DIRECTION FINDERS

During World War II the Sino American Cooperative Organization (SACO) built a network of direction finder (DF) stations in and near China (fig 1). The DF activity was part of Radio Intercept (RI), that was tasked with locating and tracking Japanese assets. Numerous mobile and fixed, or stationary, direction finders were used to ferret out spies and to acquire intelligence important in fighting the war against Japan. The following is a summary of the sparse information about the direction finder use by SACO – from both published and unpublished documents as well as from conversations with veterans who were DF operators or were familiar with the equipment. This was a very secret activity within the especially secret SACO operation.

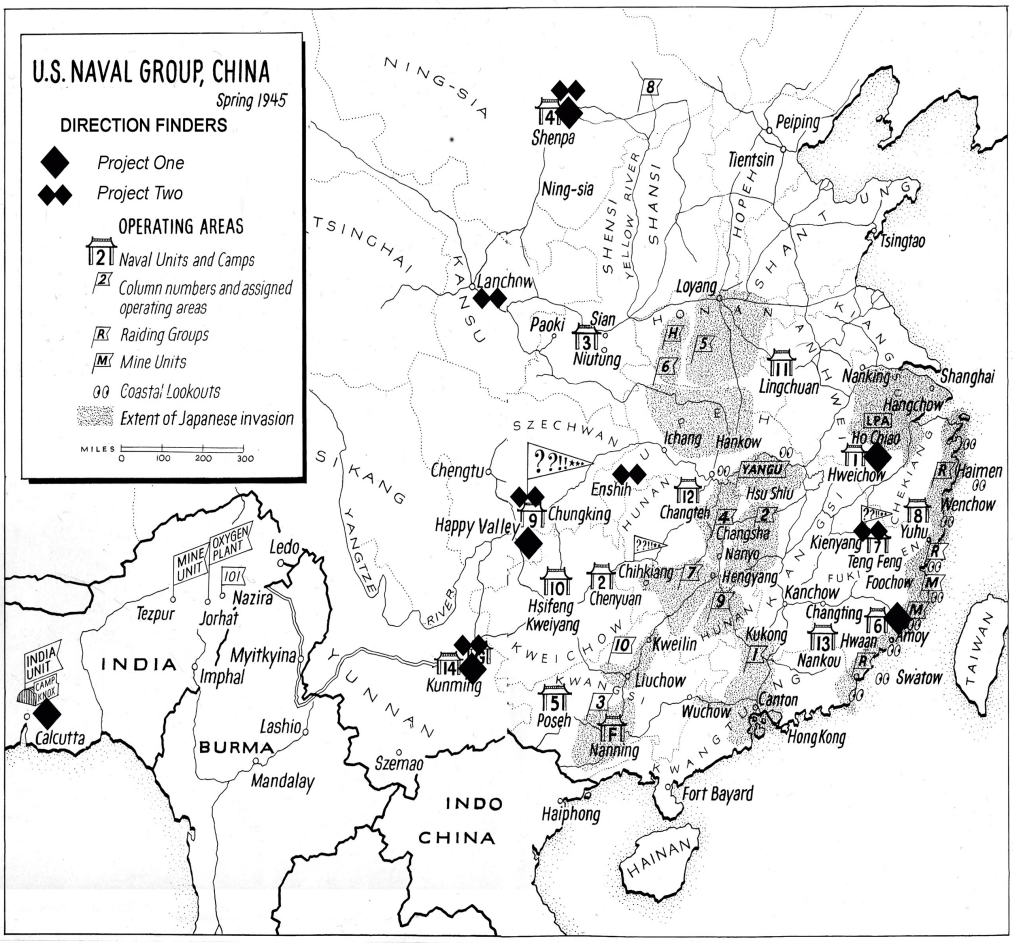

Figure 1. Map showing the locations of fixed direction finders operated by SACO in the Far East during World War II. The source for this information is a preliminary map of SACO communications facilities dated April 10, 1945 (Miles, undated, v 2, p 11). The base map of SACO operations in the Spring of 1945 is modified after that following page 126 in Miles, 1967.

Captain Miles had understood that communications would be important for any wartime China endeavor; his major at the U.S. Naval Academy had been electrical engineering. Before the end of May 1942, they had rounded up in Washington a group of six navy specialists in radio, – Lt Daniel Webster "Web" Heagy, CRM Theodore J.Wildman, CRM Robert L. Dormer, CRM Kenneth A. Mann, his brother CRM Lashley H. Mann, and LTJG Terrence J. 'Terry" O'Neill. These men arrived in Chungking (now Chongqing) early in September 1942. They were given access to the large caves in which Gen. Tai Li had stored all of the radio and electrical gear, mostly old and broken, that had been salvaged from throughout China. They were able to repair or cobble together several radios for their own use.

> Wildman had already shown his great ingenuity and the stamina as well as his unusual rapport with the Chinese. He also knew how to operate direction finders and had trained himself to receive "Katakana," the Japanese simplified language that was widely used in radio communications. The fact that he had no direction finders created a problem, of course, but he soon managed to make what he needed out of bamboo and such radio receivers as he could find among General Tai's evacuated spoils. Then, for a quick try-out, he and about a dozen of his Chinese associates worked over our immediate area and promptly located a spy station in Chungking. Miles, 1967, p 196-97

On 1 October 1942 the group moved to the new headquarters eight miles west northwest of Chungking. This location became known as Happy Valley.

> Our boys were so anxious to work that within an hour of the time we moved into our new quarters they set up the one radio receiver we had been able to borrow from General Tai, and from that minute on they took turns listening in on the great volume of Japanese radio traffic. Naturally they wanted to know where it came from, so Ted Wildman rigged up a direction finder, making it, for the most part, out of a couple of buggy-whip antennas, some of the "useless" oil cans, our one radio receiver, and a lot of bamboo poles that were lashed together. Luckily, the Navy knows how to lash for, as I have said, there were no nails in Chungking. And the thing worked!
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> So now we could listen in on any number of stations and could even determine their direction. Still, we could not determine their distance. The next job, therefore, was to build some other direction-finder sets so that we could get triangulation fixes. And that worked, too. Miles, 1967, p 970

Plans were made to set up a network of DF locations that could cover the enemy forces and supply lines. Project One (see fig 1) was the first phase and consisted of six fixed stations.

> But for radio direction finding, also, we needed a station as far north as possible, a long base line being necessary in order to permit us to obtain such cross bearings as would be most useful in helping us pinpoint Japanese radio sources at sea. Furthermore, such a station would be useful in intercepting Japanese

> Navy messages from North China waters. The fact is that the station ultimately justified its existence from this point of view alone, for in its first year of existence it was given credit for "an assist" in the dramatic and decisive Battle of Surigao Strait. Miles, 1967, p 405

Camp Four, established in January 1944, was located near the 41st parallel, it was 350 miles north of Tokyo's latitude. It was both an excellent site for gathering radio intelligence and for monitoring the weather upwind from Japan and the Philippines. This was the furthest north SACO facility.

> Some of the listening was for river and harbor traffic. Ships sent a good many messages while convoys were making up in a harbor, but once the convoy was under way their radios were significantly silent. But let a submarine or a plane appear and they opened up with a squawk. "Help!" they would call, and sometimes after the danger seemed to have passed, "He missed me" or, more desperately, "SOS."
>
> Our men were trained to decode such messages in a few minutes, for they were usually in easy merchant marine codes. If a ship was cautious and did not mention her position we found it anyway—by triangulation fixes with our direction finders. Miles, 1967, p 295-96

Figure 2. Direction finder built by SACO hands. This is the prototype for many of the DF units. (Miles, undated, v 1, p 77)

The first DF unit was rebuilt as soon as the necessary equipment arrived – most important were nails and modern radio receivers. This improved version, shown in figure 2, was set up on the ridge just south of the Happy Valley complex and just north of the "White House", which became home for the RI group. Most of the DF sets in SACO were replicas of this unit. The tower for the original DF set was made of three- to four-inch diameter bamboo poles. There was no deck and the operator had to stand, and dance about, on a horizontal pole while rotating the unit.

The antennas for these direction finders were "modified Adcock" (Miles, 1957, p 22). The vertical antennas were divided in two parts on each side. The upper left was wired in series with the lower right and the upper right, with the lower left. Referring to figure 2, if the American operator is assumed to have been 5 feet 8 inches tall and the set is twisted about 25 degrees then the distance between vertical antenna units measures about 16.5 feet. Since the spacing of the antenna

elements is one-quarter of the wavelength being searched, it can be calculated that this direction finder was tuned for listening to signals with wavelengths of about 66 feet, or 20 meters; the frequencies were around 15 megahertz (MHz).

SACO imported a large number of the newly invented Hallicrafters SX-28 "Super Skyrider" receivers, an AM/CW superheterodyne radio that received all frequencies from 550 kilohertz to 43 MHz. It could operate with power sources of 110-125 volts AC (alternating current) or 6-18 volts DC (direct current). The SX-28 receiver was used in the directional finders as well as in all the camps and communication centers throughout SACO.

> . . . [T]he first hundred students we had trained at Happy Valley were already at work for us. One of their earliest and most important tasks was to catch the spies who were informing the Japanese about the flights and destinations of General Chennault's planes when they took off from Kunming.
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> When Lieutenant Colonel B. T. (Banks) Holcomb, U. S. Marine Corps, arrived in May 1943, to take charge of our radio intercept work, he told us that he could trace a flight of Chennault's planes from Kunming all the way to the selected target by the stations that went on the air to report them to the Japanese. He promptly went to work on ways to track down these collaborators . . .
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> (Miles, 1967, p 196)

Chief Radioman Wildman took a gang to Kunming. With two fixed DFs and one roving DF in a specially constructed wooden-bodied truck, they located many transmitters and then determined which probably were spying. General Lee, Gen. Tai's representative in Kunming, pounced on all five stations at once and captured 35 Puppet Chinese (Chinese working for the Japanese). After the crackdown, Chennault's planes met considerably reduced interference on their missions and sometimes arrived at their targets before the Japanese could get their defense fighter planes airborne.

> . . . [W]hen Buck Dormer, a radioman from Camp One, was commissioned as an ensign, we sent him to the 75th A.A.F. at Hengyang to join Lieutenant Harned P. Hoose who, as the son of missionaries, had learned Chinese as a child.
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> With a transmitter in Changsha and a small loop direction finder in a Jeep, they listened to the goings on. Hoose finally spotted repeated conversations about shoes—big shoes in big boxes and small ones in small boxes. It checked out as information that was being passed on the movements of the 75th A.A.F. fighters, and the source of the information that was being sent to the Japanese was the 75th fighter pilots themselves! Miles, 1967, p 309

Four DF units were set up in SACO training camps – Happy Valley, Camp One, Camp Four, and Camp Six (fig 1). One was built in the SACO facilities at Calcutta, India. And one was placed in Kunming alongside of, and adjunct with, Gen. Claire L. Chennault's 23rd Fighter Group which, in March 1943 became the 14th Air Force. Project One was completed in September 1944 with the opening of Camp Six-at-Hawaan.

Project Two (fig 1) added DF elements to Camp Four, Camp Nine (adjacent to, and east of, Happy Valley), and Unit Fourteen at Kunming. As well, stations were set up in Lanchow (now Lanzhou), Enshih (now Enshi), and Kienyang (now Jianyang) – home to a supply and distribution center and by year's end to be the headquarters for the Eastern China Command of SACO (COMNAVCHEC).

In October 1944, within the Camp Nine portion of headquarters, a new direction finder complex was established. This included "a master control and three sub-masters, though we had to cut the top off a mountain so as to make a level space" (Miles, 1967, p 296). Sometime in late 1944, all direction finding activity fell under the direction of LCDR Reuel V. Robinson, the Staff Communications Officer.

The master control direction finder at Camp Nine was a DAB (fig 3) which was developed for the US Navy in 1942 by Collins Radio Company of Cedar Rapids, Iowa. The DAB was concealed in a double-floored, 24-foot square wooden building designed so that there was almost no effect on the signal bearing or strength; material for the building and suggested construction plans accompanied the instrument from the manufacturer. The instrument weighed 850 pounds. At the ends of the horizontal arms were vertical cross-connected loop antennas. In the center were two receivers and an oscilloscope which was used to measure the phase difference of the signals from each antenna in order to determine more accurately the direction, or bearing, of the source. Frequencies in the 2.0 to 18.1 MHz range could be received. The DAB was considered one of the most accurate direction finders in production; the accuracy was reported to be plus-or-minus one degree of arc.

At the SACO conventions, especially the one in 2010, Kenneth Brown described some of his experiences with operating a direction finder station in China. Radioman First Class Brown arrived at the "White House" south of the Happy Valley main camp in March 1944. Someone asked if he could drive a 6 X 6 and then "they" volunteered him for a convoy to somewhere. As soon as he finished his medical and dental checkup at the infirmary, which was attached to the southwest corner of the Happy Valley mess hall, they started on the road. Kenneth Brown recalled driving through "Canjo" (Kanchow) and on to "Jingyang" (Kienyang) where he made radio contact with headquarters and was ordered to pick a site and set up his direction finder station.

Figure 3. DAB direction finder in the Camp Nine portion of Headquarters near Chungking (Miles, undated, v 2, p 14).

Radioman first Class Brown had carried from Happy Valley an already made-up DF set, a replica of that in figure 2,. The receiver was a Hallicrafter SX-28 which was powered, through a converter, by six motorcycle 6-volt-batteries which he recharged with a jeep and later a charger. A surveyor came and aligned his station so that north really was north.

A team of two men normally staffed a DF unit. At Kienyang RM1c Brown was partnered with RM1c Samuel Stallworth, who handled the coding and transmission of their sessions. They normally worked at night. From 2000 (8 pm) to 0200 (2 am), Brown monitored the Japanese, often on frequencies designated by Happy Valley. The DF crews were issued a set of codes different from any used elsewhere in SACO. Brown coded his output each night by hand – direction, time, frequency, text – and handed that to his radioman who encoded it with the SACO coding machine, "a small metal box with some wheels that twisted around." By 0400 they had to report these intercepts to Mainradio in Happy Valley, call sign NKN. As it turned out, Stallworth came down with amoebic dysentery and was out of commission for about eight months. Radioman First Class Brown had to stand double duty during much of his tour at Kienyang.

During the evening of 8 October 1957, ADM Miles addressed the Naval Reserve Composite Company 3-6 in Chatham NJ. The talk was given without any script but it was recorded and later transcribed. The Admiral told of his experiences as Commander, U.S. Naval Group China. The SACO organization was not named but much of their activity was described. The following is what the admiral said about radio intercept and direction finders.

> Do I have a little time? I'd like to talk about communications a minute.
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> We had a big network there and we had continuous communication from Australia, Guam, and the U.S. Navy in Washington and San Francisco with just perfect communications. We had some radio direction finders which were wonderful. Those radio direction finders were on the map and they could come up with a message and intercept a ship out at sea and could get a pretty good picture of a ship going in a certain direction. If he came up for as much as five or ten seconds in regular transmission, they could get that much.
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> Mostly homemade sets but they were beautiful rotation Adcock type with regular direction finder. They worked fine. They worked in conjunction with the Forward Unit of the 14th Air Force Command and the 69th Bomber Command which was sitting down there – waylaying part of the time and operational part of the time.
>
> But we had a group of Naval officers sitting down there occupying a little secret room and they would intercept the message. They would get the dope from the DF net. The message usually came from the Japanese merchantmen. They would see a swab handle somewhere and come up on the air and we would have a periscope. These people would use the Japanese simple code for translation and we would have it decoded in a matter of seconds.
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> We would take it over to CDR Vincent at the Bomber Station. We would say, "There is a Japanese ship down there." He would always have his three bombers

ready and we would take off from this small place and go out there and sink the ship. We were favored with a hit on that almost in every case. You know how easy it is to claim you have done something and there is no one to say you did or you didn't.

We'd listen in on this thing, at the 69th Bomber Command on our direction finder sets down there and we could hear this Japanese ship scream to high heaven that there were airplanes coming over there and that they were being bombed. Most of the time they would go off the air, meaning they were disabled or sunk, but sometimes they would say "OK, the three bombers are going back and we got some fire we're putting out and we are heading for Keelung or some place."

We'd have a message over to CDR Vincent saying, "The three bombers came close but they didn't sink it and the ship is headed for Keelung"and he'd be out there with fire in his eyes personally when the bombers came back to claim that they had sunk the ship and he'd say, "Get your bombs back in and you go back and you do it again."

We had a good liaison. That was a communication method that was really perfect.

Miles, 1957, p 21-23

There are no available data concerning the number of ships sunk or enemies killed as a result of intelligence collected from the direction finders operated by SACO. As ADM Miles mentioned in his 1957 speech, above: "You know how easy it is to claim you have done something and there is no one to say you did or you didn't." General Tai Li and COMO Miles were so convinced in the usefulness and effectiveness of DFs that SACO ultimately established a network of nine radio direction finder stations in the Far East (fig 1).

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Charles H. Miles, Ph.D.
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