum of 70 yards (64 metres) apart, and with the guns unaffected by masking that would prevent at least three of the guns firing at any target above 3,000 feet (914 metres), and that all four guns could fire at a target above 6,000 feet (1,828 metres). It also needed excellent operating conditions for the SCR-545 radar, and had to be accessible by road.

[70] *Security and Defense of the Panama Canal, 1903-2000* by Charles Morris (Panama Canal Commission).

[71] https://cdsg.org/coast-artillery-corps/

[72] These terms refer to the reviews which had determined the types of defences and guns required for the coastal defence role. The Endicott Board Review was published in 1885, and the *Report of the National Coast Defense Board . . . on the Coast Defenses of the United States and the Insular Possessions* (aka the Taft Review) was published in 1906. The latter surveyed the progress in harbour defences made since the Endicott Report and recommended a number of technical improvements, as well as the fortification of key harbours in the newly acquired overseas possessions such as Hawaii and the Philippines.

no) gun defences were needed, and by 1948 almost all the seacoast defences had been scrapped. With only the anti-aircraft mission left, the Coast Artillery Corps was disestablished and the anti-aircraft and field artillery[73] branches were merged in 1950.

In Panama, the immediate postwar plan had, in 1945, as in 1940-41, seen the chief threat to the Canal as being from a carrier-based attack, and the proposed countermeasures also being similar.[74] The Commanding General at the time, General Brett, had a plan which called for a number of airbases throughout Panama, as well as on the Galapagos Islands and in Nicaragua and Peru.[75] As before, the need was seen for a layered defence, based on air defences, with bombers whose task was to destroy enemy aircraft and their carriers before take-off, while fighters and anti-aircraft artillery would act as the inner screen round the Canal locks and the spillway which enclosed the Canal's principal water supply in Gatun Lake.

However, by the 1950s, nuclear weapons and increasingly capable missiles complicated the issue, and by the 1960s it was clear that an attack intended to disable or destroy the Canal could be mounted without any realistic prospect of prevention. In a sense, the view of the Isthmian Canal Commission (that the Canal was essentially indefensible) at the start of the century had become true.[76]

The US Army's anti-aircraft and field artillery branches were later separated again and regiments eventually re-appeared. In the 1950s through into the early 1970s, the Anti-Aircraft Command and its successors operated missiles that, along with the USAF BOMARC

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[73] In March 1942, the War Department created the Army Ground Forces to produced properly trained and equipped units. At the same time, the new Antiaircraft Command (AAC) was established, separate from the Coast Artillery Corps. The new Command set up training and deployment standards. It published training inspection checklists to aid the rapidly expanding force.

[74] This was, of course, highly theoretical, as the only other country with a sizeable carrier force was Britain, a close ally. The USSR, still then an ally and even if envisaged as a potential enemy, did not have a carrier fleet, and would not have any significant carrier forces until (as Russia) into the 21st Century.

[75] *Wasting Asset: The U.S. Re-Assessment of the Panama Canal, 1945-1949* by John Major (Journal of Strategic Studies), 2008.
As it was, the failure to reach an agreement on bases outside the Canal Zone on an ongoing basis, and the attitude of many Latin American states in the postwar period, meant the plan became a non-starter.

[76] The Isthmian Canal Commission was established in 1904 to oversee the construction of the Canal.

interceptor missile, were the successors to the Coast Artillery in defending the US Continent.

The wartime air defence system in the Canal Zone was effectively revived at the end of June 1950 when North Korea invaded South Korea. As a result, on 28 June, the Commanding General of the US Army Caribbean (USARCARIB), the successor to the wartime Caribbean Defense Command and also headquartered in the Canal Zone, placed the Panama Command on a modified alert status. This involved increased security at key critical Army installations and military guards at critical Canal facilities. Anti-aircraft artillery units were ordered to prepare for deployment, and live ammunition was issued to all troops. After two days, defence security was increased, with all Army installations placed under guard, anti-aircraft units deployed to tactical positions, to defend against air attack and to assist in harbour defence – with all this done by July. The Army assisted in the control of entry and exit of the Canal Zone by sea, in the arrest and detention of designated enemy aliens and all known subversives, and a mobile reserve was established on both ends of the Canal, mustered at Fort Gulick and Fort Clayton.[77]

The heightened defence status included an active air defence, formally activated in July 1950, which would be triggered by the approach of unidentified formations of "*three or more aircraft violating restrictions on flight within Canal Zone military airspace, and any aircraft committing a hostile act*".[78]

The sites of the anti-aircraft units were the same as those occupied during the war, which of course had been abandoned. It was necessary to repair any existing huts, or erect tents. For gun crews. In due course, accommodation, defensive positions for troops guarding the sites, and gun emplacements were rebuilt, although initial conditions for the troops were described as primitive, by 31 December 1950, the necessary improvements had been made.

[77] *Security and Defense of the Panama Canal, 1903-2000* by Charles Morris (Panama Canal Commission).
[78] Ibid.

A 1963 press photo of a MIM-23 HAWK surface-to-air missile battery at Fort Amador in 1963

After the Korean War, one saw surface-to-air missile batteries in place of gun batteries, though far fewer in number, and located at key sites, such as on the Amador Causeway at the Pacific entrance to the Canal. Gun defences would be limited to rapid-firing weapons, the large calibre artillery no longer having a role.

Ray Todd

Panama City

Republic of Panama

26 August 2024