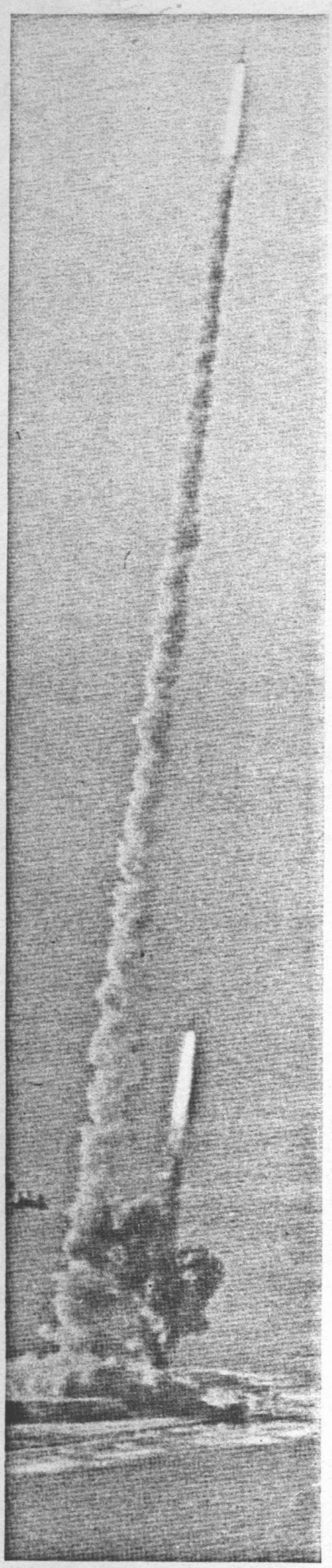


RESEARCH AND DEVELOPMENT AT BELL LABORATORIES

Kwajalein Field Station

















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Kwajalein Field Station

October 1975

prepared by Bell Laboratories
on behalf of Western Electric
Whippany Road, Whippany, N. J. 07981
for U. S. Army Ballistic Missile Defense Systems Command
under Contract DAHC60-71-C-0005

PREFACE

This is the story of the Kwajalein Field Station — the island itself, the people who worked there, the way they lived, and the job they did. Perhaps it can be best summarized by saying that the Kwajalein operation was the most complex field-test program that Bell Labs has ever been called upon to manage. Such a program — with all the associated problems of logistics, transportation, and installation — at a remote island 8000 miles from home could not have been accomplished by Bell Labs without the wide range of support, expertise, and manpower provided by Western Electric. Throughout the 15 years of test operations with seven changes in Bell Labs Technical Directors and WE Managers, a tightly integrated Bell System team was maintained on the island to work with our various development subcontractors and Army agencies. Many people tend to regard the Kwajalein test operation as a supporting part of the tactical SAFEGUARD deployment in North Dakota. We look upon our contribution at Kwajalein from a much broader viewpoint, namely, the operation of a viable and sophisticated R&D testing base in support of both offense and defense programs to keep the United States in the forefront of a rapidly developing new threat technology.

C. A. Warren
Executive Director
SAFEGUARD Division

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THE KWAJALEIN EXPERIENCE

This volume represents an attempt to preserve the highlights of 15 years of life and work at Kwajalein Field Station. There are good reasons for this effort. Bell Laboratories will probably never again establish a facility in so exotic an area. The mission, management, and organization of Kwajalein Field Station have also been unique from the start, and may well remain so throughout Bell Laboratories' history. The Kwajalein experience, finally, remains an unrivaled highlight in the careers of hundreds of Bell System employees—and in the lives of their families as well.

Of primary interest are the technical objectives that formed the Field Station's charter over the years. On Kwajalein, though, as anyone who goes there quickly discovers, working life and social life are often difficult to distinguish. Thus, we have examined not only the work undertaken, but the character of island life as well.

By any conceivable standard, the Kwajalein experience was an extraordinary one. From a project standpoint alone, an assignment there had to be exciting. In a defense program broadly



Kwajalein

concerned with what is referred to as the "unthinkable," many people worked exclusively with hypothesis and prediction—except at Kwajalein. In the BCB* or MICB,† or wherever else one happened to be at mission time, the countdowns were real, the engagements were live, and the results—far from being theoretical—were concrete and clear.

Working on a mission, or simply witnessing one, brought the gravity of the ICBM‡ threat and the complexity of the ABM** challenge vividly to life. Pressure was intense at times, the hours were long, and two-day weekends were luxuries for many. For most, however, successful missions were compensation enough, and that sort of reward came often during Field Station history. Through NIKE-ZEUS, NIKE-X, SENTINEL, and SAFEGUARD, Kwajalein was the remote but critical spot where components were checked, systems were integrated, and concepts were proven. On more than one occasion, what once was thought technically impossible was clearly and convincingly demonstrated.

The life? It is impossible to communicate the flavor of island life to someone who never experienced it, though Kwajalein veterans have earned reputations for trying. Life on Kwajalein has no valid parallel in stateside life, and opinions about it are as numerous as the people who went there. It is true to say that most people liked Kwajalein very much and adapted to life there quite readily.

But there were serious drawbacks. The great distance, the confinement, and the "small town" atmosphere were new experiences for most, and they bothered almost everyone at one time or another. There was no television to watch and only one radio station, shopping and entertainment were limited, and there was never enough news from home. Finally, there was no chance to jump into a car and drive away from it all.

There were blessings, however—more than enough to dispel the symptoms of "rock fever" whenever they began to set in. Where else but Kwajalein, for example, did people get to work by bicycle (or airplane) without the unnerving hassle of daily traffic? Where else could they sit by a palm tree and watch free movies every night? Where else could they get most anything fixed by simply dialing a Trouble Desk? Where else could they buy Japanese cameras, Hong Kong jewelry, and American appliances usually less than stateside cost? Where else could they find so much to do so conveniently and so inexpensively? And where else were swimming, shelling, sailing, diving, flying, softball, vollyball, tennis, bowling, and other forms of recreation available for the asking?

Then, too, Kwajalein was a priceless experience in life. The travel alone, it has been argued, made the assignment worthwhile. Most families traveled thirty or forty thousand miles during their tours of duty, becoming routinely acquainted with the West Coast, Honolulu, and the outer islands of Hawaii. Many also used Kwajalein as a point of departure for vacations to the South Seas, Australia, New Zealand, and the Far East. In the long run, those who enjoyed Kwajalein miss still more as time passes by—the clean air and clear skies, the casual dress and simple daily routine, bike rides and reefing, Emon Beach on Sunday afternoon, and the sunsets over Carlson Island each evening.

In a still larger sense, the lay of the land and sea offered unmatched beauty and serenity. Gleaming sands, foaming surf, and stunning skies provided a setting that almost demanded deeper examination of one's purpose in life. This, too, was an unforgettable part of the Kwajalein experience for many. "Living on a spot of land under stretches of sky that reach on every side to a far horizon does indeed inspire new perspectives," wrote one observer, "and priorities tend to rearrange themselves."

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*BCB, Battery Control Building
†MICB, Meck Island Control Building
‡ICBM, Intercontinental Ballistic Missile
**ABM, Antiballistic Missile



Memories

Kwajalein Field Station will soon close, as the Bell System steadily reduces its twenty-year effort in ballistic missile defense. Thousands of people have devoted the better part of their working lives to the effort. The result, the SAFEGUARD System in its present form, incorporates developments in missiles, radars, and computers undreamt of when testing began 15 years ago at Kwajalein. Though much has changed on Kwajalein, the Field Station's mission – to validate the system concept itself and support the test range—remained essentially unchanged throughout, and its contributions have been consistently vital.

Laboratory 656, Kwajalein Field Station, will be one of the last SAFEGUARD centers to disband. Its passing means much more than a routine organizational change, not only for Bell Labs, but for thousands of employees from many companies who will remember Kwajalein Field Station as a unique organization with a special mission in an extraordinary part of the world.

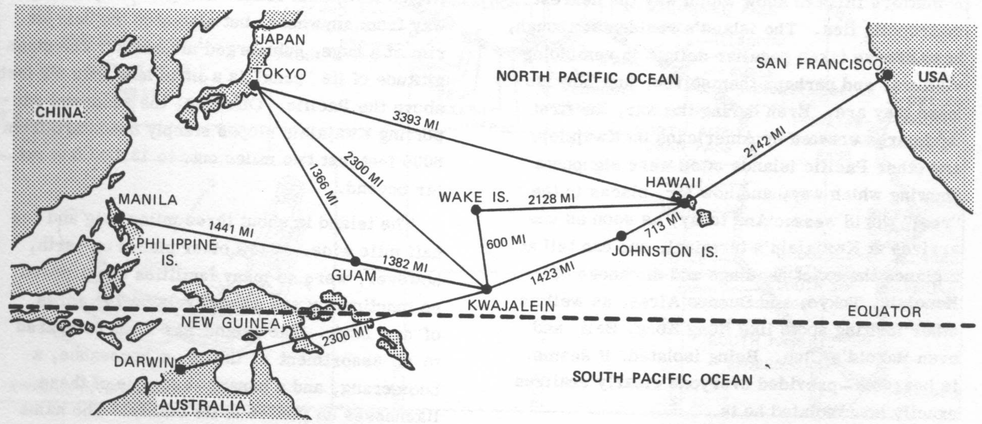
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A LONG WAY FROM ANYWHERE

Kwajalein—Where's That?

For those assigned to Kwajalein, one of the first challenges that presented itself was finding the atoll on a map of the Pacific. Kwajalein is the largest island in the world's largest atoll. This distinction, duly recorded in the Guinness Book of World Records, was one of the first things people going there were told. More obvious, however, is its remoteness. The world's largest atoll has only 6 square miles of land. Surrounding it are 64 million square miles of sea. Kwajalein's isolation is not easy to comprehend, and even seasoned travelers in that part of the world are stunned by the atoll's remoteness.

Finding Kwajalein on a map means scanning the Pacific, covering about one-third of the earth's surface. From north to south the Pacific reaches 8500 miles from the Aleutians to Antarctica.



Pacific Ocean, Showing Kwajalein (Distances in Nautical Miles)

From east to west it stretches 10,500 miles from Central America to the Celebes Sea. The Trust Territory of the Pacific Islands lies in the west central Pacific. This area, known as Micronesia, is only a small section of the Pacific, but it contains three million square miles of ocean—enough to cover the continental United States. However, Micronesia's three island groups—the Marianas, the Carolines, and the Marshalls—contain little more than two-thirds the area of Rhode Island. Kwajalein, one of 33 islands and atolls in the Marshalls, is one of 2,100 islands and atolls in Micronesia, and only one of the 10,000 or so sprinkled over the Pacific. Its latitude is about eight degrees north, its longitude is 167 degrees east.

Kwajalein is near nothing—at least nothing that sounded vaguely familiar to people back home, so describing its whereabouts often amounted to saying how far Kwajalein was from everything else. The atoll is roughly equidistant from Hawaii, Japan, and Australia, with Honolulu, Tokyo, and Darwin lying some 2500 miles to the northeast, northwest, and southwest, respectively.

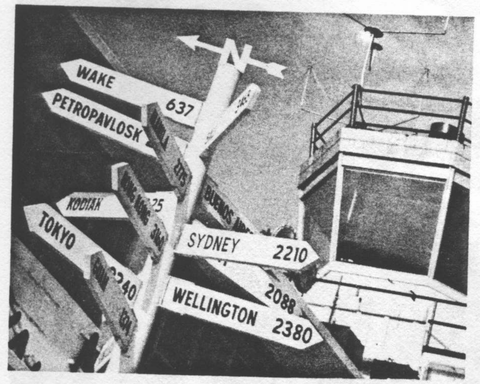
Distances are meaningless in such a setting, where jet hours, not mileposts, are casually measured by the Pacific traveler. On Kwajalein, it matters little to know which way the nearest metropolis lies. The island's residents, though, have always taken peculiar delight in reminding visitors, and perhaps themselves, just how isolated they are. Even during the war, the first landmarks erected by Americans on Kwajalein and other Pacific islands often were signposts showing which way, and how far, places in the "real" world were. And today, as soon as one arrives at Kwajalein's terminal, one can tell at a glance the exact headings and distances of Honolulu, Tokyo, and Buenos Aires, as well as other inviting spots like Hong Kong, Bali, and even Harold's Club. Being isolated, it seems, is bearable—provided everyone clearly realizes exactly how isolated he is.

The atoll itself is vast and strikingly beautiful. From the air, the islands look like a bright green necklace against a backdrop of endless blue. Closer in, the ribbon of reef connecting the islands comes into view, and near it the drop-off is visible, where ocean depths plunge steeply and the Pacific turns abruptly from incredible turquoise to incomparable blue.

In shape, the atoll looks a little like Florida. Kwajalein's 90-odd islands enclose a lagoon of nearly one thousand square miles, ranging in depth from 120 to 180 feet. Only two islands approach Kwajalein in size—Roi-Namur, 50 miles north, and Ebadon, 75 miles northwest. These three larger islands claim nearly half the dry land in the atoll. Most of the other islets are much smaller, and some are occupied by the native Marshallese. From Kwajalein island itself, fewer than a dozen islets are visible even on the clearest days. The rest lie beyond the horizon.

For all practical purposes, the island was not only home, but the entire world, for those who lived there. Though few cared to dwell on the subject, many realized that Kwajalein, like most coral atolls, is probably a volcanic mount whose coral superstructure, reef, and islets, barely break the surface of the sea. So life on Kwajalein means living not only a long way from anywhere, but also atop the narrow rim of a huge, submerged mountain. The mean altitude of its "peak" is a little less than six feet above the Pacific. Offshore, the seamount supporting Kwajalein slopes steeply downward from 6000 feet just two miles out, to 13,000 feet not far beyond.

The island is about three miles long and one half mile wide. In few other places on earth, however, were so many facilities compressed so functionally and attractively on 741 acres of dry land. The island has been compared to an assortment of things—a horseshoe, a boomerang, and a banana—but none of these likenesses do justice to its beauty. The name

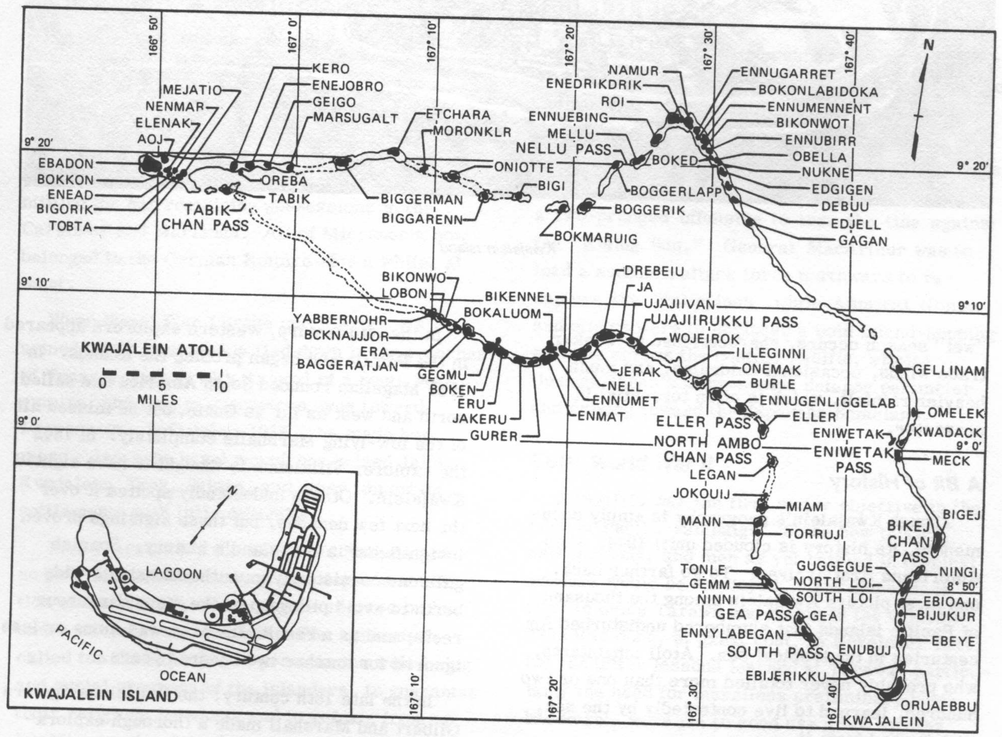


Guidepost, Kwajalein Air Terminal

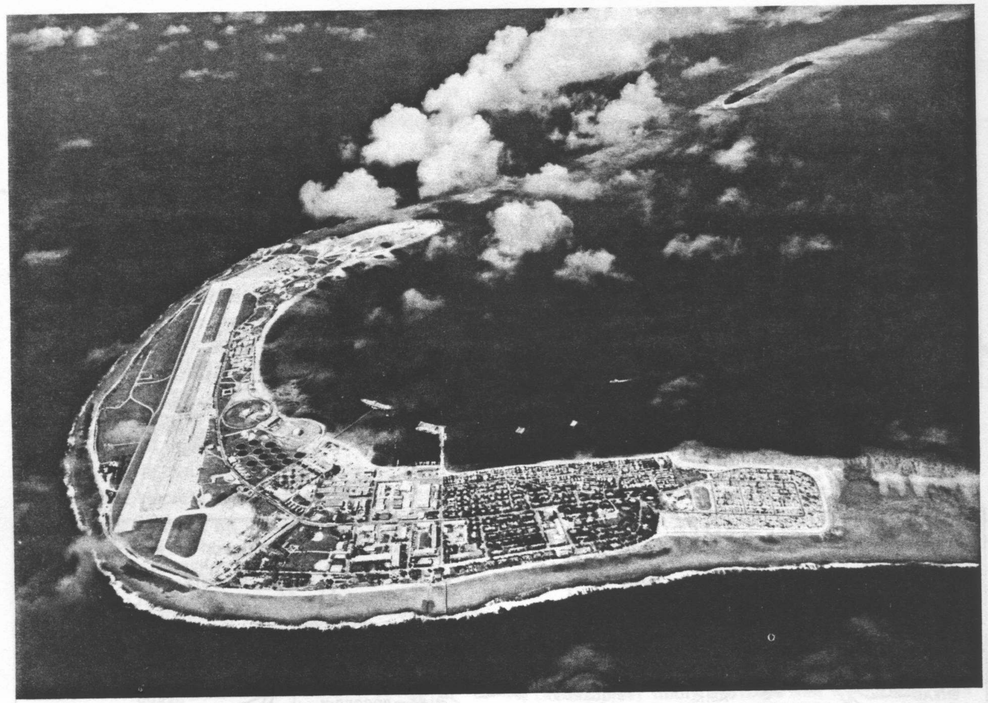
itself does. "Kwajalein" is a combination of two Marshallese words, "Kwoje" and "leen," meaning an "abundance of material and spiritual blessings."

The climate is one of them. Kwajalein's weather is endless summer—the average temperature is about 84 degrees; the average humidity is about 80 percent. The island is fanned by the northeast tradewinds, which average about 15 mph, and thus cool the island much of the time.

Rainfall averages 100 inches annually, but yearly totals vary considerably from that mean. Mid-December to mid-May, the so-called dry season, has light, sporadic rainfall and strong tradewinds. From June through December a



Kwajalein Atoll



Kwajalein Island

"wet" season occurs, characterized by weaker trade winds, occasional doldrums, and much heavier rainfall, which is often torrential in character.

A Bit of History

Though Kwajalein's geography is amply documented, its history is clouded until 1944, when Americans first arrived. To go farther back, one must picture Kwajalein among the thousands of Pacific islands that slumbered undisturbed for centuries in the tropical sun. Atoll inhabitants, who probably never totalled more than one or two hundred, learned to live contentedly by the sea, with it, and from it.

In the 16th century, Western explorers appeared in the Pacific and began probing the islands. In 1520 Magellan rounded South America and sailed north and west as far as Guam, but he missed all of the low-lying Marshalls completely. In 1542 the explorer Villalobos is thought to have sighted Kwajalein. Others undoubtedly spotted it over the next few decades, but these sightings proved insignificant in the island's history. Spanish galleons consistently gave the Marshalls wide berth to avoid piling up on the many dangerous reefs, and as a result, the area was more or less ignored for another two hundred years.

In the late 18th century, the British navigators Gilbert and Marshall made a thorough exploration of the area, and gave their names permanently to two of its larger island groups. Not long after, traders and whalers from England, America, Russia, Germany, and elsewhere came in force. Missionaries came in great numbers and enjoyed great success. Missions were established as early as 1857 at Ebon in the Marshalls, but none appeared at Kwajalein until 1892.

In 1874, alarmed by Germany's growing political and commercial power because of its thriving copra trade, Spain formally proclaimed her sovereignty over the Marshalls. The Germans, however, continued to press their program of colonial expansion, gaining the support of the Kabua family, the most powerful in the Marshalls. In 1885, Germany concluded a treaty with Kabua that effectively established its protectorate over the Marshalls. Spain was forced to recognize this claim the following year, and German warships began sailing unchallenged into the harbors of Jaluit, Majuro, and Kwajalein.

In 1899, after defeat in the Spanish-American War and the loss of Guam and the Phillipines, Spain quickly accepted a German offer of $4.5 million for her remaining possessions in the Carolines and Marianas. All of Micronesia now belonged to the German Empire—for a while, at least.

When World War I broke out, Germany's armed might was quickly tied down in the trenches of France. Japan, with its goal of a South Seas empire, had long cast covetous eyes toward Micronesia. In October 1914, she made her move. Japanese naval squadrons seized Jaluit, Kwajalein, Truk, Saipan, and other important settlements with little difficulty.

Five years later, the League of Nations had no practical choice but to accept Japan's annexation of the islands, which were conferred on her under international mandate. The agreement called for the Japanese to promote the well-being and social progress of the islanders, to guarantee their religious freedom, and to refrain from using Micronesian islands as military bases.

For a time Japan fulfilled the stipulations of the mandate quite conscientiously. Under an intensive program of agricultural and commercial development, the islands prospered economically as never before. But in 1935, Japan withdrew from the League, closed the islands to foreigners, and began fortifying them for military use. In the late 1930's and early 1940's, airstrips, cargo piers, bunkers, pillboxes, seawalls, and tank traps appeared in increasing numbers on Kwajalein, Mili, Wotje, Jaluit, Maloelap, and other atolls in the Marshalls.

By December 7, 1941, Kwajalein was ready to fulfill an important role in the initial strikes against the United States. The submarines that attacked Pearl Harbor and the task force that assaulted Wake Island departed from Kwajalein's lagoon.

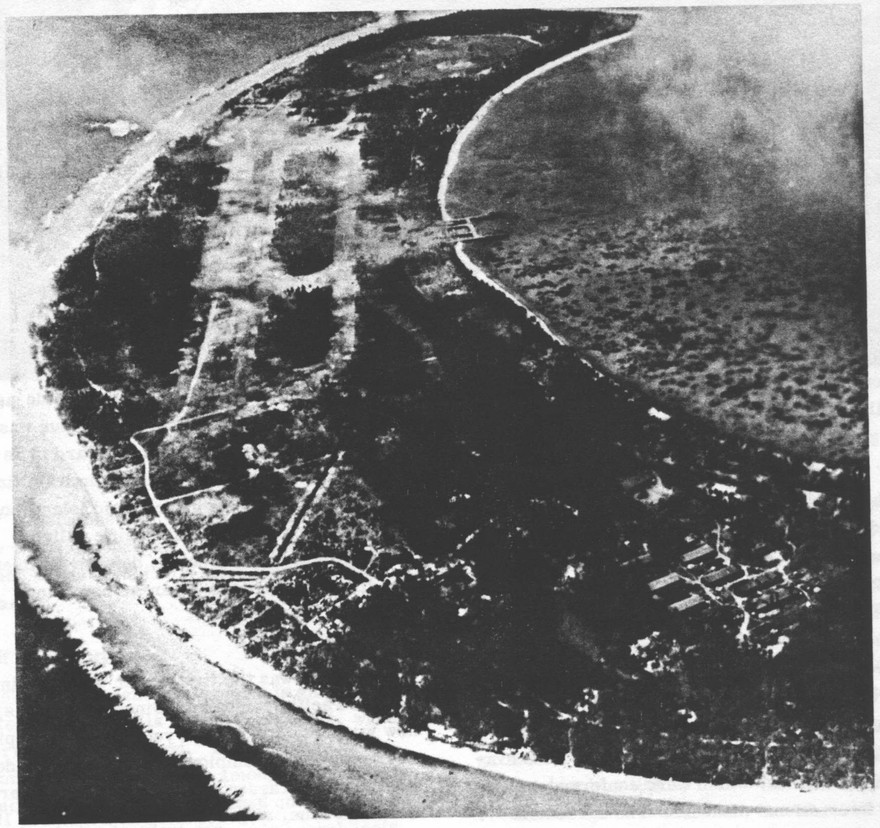
The United States soon suffered a crushing series of setbacks in the central and western Pacific, culminating with the fall of the Philippines. By the end of 1942, however, critical battles in the Solomons and at Midway checked further Japanese expansion. American strategists then planned a two-pronged offensive to turn the tide against the "Rising Sun." General MacArthur was to lead a southern attack force northward to recapture the Philippines, while Admiral Nimitz and others were to engineer a bold island-hopping advance across the central Pacific, slicing through Japan's Micronesian defense perimeter and driving toward the Japanese homeland.

Enter World War II

Kwajalein was the first major objective in the central Pacific campaign. Since new tactics, new weapons, and men as yet untried in tropical warfare would be employed, plans were made first to seize Tarawa and Makin in the Gilberts. This was done, at great cost, in November 1943, but the bitter lessons learned at Tarawa, particularly the need for merciless preliminary bombardment, were put to good use a few months later at Kwajalein.

Early on the morning of January 31, 1944, the 7th Army Division and the 4th Marine Division stormed the beaches at Kwajalein island and Roi-Namur, the key Japanese naval and air bases in the Marshalls. The attack caught the Japanese off balance. A strike in the Marshalls had been expected—but not at Kwajalein. Most Japanese predicted the assault at Jaluit, Mili, or another strongly fortified atoll closer to the Gilberts. Nimitz, however, had wisely decided to "leap-frog" and isolate all but Kwajalein itself.

In any event, the 10,000 Japanese on Kwajalein—of whom only 30 or 40 percent were combat-trained—had no hope of stopping the onslaught. With Japanese air power at Roi-Namur knocked out and the Imperial Fleet bottled up in Truk, the garrison at Kwajalein was left to face the greatest armada ever assembled.



Kwajalein, Reconnaissance Photo, January 31, 1944. Note Airstrips, Tank Trap. Invasion Began on West End of Island, at Top of Picture.

Just before H-hour, wave after wave of American fighters and bombers strafed and bombed Kwajalein without let up. Then, some 200 warships took position around Kwajalein and Roi-Namur and methodically rained 15,000 tons of explosives on the two tiny islands. Yard for yard, it was the most thorough plastering any target in the entire war was to take, and was never again equalled in volume or in intensity.

The results were devastating. "Kwajalein," said one observer, "looked as if it had been picked up to 20,000 feet and then dropped." At one point just before the landings, two shells per second exploded on Red Beach. A sizable percentage of the defenders were killed before the invasion began, and the landings themselves were so well coordinated, particularly at Kwajalein island, that the 7th Division put 20,000 troops ashore without the loss of one life. It was a far cry from the Gilberts, where hundreds of Marines fell long before they reached the beachhead.

The Japanese cause on Kwajalein was a hopeless one, but it was one that they did not abandon. The defenders had no air cover nor naval support, no armor nor artillery to speak of. The Marines swept to the north shores of Roi-Namur in a little over 24 hours, but on Kwajalein island, resistance was fierce. After seizing nearby Enubuj (Carlson Island) as a base for field artillery, American troops pushed inland on February 1 to the area where the Joint Technical Operations Building—the future home of the Field Station—would eventually stand. On February 2, they advanced to a line joining today's ZAR* complex and the scout camp. The third day's advance, by far the bloodiest, carried through blinding smoke and mountains of rubble to Echo Pier and the "downtown" area. Late on February 4, resistance finally broke under repeated attack by ground, air, and naval units. The American flag went up late that day on a battered Japanese gun emplacement very close to the spot where the Field Station's Directors would make their home. On the following day, Ebeye and the other islands of the atoll were secured after brief but spirited struggles with small bands of Japanese.* The atoll was the first of Japan's prewar territories to fall in combat.

American casualties were surprisingly light. Several hundred Marines and GIs lost their lives in the operation, but these casualties were less than one percent of the troops committed. The Japanese garrison was totally destroyed. Operation "Flintlock," as the invasion of the Marshalls was called, was a classically successful amphibious assault, masterfully planned and ably executed. Military historians have recognized the importance of the battle for Kwajalein. Kwajalein was soon overshadowed in the public eye by more climactic struggles at Saipan, Iwo Jima, and Okinawa, but students of American strategy have consistently pointed to Kwajalein as the critical first move in the offensive that eventually brought the war in the Pacific to an end.

The battle of Kwajalein touched many lives. Tens of thousands of servicemen took part in the operation, and thousands more passed through Kwajalein on their way west to other islands and other battles. Some of them would later work at Bell Laboratories, and at least a few (who could have hardly guessed it at the time) would return to the atoll years later to work at Kwajalein Field Station.

Those who visited Kwajalein in 1944 include E. H. Gill, who landed with a Joint Assault Signal Company on the west end of Kwajalein island;

*ZEUS Acquisition Radar

*It was not until June 1948, however, that the last shots were fired in the fight for Kwajalein. At that time, nearly four and one half years later, 28 United States Marines from Kwajalein were sent to North Gugeegue to investigate reports that a Japanese straggler was holed up there and was firing at Marshallese venturing into the area. The reports turned out to be true—the Japanese straggler was found in an underground dugout. He fired on the Marines, was wounded, and died on the way back to Kwajalein.



Action, Kwajalein Island, February 1, 1944



Main Street, Kwajalein, 1944



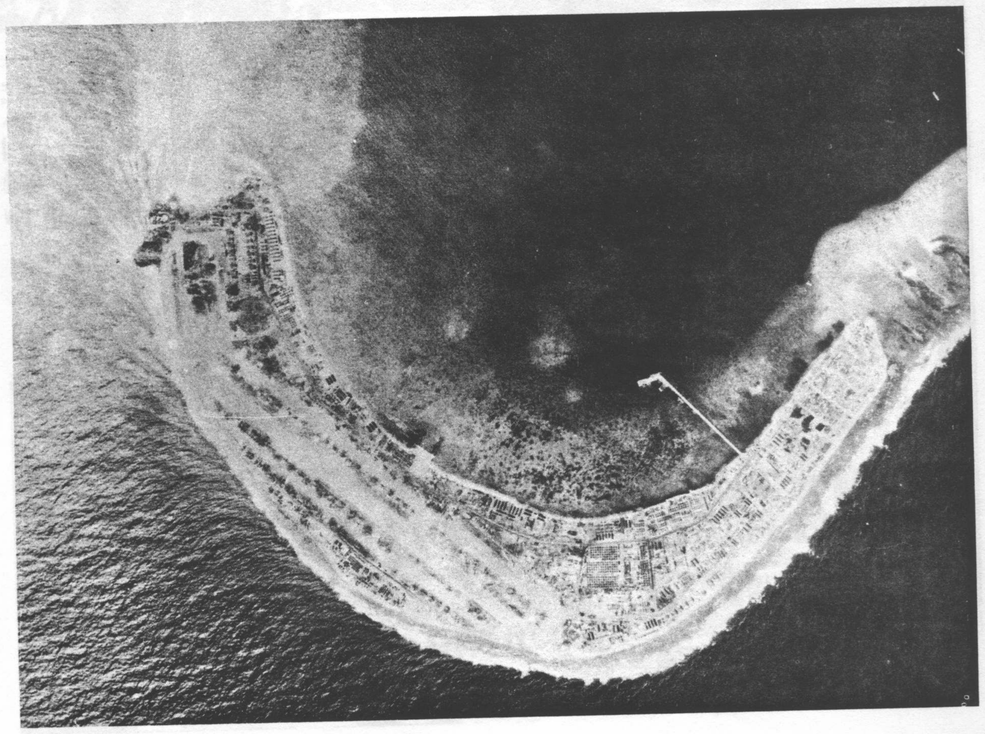
The World Learns of Victory at Kwajalein, February 1944

W. B. Hood, a Navy radar technician on Ebeye who later returned to the Field Station from 1966 to 1968; H. J. Treon, who flew attack/photo reconnaissance missions at Kwajalein as a naval aviator and joined the Field Station about twenty years later; and E. A. Alger, stationed at the Navy's hydrophone monitoring outpost on Bascome Island (now known as Meck), who returned to Kwajalein in 1961 for NIKE-ZEUS testing and worked on the Meck System for many years thereafter. Not surprisingly, there is unanimous agreement among these veterans that Kwajalein was far more "livable" the second time around.

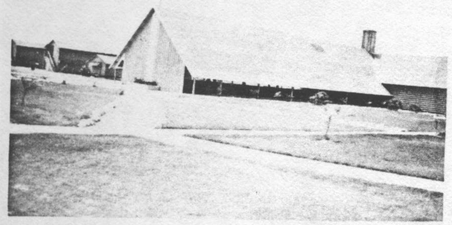
After the battle, yawning bomb and shell craters pock-marked Kwajalein, and one observer claimed that 100 pounds of shells and bombs had plowed into every square foot of coral soil. No vegetation worthy of the name survived.

Seabees began bulldozing and grading the island. They reconstructed the pier, completed the airfield, and quickly turned Kwajalein into a major air and naval base. Quonset huts, supply and ammunition dumps, and other installations covered Kwajalein from end to end, and the soldiers, sailors, and marines stationed there kidded one another about "rock-fever." At Roi, local color included a sign proclaiming, "Weep Namur," and posters at the Atoll Lodge decried the sorry plight of its guests: "No Liquor Atoll–No Women Atoll."

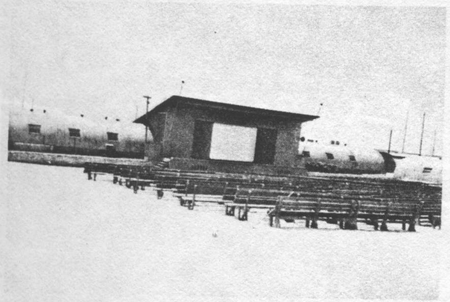
In 1945, Army and Navy personnel constructed the Island Memorial Chapel on Kwajalein, a



Kwajalein After Battle, 1944



Memorial Chapel, Kwajalein, 1945



Richardson Theater, 1945

building that would remain the most attractive on the island and by far its best-loved landmark. Before the war's end, other familiar structures went up, including the C. O.'s home, the Ocean View Club, and the Richardson Theater (named for the Army general who directed training for the invasion). Even in 1945, island residents trooped nightly into the "Rich" for the 7:30 show. "As regularly as the men attend outdoor movies," wrote a reporter, "they bring their ponchos or raincoats. Tropical downpours come often." Raincoats and umbrellas would always be standard equipment for a night "under the stars" at the Rich.

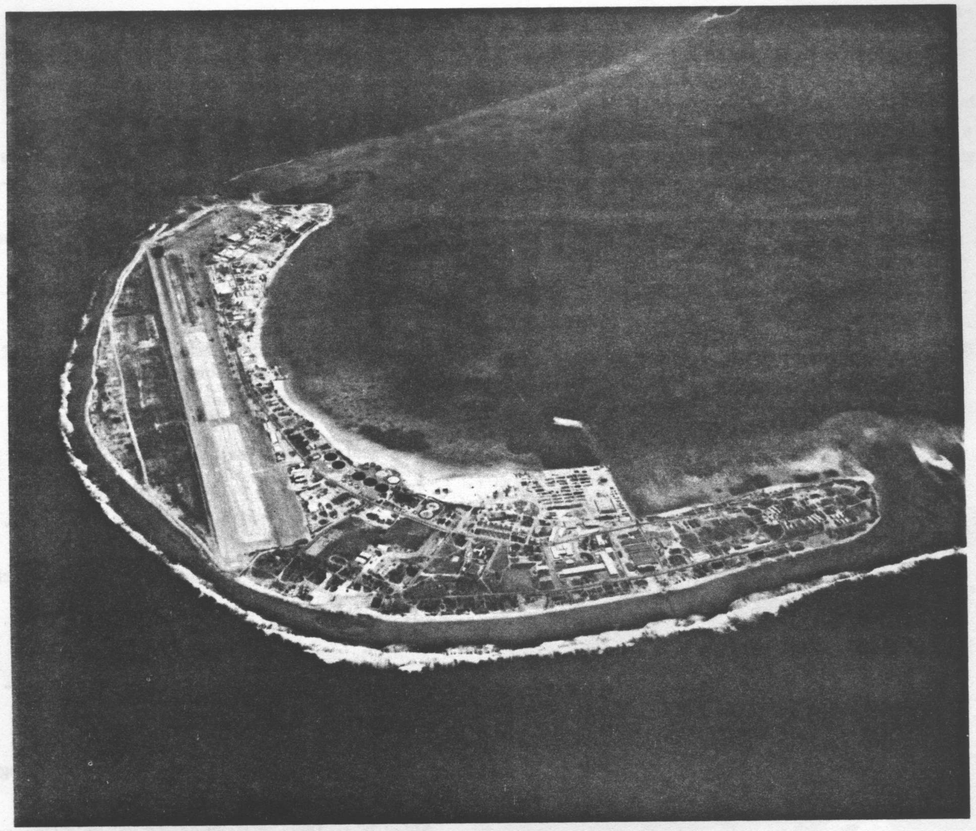
Operation Crossroads and Postwar Growth

After VJ Day, the Navy decided to retain Kwajalein and several other islands as bases. As thousands of troops again passed through Kwajalein, this time heading east and home, the Navy assumed responsibility for civilian administration. It was not long before the island started growing. In 1946 the Navy completed the first of many landfills that would eventually nearly double the island's size. The first operation added 200 yards along the lagoon shore, mostly near the marina, southwest of Echo Pier. In 1946 Kwajalein also acquired a most unlikely war relic–the German heavy cruiser "Prinz Eugen." How she came to rest at Kwajalein is a complicated–but interesting–tale.

In 1946, Congress authorized the testing of atomic weapons at Bikini Atoll in the Marshalls. Two blasts were planned in an effort to evaluate the vulnerability of naval vessels to atomic attack. Since the Atomic Age had brought mankind to a critical point in world history, humanity itself, it was felt, was "at the crossroads," and the Bikini tests became known as "Operation Crossroads." Over 40,000 scientists, technicians, and military personnel participated in the program, and many of them visited Kwajalein during preparation for the tests.

On July 1, 1946, a B-29 called "Dave's Dream" took off from Kwajalein with an atomic bomb in its belly, flew to Bikini and dropped the weapon on a carefully arrayed target fleet of aging warships from World War II. As hundreds of eyewitnesses watched, and millions listened by radio, the explosion rocked the little atoll and sent many of the ships to the bottom immediately. This was the "Able" blast, followed a few weeks later by the spectacular "Baker" shot, detonated underwater beneath a second target fleet.

The "Prinz Eugen," a 654-foot, 15,000-ton German heavy cruiser, was among the ships in both tests. The "Prinz" had helped the "Bismarck" sink the battleship "Hood" during the war, but her career otherwise had been luckless and

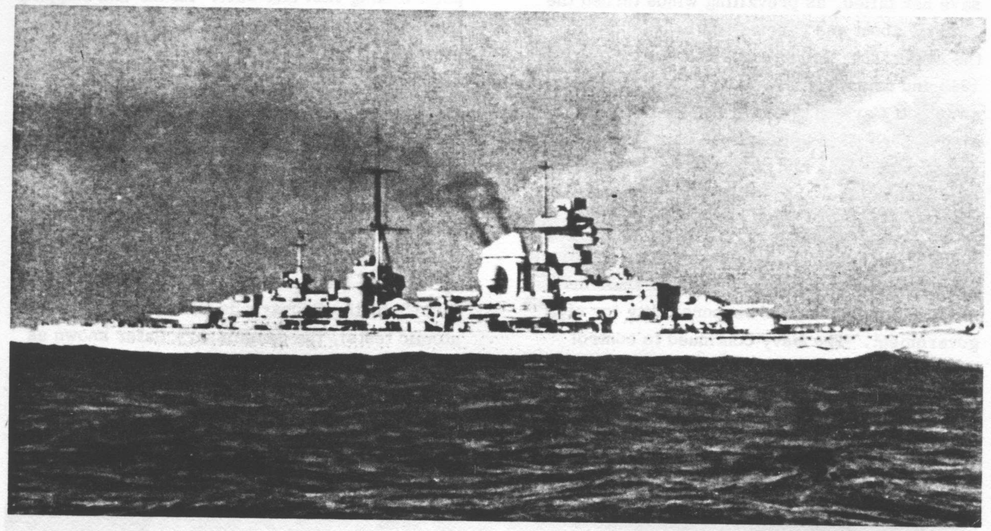


Kwajalein, 1953 (Note Landfill to left of Pier)

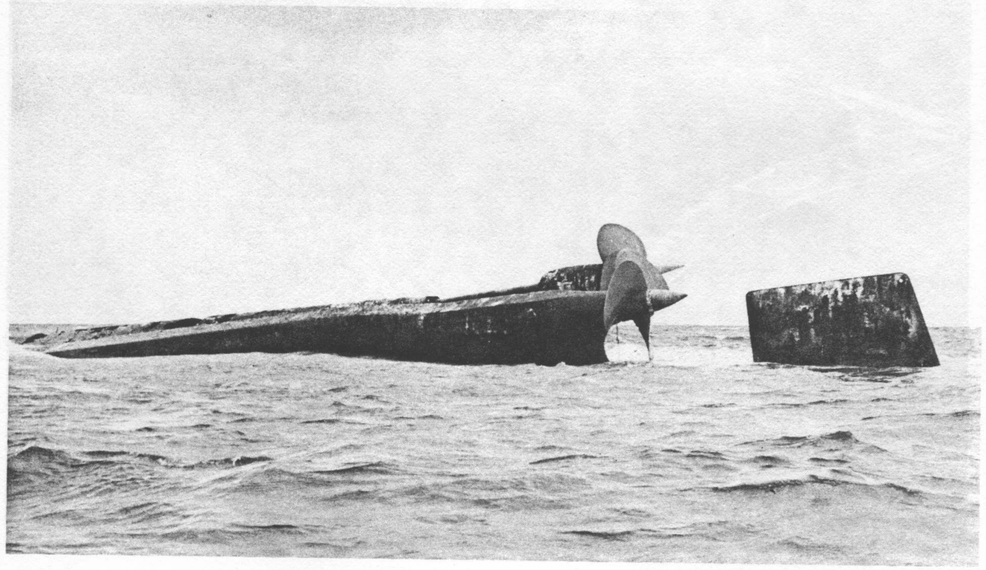
undistinguished. After the war, she was brought to Philadelphia, then taken to the Pacific and to Bikini to join the Crossroads flotilla. The "Prinz" was not particularly close to either blast, and survived both in style.

The "Prinz Eugen" and 50 other survivors of Bikini were subsequently towed to Kwajalein's harbor in the latter part of 1946. Among these ships were such famous fighting vessels as the carrier "Saratoga" and the battleship "Pennsylvania." The fleet rode at anchor for several months off Echo Pier, while inspection teams and decontamination squads studied the effects of blast and radioactivity.

On December 21, the "Prinz" began to take on water and list. All attempts to identify and correct the problem failed. Commodore George A. Seitz, Kwajalein's Commanding Officer (for whom the island's elementary school would be named), feared that the "Prinz" would sink and block the entire harbor, so he ordered her pushed across the lagoon and beached. The attempt to



"Prinz Eugen" on High Seas

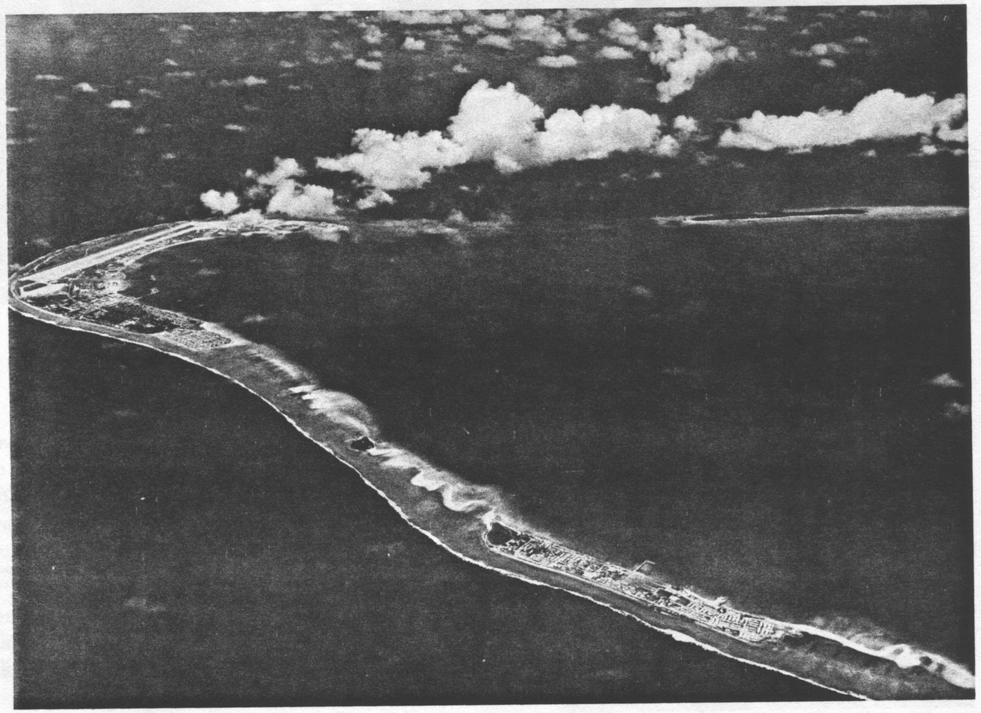


"Prinz Eugen" Capsized off Carlson Island

save her failed, as prevailing winds turned the "Prinz" about and carried her broadside onto the reef. The "Prinz" capsized on December 22, 1946 and remains there today, her rusted stern awash off Carlson Island. The "Prinz" has always been Kwajalein's most impressive war relic, despite the fact that she came to Kwajalein from another theater of war and met her end long after the fighting had ceased.

In 1947, Micronesia became a United Nations Trust Territory, and in 1951, the Department of the Interior assumed responsibility for civil government. The Navy continued to control Kwajalein and certain other bases in the Marianas. When the Korean conflict broke out, Kwajalein gained prominence as an important refueling, transportation, and communications point linking east and west. As air and shipping traffic increased, Kwajalein's native laborers, who resided at the southern part of the island, were moved to permanent quarters on Ebeye, four miles north. The beginning of Ebeye's "commuter" culture was at hand.

As increasing numbers of dependents joined naval officers and senior enlisted personnel, construction began on many of the facilities still in use today. Ten houses (31 family units) went up between 1951 and 1953, along with the Yokwe Yuk Club, the Crossroads Club (named for the atomic tests), the commissary (later known as Surfway), the fire and weather stations, the hospital, and the swimming pools. To accommodate bachelor personnel, the Pacific Barracks, Pacific Dining Room, and Surf BQ were erected.



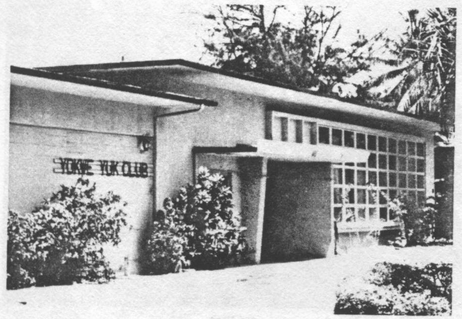
Kwajalein (left) and Neighboring Islands: Carlson (top, right) and Ebeye (below, right)



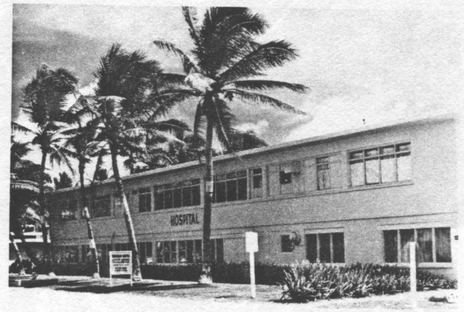
Navy-Built Family Housing



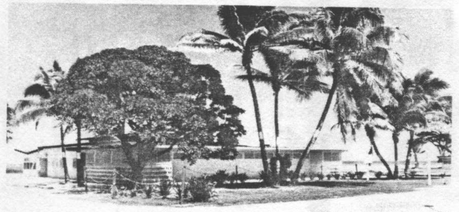
Surfway



Yokwe Yuk Club



Kwajalein Hospital

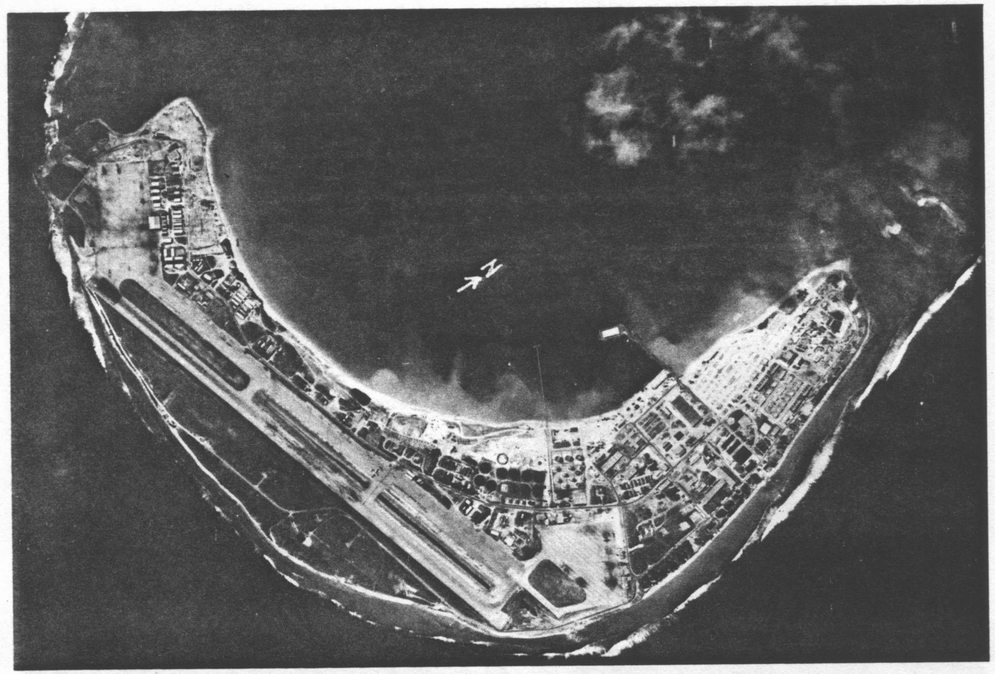


Crossroads Club



Dependents' Swimming Pool

Facilities on Kwajalein



Kwajalein, 1956 (Note Housing Fill north of Pier)

Telephone exchanges, power plants, and sewerage facilities were installed.

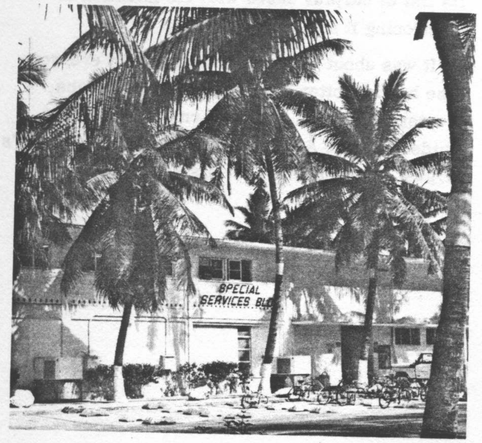
During this period, island residents were already reading the Hourglass, the daily newspaper named in honor of the 7th ("Hourglass") Division that captured Kwajalein during the war.* The school system opened in 1953 with two teachers, and Kwajalein began to look more and more like a community.

Between 1954 and 1956, with continued nuclear testing at Bikini and Eniwetok, Kwajalein flourished. A second landfill took place, this time north of Echo Pier and west of Lagoon Road, where 257 concrete block houses were construc-



Memorial Cross

*The Division's patch consisted of two sevens—one sewn right side up, the other sewn upside down and backwards. Together they formed the outline of an hourglass.



Special Services Building, Kwajalein

ted. A new air terminal also opened near the center of the island. Nearby, the memorial cross so often photographed went up in 1956 for the world's first Easter Sunday Sunrise Service that year. Also new were the Special Services building, the Yokwe Yuk Theater, several one-million-gallon fresh water storage tanks, the fuel farm and the fuel pier, a number of warehouses, and other structures for engineering and base support.

By 1957, with a halt in nuclear testing and the advent of longer range aircraft, Kwajalein had lost its importance as a Pacific crossroads. The Navy placed the island on caretaker status, employing it primarily for SAR* missions and occasional stops for transient aircraft and ships.

*SAR, Search and Rescue



Transient Hotel

The only structure completed during this period was the Transient Hotel, eventually renamed the Kwaj Lodge, which would host thousands of Bell Labs Field Station visitors. Otherwise, inactivity, lack of funds, and the corrosive marine climate began taking their toll. The island soon became an all but forgotten way station, and in 1958, the Navy placed Kwajalein on its list of surplus bases with the intention of abandoning it the following year.

It was about this time, when almost everyone else had forgotten Kwajalein, that Bell Labs, Western Electric, and the Army's Rocket and Guided Missile Agency decided to give the world's largest atoll a brand new mission and a brand new lease on life.

3

WHY KWAJALEIN?

The Ultimate Weapon

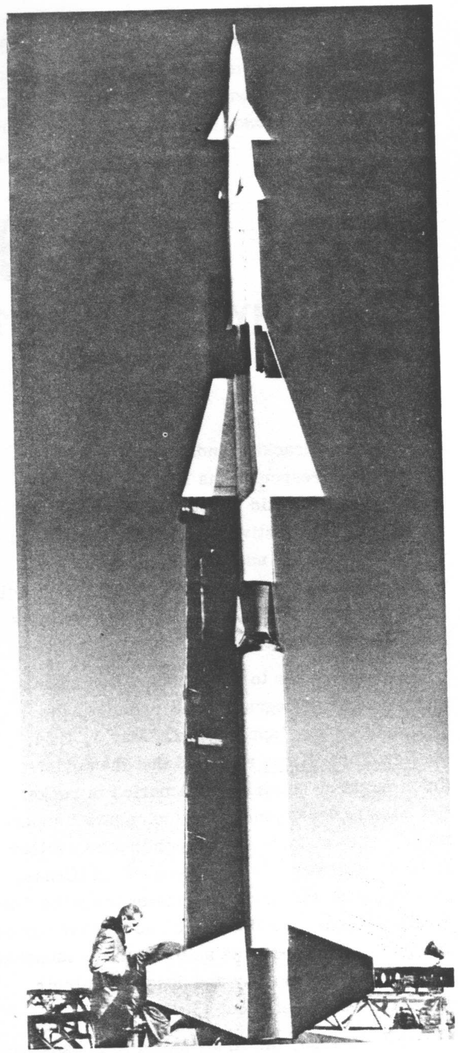
The antiballistic missile system tested at Kwajalein evolved from a series of air defense systems, developed by Bell Labs, which date as far back as World War II. After the war, the government asked the Bell System to begin research and development of a guided missile defense system against a new generation of strategic bombers capable of flying at far greater speed, and higher altitude than World War II aircraft.

The result was the NIKE-1 (later called NIKE-AJAX) system, employing the principles of command guidance first elaborated by J. W. Schaefer and others. The NIKE-prototype system (NIKE-0) was successfully tested at White Sands Missile Range starting in November 1951, with Bell Labs developing the system, radar, computers, and electronics, and Douglas Aircraft, under subcontract, overseeing the development of the missile itself.

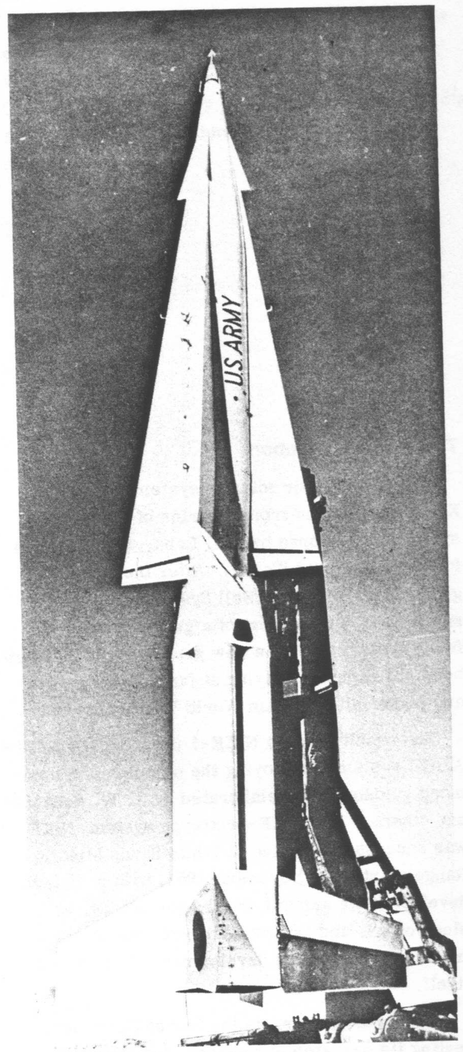
A few years later, as the Soviet Union began testing its own atomic weapons, the Department of Defense ordered deployment of NIKE-AJAX with all possible speed. As AJAX installations began dotting the countryside around America's major metropolitan areas, the government voiced concern in 1953 about further increases in the offensive capabilities of manned bombers able to confuse radar tracking and saturate AJAX defenses. The response was NIKE-HERCULES, a system which could employ atomic warheads and extend the effective range of air defense outward as far as 100 miles. HERCULES, too, was put through its paces at White Sands by Bell Labs, Western Electric, and Douglas, and was later widely deployed.

As these efforts to defend the nation against manned aircraft began to show promise, the "ultimate weapon" appeared. On May 5, 1954, the New York Times reported that the Soviet Union might be outstripping America in rocket and missile development, including new "supersonic" types capable of intercontinental nuclear strikes. The new missiles were called ICBMs, and the press was quick to christen them the "ultimate weapons," against which no defense seemed possible. ICBMs, it was said, might be launched thousands of miles away and descend on their targets at speeds of about 15,000 mph.

In March 1955, the Army asked Bell Labs and Western Electric to carry out an 18-month study of defense against future air threats, including ICBMs. The first status report on the system referred to as NIKE II was presented to Army ordnance at Redstone Arsenal on December 2, 1955.



NIKE-AJAX



NIKE-HERCULES

The final study results were presented to Lt. Gen. J. M. Gavin and the Army General Staff in October 1956. On November 15, NIKE II was officially named NIKE-ZEUS and on December 1, a contract for development work was awarded to Western Electric Company, the prime contractor, with Bell Laboratories responsible for systems design and development. Early in 1957, the scope of work was greatly expanded to include a complete NIKE-ZEUS R&D system and test program, which Bell Labs would plan and execute.

NIKE-ZEUS was expected to counter a threat far more sophisticated than any previously faced. ICBMs traveled 25 times faster than conventional bombers and had radar cross sections as little as 1/1000th of their size. The time available between detection and interception was critically short, and the probable use of offensive decoys further complicated the task. For NIKE-ZEUS, new radars would have to be designed, more complex computers would be needed, and the interceptor itself would have to be superfast and capable of operating within and outside the earth's atmosphere. It would take a system of enormous complexity, as well as unquestionable reliability, to present a plausible defense against the ICBM.

Though planning for NIKE-ZEUS had barely begun, the Soviet Union gave added impetus to the project when it announced, on August 26, 1957, that it had successfully tested an ICBM. Shortly after, Sputnik I went into orbit, and at no time since the early days of World War II did Americans feel more insecure. NIKE-ZEUS was given high priority in Washington.

Site X

Sites were selected for construction and testing of NIKE-ZEUS R&D facilities. At Whippany, a tracking radar and other facilities would be built. Another tracking station would operate on Ascension Island, in the Atlantic Missile Range, to study ICBMs launched by the Air Force from Cape Canaveral. At White Sands, components and subsystems would be tested, and shorter-range ZEUS atmospheric capabilities would be evaluated. On the West Coast, at Point Mugu in the Navy's Pacific Missile Range, ZEUS would undergo more demanding tests to measure its long-range and extra-atmospheric performance. Still to be found was a spot where the entire NIKE-ZEUS system could be installed and eventually pitted against real offensive targets. Since this one site had yet to be agreed on, it was temporarily referred to as "Site X."

In January 1958, Army planners, with the assistance of Bell Labs and WE, began shopping for a suitable location. The logical place to look was the Atlantic, where Antigua and Ascension were among the first islands considered. These locations, however, were not United States possessions, and their potential use for missile tests was thought to be too sensitive. Another spot would have to be found.

Attention then turned to the other side of the globe, to the Pacific. Planners pored over maps and studied data and photographs of a dozen Pacific islands and atolls. As the study progressed, Kwajalein Atoll in the Marshalls began to look more and more attractive, for a number of reasons. Kwajalein was not owned by the United States, but it had been under American stewardship continuously since 1944. Though it was remote, Kwajalein was still within a day's flying time from Hawaii, and Johnston Island, another possible test site, lay almost directly en route. Kwajalein's weather was also relatively stable – the atoll was in an area where tropical storms often originated but rarely struck. Most desirable of all were Kwajalein's existing facilities and its geographic location. Kwajalein already had an airstrip, a harbor, housing areas, schools, a hospital, merchandising facilities, and more. Additionally, Kwajalein was roughly 4800 miles from the West Coast, a range nearly ideal for testing NIKE-ZEUS against ICBM targets of opportunity to be launched from Vandenberg AFB.

There was naturally some concern over the island's small size. But when planners started comparing Kwajalein acre for acre with other communities back home, they realized that many



Whippany, Aerial Photograph



White Sands, Aerial Photograph



Sign Post and Anchor on Memorial Hill, Kwajalein Naval Station, Late 1950's

attractive towns in North Jersey – Bell Labs own backyard – had population densities of 8000 per square mile and more. With proper planning, it was felt, Kwajalein could accommodate both the technical facilities and contractor personnel necessary for the few years the test site was expected to operate.

On February 12, 1959, on the recommendation of Bell Labs, WE, and the Army Rocket and Guided Missile Agency, the Department of Defense approved a test program for NIKE-ZEUS at Kwajalein, with the sponsoring Army organization a tenant on the naval base. Plans called for a Kwajalein-Johnston Island testing complex, with Jupiter IRBMs* fired from Johnston toward Kwajalein. A year later, however, the Defense Department ruled that only Atlas ICBMs, launched from Vandenberg, would be used as target vehicles for NIKE-ZEUS. Work on Johnston Island was then halted.

WE, Bell Labs, and ZEUS subcontractors were going to Kwajalein. The island, as it happened, was about 12,000 miles from another NIKE-ZEUS test site, Ascension Island, in the Atlantic Missile Range. So for a few years at least, until operations on Ascension closed, WE and Bell Labs would send employees on assignment to two spots on almost opposite sides of the globe.

Early Journeys

By mid-1959, a little more than a year before the Field Station was to open, practically no one from Bell Labs or WE had visited the island. Project managers, anxious to inspect the new site, chartered a Pan Am DC-7, which touched down on Kwajalein on August 4. The 41 passengers aboard represented various Army agencies, Bell Labs, Western Electric, Douglas, and other subcontractors. C. A. Warren, who directed the overall project engineering effort and whose organization eventually served as parent to Kwajalein Field Station, came from Bell Labs. Also on board were J. W. Schaefer, who headed the NIKE-ZEUS System Department, and W. O. Arnold, of the Bell Labs Planning Group that had helped select Kwajalein as the test site.

In May 1960, a second inspection of Kwajalein took place. This time, Western Electric chartered a Hawaiian Airlines DC-6C, the "Kamehameha I," to handle the 5,000 mile flight from the West Coast to Kwajalein. The manifest referred to the voyage as "the WE flight," and the menu invited passengers to "smile the miles away" in "Hawaiian-style" comfort. Breakfast, lunch, and dinner were offered, as well as an impressive list of spirits. All of this, including the stopover in Honolulu, made for "much aloha," as one passenger remembered. Project personnel were quick to recognize one of the Field Station's chief geographic blessings – getting there meant stopping over in Hawaii en route.

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*IRBM, Intermediate Range Ballistic Missile

Bell Labs passengers on this flight included the NIKE-ZEUS project's Executive Director, L. W. Morrison, as well as J. G. Nordahl and G. A. Sharpe. Also, Mr. S. C. Donnelly, WE head of ZEUS Production Planning, was part of this inspection trip. Mr. Nordahl, Site Selection and Test Planning Department, was responsible for the test planning. Later, Mr. Nordahl would be primarily responsible for liaison between Kwajalein, Whippany, Hunstville, Point Mugu, and other project locations. Though he was never assigned to Kwajalein, he would cover well over a quarter million miles on his many voyages between New Jersey and Kwajalein. Mr. Sharpe, supervisor of the staff Service Group at Kwajalein, was the first Bell Labs employee assigned to the Field Station on a PCS* basis.

These first visits to Kwajalein showed that the island was indeed suitable for its role, but it was by no means in "move-in" condition. It was apparent to all that housecleaning and renovation would be needed to transform a sleepy naval station into a proving ground for some of the world's most sophisticated technology. Of still greater concern to project management was the difficult and sensitive recruiting effort that lay ahead. The most sophisticated research, development, and planning would be of little consequence without a successful test program. The right people had to be found for Kwajalein, and found quickly. Somehow, they had to be convinced that moving from Greater New York to a Micronesian atoll was a worthwhile thing to do.

It was now 1960. International relations grew tense as the U-2 affair unfolded. John F. Kennedy began sparring with Richard Nixon for the Presidency. And in Morris County, New Jersey, Bell Labs husbands began coming home to Bell Labs wives with the second biggest proposal of their lives: "How would you like to go to Kwajalein?"

*PCS, Permanent Change of Station

4
A NEW ISLAND

The First "Recruits"

It was a tough question to ask—and an even more difficult one to answer. Recruiting people for Kwajalein was not an easy task, at least the first time around. Even before 1960 arrived, deadlines for NIKE-ZEUS testing had already been set. They called for rapid construction on the western end of the island, installation and checkout of components, and a system demonstration against an ICBM by mid-1962. As yet, however, site preparation and construction had barely begun, and no one had yet been assigned to Kwajalein.

So rigorous a timetable allowed little margin for delay or inefficiency, and it was clear from the outset that the Field Station would be no place for training fresh talent. Seasoned professionals were needed—people who would be immediately useful on arrival. Given the remote island environment and the problems it might present, maturity and adaptability as well as technical competence were essential for productive performance at Kwajalein.

After recruits of this caliber were identified, a good deal of understandable reluctance could be expected from them. Even individuals with solid field experience at White Sands or at Cape Canaveral might find Kwajalein a little "far out."

Clearly incentives were in order. From the start, the rules set the standard assignment for employees on family status at two years. This arrangement, it was felt, would minimize personal hardship for the individuals and also avoid the costly and inefficient rotation of married personnel on short-term field assignments. The two-year tour, beginning and ending in the summer months, would also coincide with the opening and the closing of school for dependent children.

Other incentives were offered—a salary bonus, free or subsidized housing and meals, special insurance provisions, R&Rs for those on bachelor status, and, of course, relocation assistance at the beginning and at the conclusion of the assignment. Since Kwajalein was actually a foreign country, the two-year stay would also give most people the opportunity to qualify for at least a partial exemption from federal income tax after working 510 days abroad.

Despite these encouragements, the decision to move to Kwajalein could not be made hastily. Going to Kwajalein meant selling or renting a home, disposing of automobiles, placing a lifetime's possessions into storage, uprooting the family, leaving friends and relatives behind,

and flying 8000 miles to take up residence on a wisp of coral soil ten hours flying time from anything approximating regular stateside life. Once there, arrivals would face new jobs, new neighbors, and a new way of life. Two years later, coming back would mean a reversal of the process, with relocation and reacclimation to stateside life requiring adjustments no less difficult. For the "first wave" going to Kwajalein, these prospects were cause for justified apprehension, especially since the procedures for handling such complex moves were still in the formative stages.

The island also promised inconveniences that most people never endured. There was no television and no telephone service back home, quarters were not air-conditioned, and merchandising facilities were limited. Elementary schools were established, but there was no high school. It was clear that the "first wave" going to Kwajalein would have to make needed improvements themselves and also establish a genuine sense of "community." However, in a few short years so much was accomplished that recruiting for Kwajalein would never again pose a problem. In later years, in fact, there were usually more volunteers for Kwajalein then there were jobs available for them.

The most critical of the first appointments to Kwajalein was the job of Field Station Director, a position with unique, wide-ranging responsibilities. The Field Station Director would not only oversee the test program, but also would have to work productively with the sponsoring Army agency, with the Naval personnel who controlled the island, with Douglas Aircraft, and with many other subcontractors. When problems arose that demanded quick resolution, there was no chance to refer the matter to the stateside "chain of command." Finally, the Field Station Director would have to contend with an unending stream of visitors from Whippany, Huntsville, and Washington—all of whom would be anxious to inspect the new facilities and review the progress of the test program. Such visits, of course, meant attending numerous official receptions and also entertaining frequently at home—a responsibility that would also demand much of the Field Station's "first ladies."

Also, it was apparent that directing the Field Station would take much more than competent technical management on a "9-to-5" basis. The Field Station would have to seek its proper place in the life of the community, as well as in its work, and Bell Labs would necessarily become a major point of reference for its employees on a 24-hour basis. Considerations beyond the scope of work often arose—housing, travel, emergency leaves, and special educational and medical needs were just a few of them. Decisions were difficult, but they had to be made with fairness. In short, running Kwajalein Field Station was no ordinary executive challenge—nor would it ever be.

The first man chosen for the job was R. W. Benfer, who had been the first and only resident director of the White Sands Laboratory from its official opening in 1953. Mr. Benfer's background in NIKE field testing and his experience with the military and subcontractors were considered ideal credentials for the job. He accepted the appointment in the summer of 1960, and L. H. Kellogg, another project veteran, replaced Mr. Benfer at White Sands.

On October 1, 1960, Bell Laboratories announced the formation of Kwajalein Field Station, Center 644. But it was not until October 5 that Mr. Benfer and others from Bell Labs arrived on the inaugural NIKE-ZEUS charter flight, a Hawaiian Airlines DC-6.

For several months, Mr. Benfer divided his time between Kwajalein, Whippany, Huntsville, and other ZEUS sites, attending frequent meetings on policy, program planning, and technical recruiting. It was not until the following spring that the Benfer family took up residence at Quarters 103, which would be the home of the Field Station's seven directors.

During the early part of 1961, the "show" at Kwajalein still belonged to the Army's Corps of Engineers, the Pacific Martin Zachry Company, and Western Electric. While intensive recruiting was in progress at Whippany, these and other organizations were readying the western half of Kwajalein for the space age.

Technical Construction

As early as 1959, site preparation began at Kwajalein, and by 1960 the facilities for an operational NIKE-ZEUS battery began to appear. Largest among them was ZAR, consisting of a transmitter, a receiver, and a power plant. The ZAR transmitter, with three antenna arrays in a horizontal triangular arrangement, would rotate in a horizontal plane, scanning millions of cubic miles of space for threatening objects. The search signal sent by the ZAR's transmitter would be bounced back to the ZAR receiver, located near the transmitter and designed to rotate synchronously with it. The acquired signals would then be analyzed by computers to determine the presence and location of a target.

The ZAR complex was huge. The transmitter antenna was about the size of a baseball diamond and was surrounded by a 60-foot-high radio frequency shielding fence nearly 700 feet in diameter. The receiver, with a large ground reflecting plane, was about eight stories tall and revolved on the world's largest precision ball bearing—13.5 feet in diameter. The power plant for the ZAR complex featured nine 1500-kw diesels producing enough energy to serve a city of 5000 people.

In an engagement, the ZAR complex would acquire potential targets, then feed data to DR*, a 40,000 square-foot structure topped by a 38-foot radome. The DR's mission was to examine a number of potential threats (or a "cloud" of objects), to analyze their reentry characteristics, and to select the real targets from decoys or debris. The position of the actual target would be relayed to TTR*, two of which (numbers 4 and 5) were installed on Kwajalein.†

At this point, TTR would lock on the target and feed precise tracking information to the TIC‡ in the BCB, the "nerve center" of NIKE-ZEUS. The TIC would then compute a continually updated intercept point and generate the appropriate commands to fire and guide ZEUS. An MTR** would transmit these instructions to the missile.

At the extreme western tip of Kwajalein, at the point farthest removed from residential areas, ZEUS missiles would be assembled, checked, loaded, and fired. Ideally, the launch cells should have been installed below ground to simulate deployment conditions, but Kwajalein's water table was far too shallow to allow this installation. The solution was construction of "launch hill." The hill contained 200,000 cubic yards of coral soil and stood 65-feet tall. It was the highest point anywhere in the Marshalls, and it quickly acquired the name "Mount Olympus."††

Also erected during this period was the Field Station's Headquarters, the Joint Technical Operations Building, or "JTO." The JTO was a two-story, steel-framed concrete block structure with 62,000 square feet, accompanied by shops and warehouses. This building housed the Field Station Director and other Weapons System Contractor site managers, as well as various Army project groups.

In a sense, ZEUS construction on Kwajalein was a major achievement in itself. The remoteness, the climate, and the deadlines were difficult obstacles. It is no small tribute to note that the dozens of

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*DR, Discrimination Radar

*TTR, Target Tracking Radar

†The first three were installed at Whippany, White Sands, and Ascension Island.

‡TIC, Target Intercept Computer

**MTR, Missile Track Radar

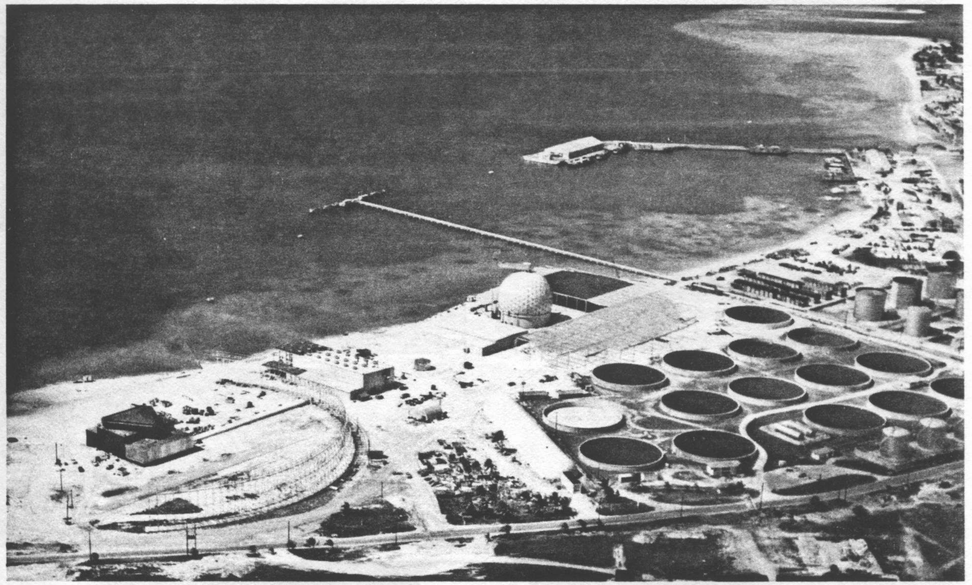
††The ancients considered Olympus, the highest mountain in Greece, the abode of the higher gods. The ABM project's namesakes, Nike, goddess of victory, and Zeus, father of the gods, were among them.



Inaugural Flight, October 5, 1960, left to right:
Col. R. Burkett, ARGMA, R. W. Benfer,
Field Station Director, 1960–1963,
Hawaiian Airlines Stewardess, J. G. Lawrence (WE),
and P. C. Swan (Douglas Aircraft)



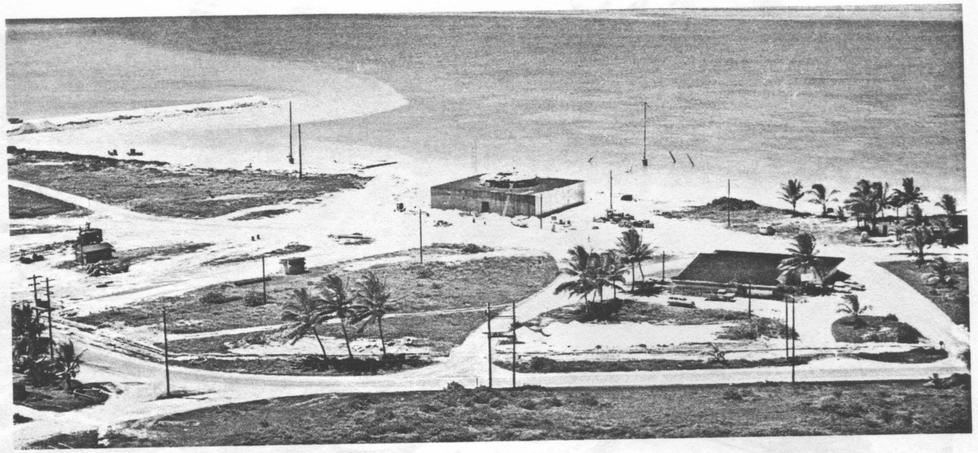
"First Wave" En Route to Kwajalein, 1960



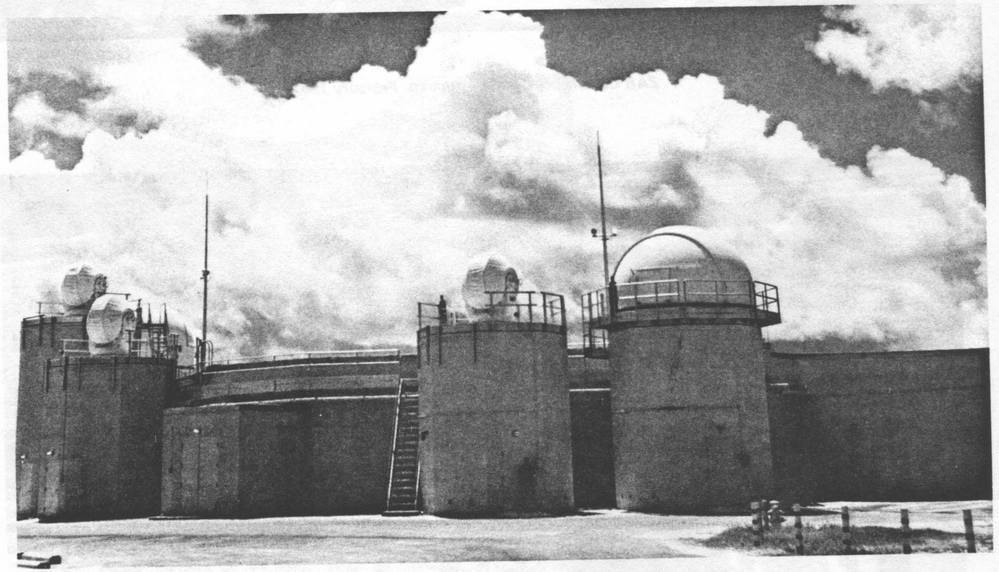
ZAR Complex Under Construction, February 1961



Discrimination Radar, October 1961



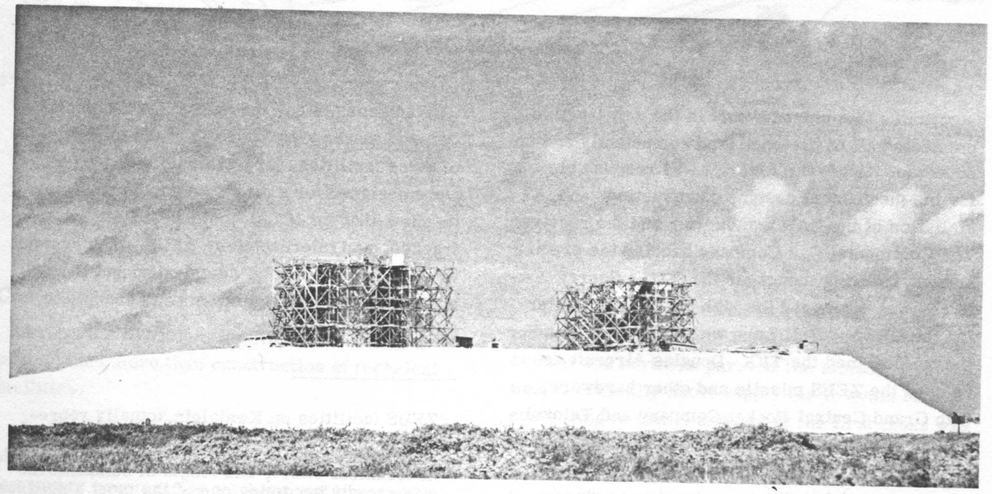
TTR-4 Construction, 1960



Battery Control Building



West End of Kwajalein, March 1961 (Note Launch Cells Under Construction)



Launch Cell Construction, Mount Olympus, May 1961



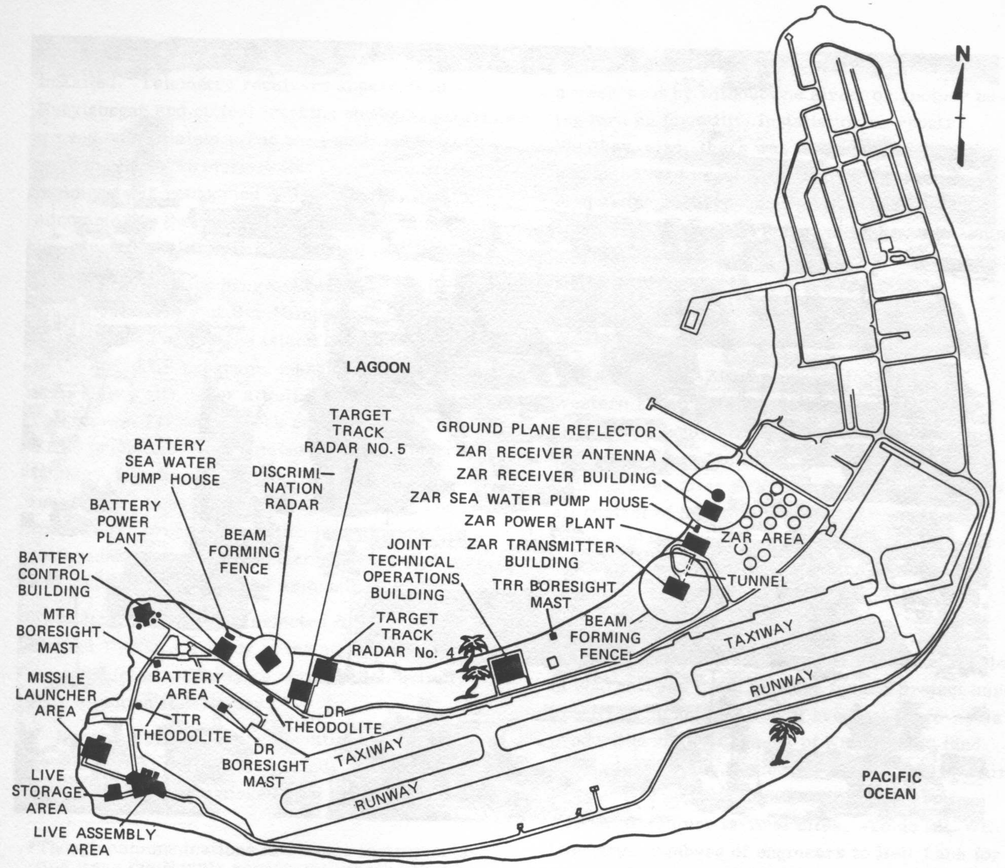
"JTO" Building Nearing Completion, 1960

companies that played a part in the construction completed all of the work load competently and on schedule. Goodyear Aircraft was responsible for the mechanical design, construction, and installation of the ZAR transmitter and the receiver. The Continental Can Company handled the precise antenna tracking mount for the TTR. Sperry Gyroscope developed the high power transmitter for the DR, and Bell Labs with Remington Rand Univac designed the TIC. Douglas Aircraft developed the ZEUS missile and other hardware, with Grand Central Rocket Company and Thiokol Chemical under subcontract. During construction, Bell Labs called on Burns & Roe for criteria drawings, and for other construction engineering advice and support. The work itself was performed by Pacific Martin Zachry under direction of the U. S. Army Corps of Engineers, Honolulu District.

When completed, the entire ZEUS complex covered a substantial portion of the island. All of these facilities, largely completed by 1961, were designed for a single, common purpose—to show that an ICBM could be identified, tracked, and intercepted by ZEUS. The system was one of monumental complexity, but it was engineered, from acquisition to intercept, to function automatically.*

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*ZEUS facilities on Kwajalein actually represented only a fraction of the entire project at Bell Labs—a program that in manpower, range of technical effort, and length of commitment was rapidly becoming one of the most ambitious in corporate history. Involved were hundreds of personnel in the NIKE-ZEUS organization at Whippany, as well as many scientists and engineers in military research, mathematics, physical sciences, electronics, and communications areas of Bell Labs.



NIKE-ZEUS Technical Facilities

Community Facilities and Range Support

Preparing Kwajalein for NIKE-ZEUS testing meant much more than construction of technical facilities.

In January 1960, there were only 1500 people on Kwajalein, of whom a sizable number were temporary construction workers and installation crews. Before long, the resident population would reach 3000. To house and to support this influx, a good deal of "city" planning, as well as range planning, had to be done.

Concurrent with technical construction, extensive renovation and building took place on the central and northern parts of the island. Housing was in critically short supply (as it would be for some time to come) and one of the first tasks was to refurbish the 289 existing concrete block homes. Power, telephone, water, and sewerage lines were also overhauled or replaced, and utilities were buried underground. To supplement existing bachelor quarters—the Surf BQ and the Pacific Barracks—work also began on the air-conditioned Sands, Reef, and Coral BQs,



BQ's Under Construction, December 1960

with a combined total of 208 rooms, just north of the "downtown" area.

At the same time, ground was broken for the new George Seitz School, and the Yokwe Yuk* Club and Pacific Dining Room were expanded and remodeled. The new Pacific Club went up for the bachelor population, and the pavilions and the picnic areas at Emon† and Coral Sands Beaches were installed. Somewhat later, the Teen Center rounded out the community development program.

The burst of construction activity in 1960 and in 1961 was not confined to Kwajalein. On Gugeegue, several miles north of Kwajalein, the range communications transmitter went up, and across the lagoon, on the west reef, a receiver site was erected on Ennylabegan Island (also known as Carlos). These facilities established a radio link with Honolulu and were connected with Kwajalein via submarine cable. In this project, and in others like the upgrading of island telephone service, Western Electric know-how proved invaluable.

*"Yokwe Yuk" is the all-purpose Marshallese greeting, similar in meaning to the Hawaiian "aloha."

†"Emon" is the Marshallese word for "good."

Range instrumentation facilities were also installed. Telemetry receivers appeared on Ennylabegan and optical tracking stations appeared on Kwajalein. The base photo laboratory near the BCB, formerly a Navy communications building, was remodeled and air-conditioned to accommodate the sophisticated equipment needed for comprehensive documentation of test firings.*

The construction program for NIKE-ZEUS included one facility at Roi-Namur—the Speedball rocket launch site at the island's northwest corner. In the Speedball program, managed by New Mexico State University under a Bell Labs contract, test rockets were fired to check out and test NIKE-ZEUS prior to system demonstration against ICBMs. Roi-Namur, of course, was largely untouched since the Navy departed in 1945. The island was covered with dense jungle, dotted by battered Japanese gun emplacements and bunkers, and strewn with shells and ammunition.

At this time, ARPA† selected Roi-Namur for Project PRESS,‡ a study of the behavior of reentry vehicles. Extensive construction activity soon began on Roi-Namur.

Needless to say, living conditions on Kwajalein were not ideal during this period. During dry spells, construction kicked up a lot of coral dust. With rain, there was mud everywhere. Hardly a week went by without one street or another being torn up for utility installation or repair. Weather-wise, there was the usual tropic sun and humidity to deal with, and at least one very disquieting occurrence as well. On May 24, 1960, Kwajalein experienced a tidal wave warning. The wave, as expected, did reach Kwajalein, but fortunately measured only 1.3 feet.*

Western Electric's Role

As the NIKE-ZEUS complex took shape, Western Electric began dominating the scene, performing equipment installations and testing to bring the new facilities up to operating condition. Even after Bell Labs had assumed overall control of the Field Station, WE would continue to play a sizable engineering support role at Kwajalein—including inspection, quality control, C. I. B.† operation, test and repair, and communications.

As prime contractor, Western Electric's role, of course, was much broader from a project perspective. In anticipation of eventual large-scale production and deployment of NIKE-ZEUS (and the systems which succeeded it), WE had to train an adequate supply of competent engineers for work at the future tactical sites. To do so, WE lent large numbers of engineers to Bell Labs for direct exposure to the testing program. These assignments generally ran for eighteen months.

Meeting these diverse responsibilities made Western Electric the largest employer at the Field Station. WE employees numbered as many as 300 during periods of peak testing activity.

*Though communications and range instrumentation were the Navy's responsibility, the Pacific Missile Range contracted these services to Ling-Temco-Vought and its subsidiary, Kentron of Hawaii, which became the Technical Support Contractor for Kwajalein.

Likewise, as landlord to both the Army and NIKE-ZEUS contractors, the Navy decided that such jobs as merchandising, transportation, maintenance, and community support were best left to civilians. Accordingly, the Navy contracted with TCT** in July 1959, to serve as Kwajalein's Logistical Support Contractor. The contract was a first of its kind. The only Naval personnel remaining on Kwajalein were a small group that monitored TCT's performance, and a SAR†† Unit that served Kwajalein and other neighboring areas of the Pacific.

†ARPA, Advance Research Projects Agency

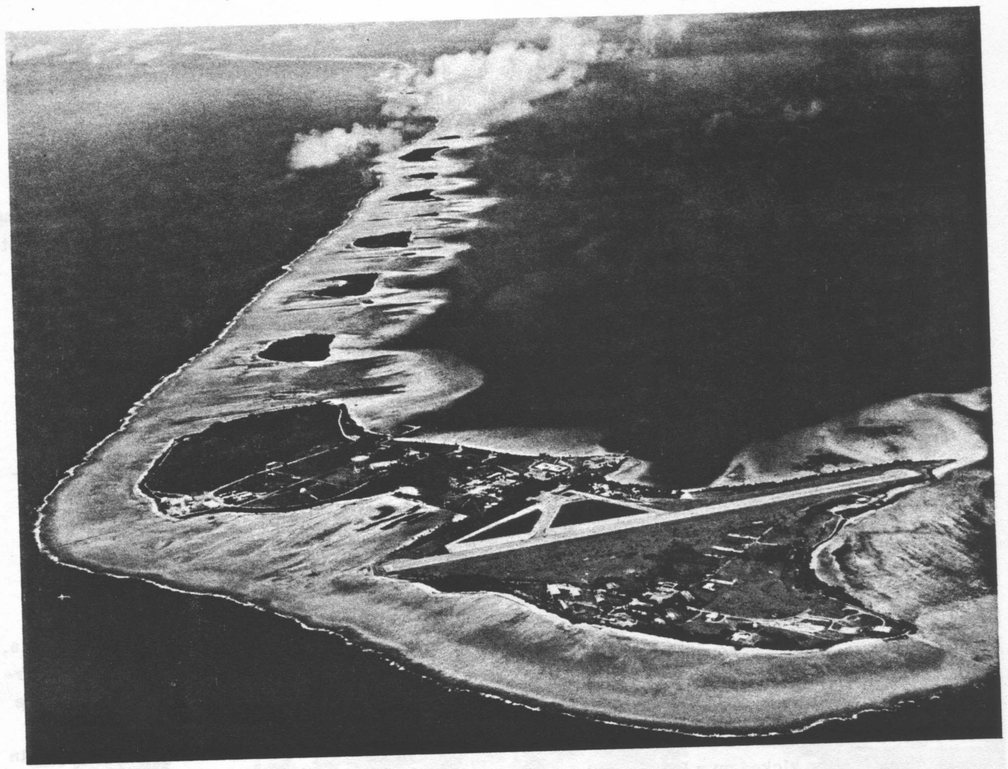
‡PRESS, Pacific Range Electromagnetic Signature Studies Program

**TCT, Transport Company of Texas

††SAR, Sea-Air Rescue

*The City of Hilo, Hawaii was not so fortunate. The city was devastated shortly before by the same wave with many deaths and substantial destruction of property. Low-lying Kwajalein, with its protective reefs, had relatively little to fear from tidal waves, though it was possible that a "tsunami" striking the atoll from the north might conceivably cause the lagoon to "back-up" at its southern end, and "spill over" into Kwajalein island.

†C.I.B., Central Instrument Bureau



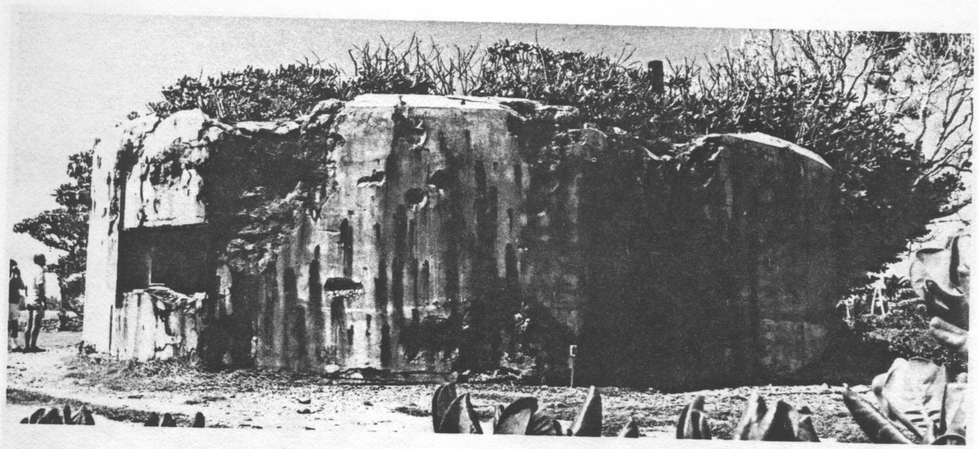
Roi-Namur

Indeed, only TCT and its successor, Global Associates, had more personnel on the island.

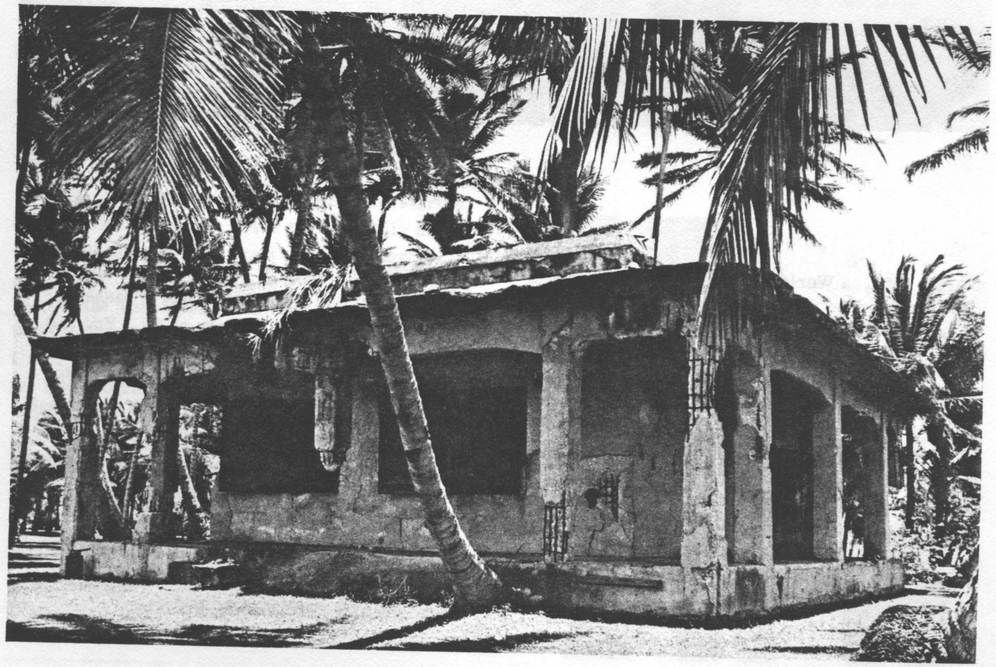
WE was also directly responsible for transporting all project personnel and cargo between the United States and Kwajalein. This was a complex assignment, requiring close coordination with the military, with commercial and chartered airlines, shipping lines, hotels, moving companies, warehouses, and other concerns. The WE transportation organization, based in North Carolina, began planning for the job several months before the Field Station opened, and in June 1960, the WE field office at Honolulu was established. Another office at Stockton, California, handled traffic, passengers, and cargo leaving CONUS* for Honolulu and Kwajalein on the new charter flight.

The "WE Flights," which served the project from 1960 to 1968, made the trip to Kwajalein something to remember. The initial carrier, Hawaiian Air, held the contract five months—from October 1960 to February 1961. In

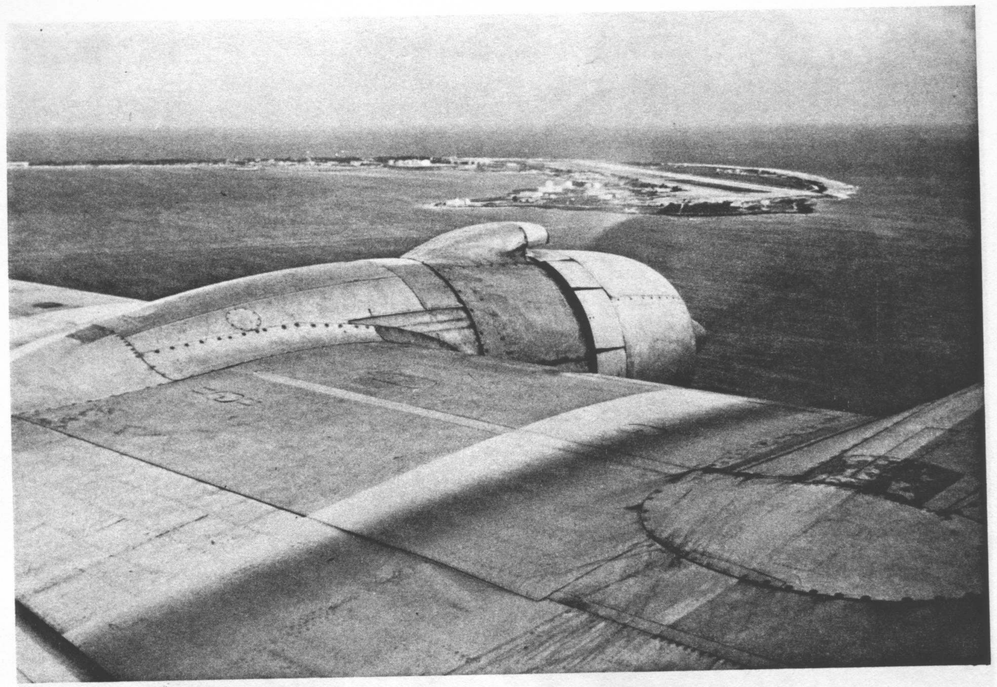
*CONUS, Continental United States



Japanese Blockhouse, Roi-Namur



Japanese Admiral's Command Post, Roi-Namur



"World" Approaches Kwajalein

March 1961, a World Airways DC-6 made its debut and served the Kwajalein community for seven years.

World passengers have fond memories of the 10-hour prop flights from the West Coast to Hawaii, and from Hawaii to Kwajalein. The DC-6 was reliable and well-appointed, the service was extraordinary, and cocktails cost as little as 25 cents.

"It was 10 hours of Elysium each time you went," recalled one veteran World passenger. "You didn't mind the journey at all. You had the feeling you were going someplace really special, and you were treated that way. The people on board, whether they knew each other or not at takeoff, might become the best of friends by the time they landed. That sort of spirit came naturally on flights so long."

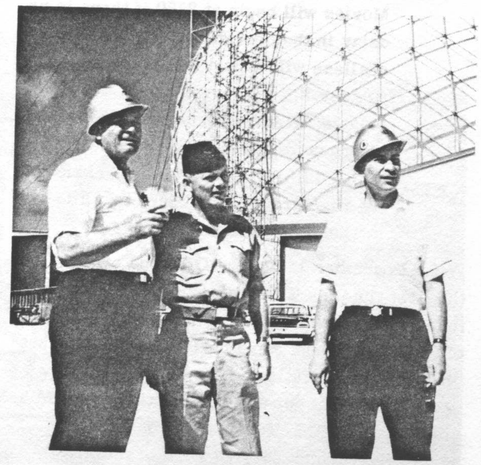
5
A BULLET HITS A BULLET

Early Arrivals, Early Successes

In the fall of 1961, the Field Station was still a fledgling, but the technical challenge facing it was immediate and immense. Radars, computers, launch equipment, and missiles had to be quickly readied for the first firing in December. Such was the task facing Mr. Benfer as he established his office at "JTO," and others as they arrived on regular World Airways charter flights.

NIKE-ZEUS personnel from Bell Labs started arriving in force in the latter part of 1961, and quickly began putting the test program together. Among the first on the island were W. L. Mraz, head of the Test Operations Department, which included D. H. Larsen, E. R. Souders, and C. L. Hastings. J. L. Troe was responsible for the Program Coordination Department, to which D. J. Enright was assigned. G. A. Sharpe, who had been on the island several months, directed the Kwajalein Staff Department, which completed the Bell Labs organization chart at this time. Many of the clerical staff support people, then as later, were spouses of Bell Labs, WE, and Douglas personnel.* P. C. Swan managed the missile operations effort of Douglas Aircraft, and was assisted by J. L. Cuba. M. L. Fox assumed responsibility for site operations as WE's Resident Manager. Toward the end of 1961, ZEUS contractor employees on Kwajalein numbered about 400—four times as many as the year before—and by February 1962, the total reached 550, plus an additional 650 dependents. On the island, Capt. G. W. Smith was the

*Bell Labs did send several secretarial supervisors to Kwajalein on "bachelorette" status during the mid-sixties. They resided in the Surf BQ.



P. C. Swan, Col. M. R. Collins, R. W. Benfer at ZAR Receiver, 1961

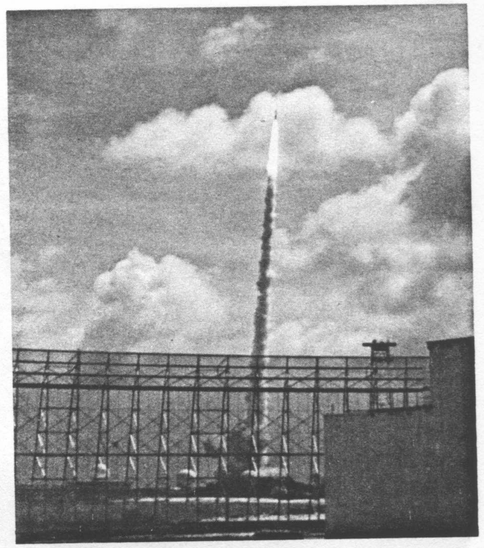
Navy's Commanding Officer, and Col. M. R. Collins directed the Pacific Field Office, the Army's resident project group.

The technical effort moved ahead rapidly, and on November 15, a first encouraging milestone occurred. A Speedball rocket, streaking into the heavens from Roi-Namur, was tracked continuously for 98 seconds. At Mount Olympus, work proceeded on the launch cells in preparation for the December firing. As a precaution, 234 native residents of the island of Lib, southwest of Kwajalein, were repatriated to a new village on Ebeye. With their evacuation, the "ZEUS Corridor" was officially open for traffic.

In early December, notices in the Hourglass announced the impending ZEUS mission and for the first of many times outlined well-known "take cover" procedures for island residents:

> "All quarters not approved as shelters will be evacuated in accordance with PMRF Instruction 5100.3. Upon sounding of the warning, personnel residing in nonapproved shelters are requested to TAKE COVER in an approved family house or in the Yokwe Yuk Club . . . Regular movie schedule is cancelled. Movies will begin at 2100 if there is no delay in the operation . . . . All Marshallese will depart Kwajalein on the regular Ebeye ferry at 1630 . . . . Signals: WARNING - three, 10-second blasts on the fire siren – TAKE COVER! ALL CLEAR - one, 20-second blast on the fire siren. Keep tuned to AFRS for further information."

On December 15, Mount Olympus erupted for the first time, as ZEUS missile 20047, Round ZK-1, thundered from its cell. Primary objectives of the historic shot were partially achieved, but disappointingly, failsafe occurred after 11.2 seconds of flight due to a malfunction of the Missile Track Radar. Nonetheless, newspapers across the country carried word of this first ZEUS firing at Kwajalein, as well as other missions conducted the same day at Point Mugu and

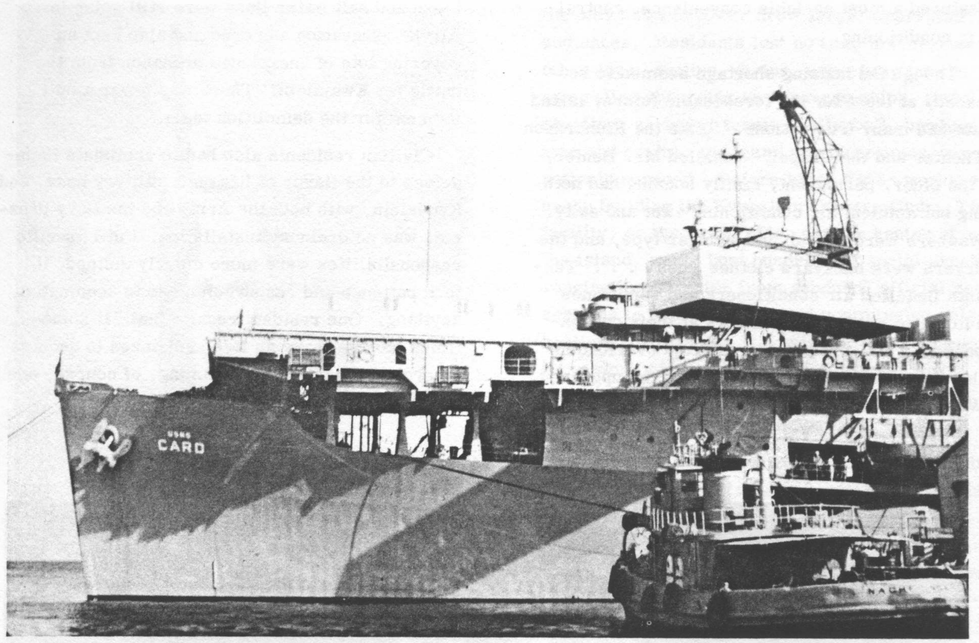


ZEUS Mission

White Sands. At the latter site, ZEUS scored a notable first by successfully intercepting a HERCULES missile.

Life and Work

Over the next few months, as work progressed on the second ZEUS shot, Field Station employees and their families began settling into island life. As everyone expected, there were difficulties – foremost among them was a continuing need for still more family housing as professional personnel continued to pour into Kwajalein. In late 1961, after considerable discussion, the Field Station's urgent requests for more housing were answered, as plans for the first trailer park in the Pacific were completed. After 20 acres of landfill were added to the northwest section of Kwajalein, 257 three-bedroom house trailers were brought to the island by the Navy. In 1962, the first Field Station personnel were assigned to these compact but comfortable quarters, which



Trailers Arrive, 1962

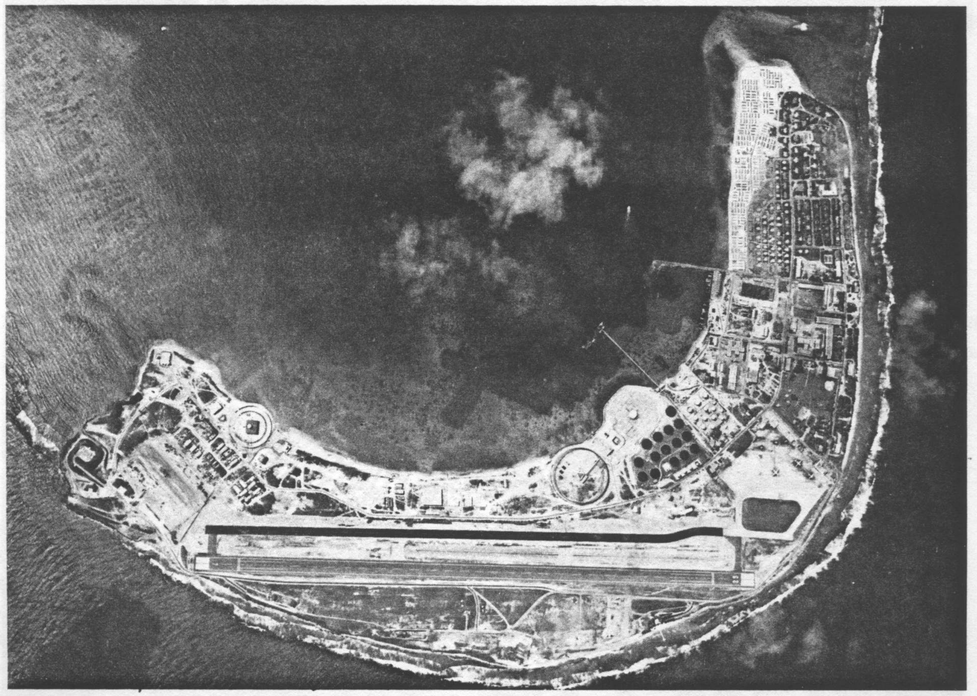


Trailer Area and Landfill, 1962

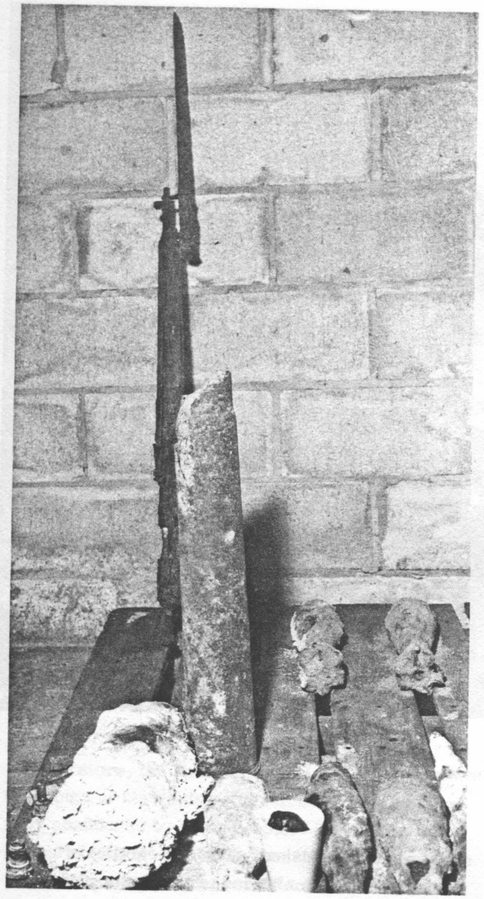
featured a most enviable convenience, central air conditioning.

Though the housing shortage seemed to be eased, at least for the foreseeable future, island life had many frustrations. "Like the Richardson Theater and the Chapel," recalled Mr. Benfer, "the older, permanent, family housing had nothing but ambient air conditioning—wet and salty. Washers were the tub and wringer type, and the dryers were backyard clothes lines . . . . Tenants installed air conditioners and sometimes automatic washers and dryers at their own expense. This, predictably, started overloading the electrical system, which had to be upgraded. Work continued on underground utilities, and fresh and salt water lines were still going in. All the excavation and dredging also kept uncovering lots of unexploded ordnance from the battle for Kwajalein. There was never a dull moment for the demolition team."

Civilian residents also had to acclimate themselves to the flavor of life on a military base, and Kwajalein, with both the Army and the Navy present, was no ordinary installation. Until specific responsibilities were more clearly defined, it took patience and resourcefulness to accomplish anything. One resident recalls that "it sometimes took as many as five signatures to acquire an ordinary light bulb—assuming, of course, one could find out where to look to begin with."



Kwajalein, 1962, Showing ZEUS Facilities (left) and Trailer Area (top)



Battle Relics Unearthed at Kwajalein

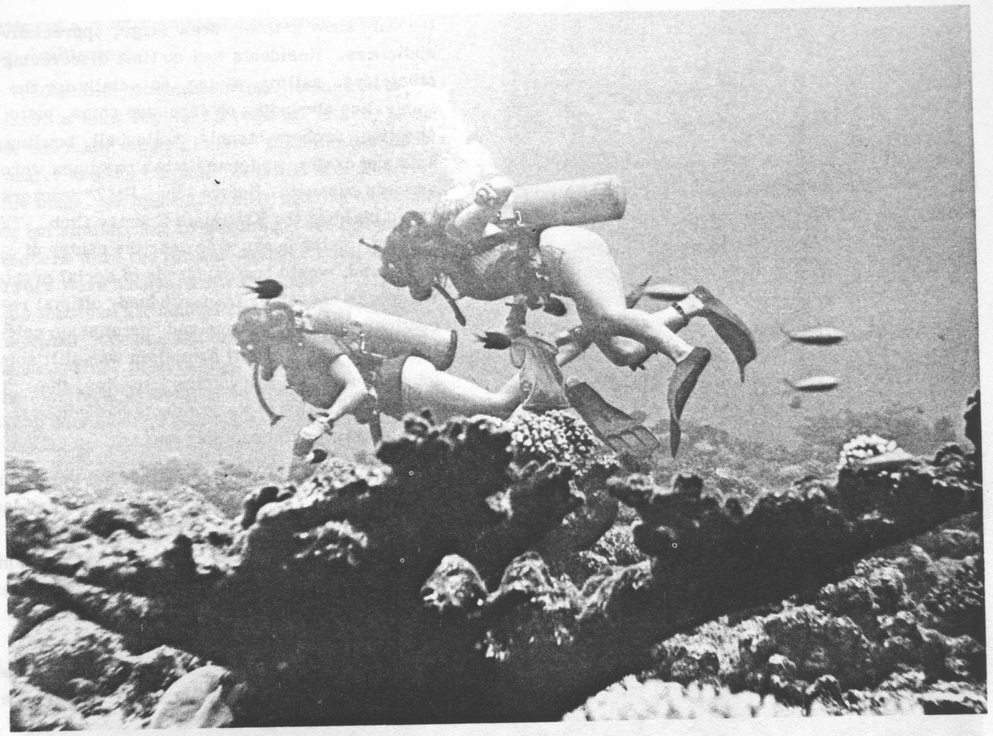
Although some recreation facilities existed, they could not handle Kwajalein's booming dependent population. Therefore, Army, Navy, and contractor personnel began expanding existing diversions and establishing many new ones. Softball, "mountainball," and little league play grew quickly. The Scouting program was revitalized, and a talented community theater group, featuring the only show in town, drew large, appreciative audiences. Residents lost no time discovering other joys: sailing, diving, especially for the war relics abounding on Japanese ships, pistol shooting, archery, tennis, volleyball, bowling, arts and crafts, and many other pastimes were actively pursued. Before long, PMZ* workers began building the Kwajalein Country Club. This facility, on the ocean side near the center of the island, would host hundreds of social events ranging in character from subdued, official receptions to colorful luaus and postmission celebrations. All in all, if Kwajalein was still something short of a South Pacific paradise, the community spirit of its residents had gotten it well on its way to becoming one.

The island's appearance also began improving dramatically. Construction, excavation, and landfilling had left large areas of Kwajalein white, barren, and hot. New coconut palms were planted all over the island, and others, fully grown, were transplanted from outer islets. Grass soon appeared in front of JTO, on the sides of Mount Olympus, in the new trailer area, and on the new nine-hole golf course, which began taking shape south of the runway.

With the enthusiastic support of Capt. Paul Holmberg, the Naval Commanding Officer who assumed control in August 1961, the golf course became a reality. The course was known initially as the "Lone Palm" Golf Course, after the single, carefully preserved palm tree on the ocean side that had been among the few to survive the battle. The golf course later became known as Holmberg Fairways in honor of the man who had done so much to create it.

As a result of the beautification program, in which residents participated as enthusiastic, if amateur, tropical gardners, Kwajalein began looking more like a resort than a highly classified missile installation. So successful was the greening of Kwajalein that in later years visitors and new-

*PMZ, Pacific Martin Zachry

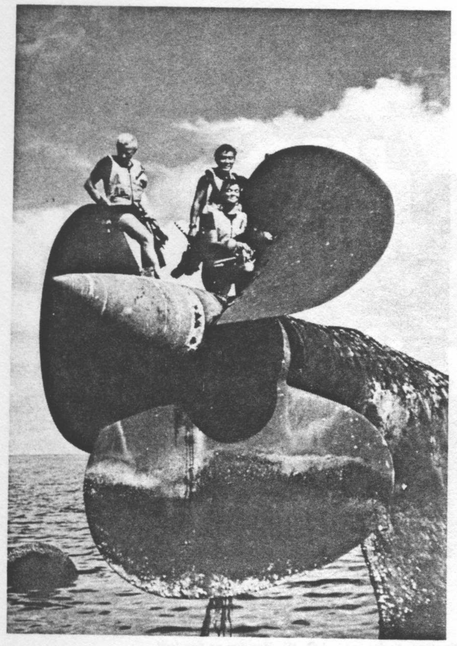


Scuba Divers, Kwajalein Lagoon

comers to the island would have a difficult time believing that the island had once been completely stripped of vegetation during the war. Indeed, except for the "Lone Palm," the Japanese cemetery, and the few surviving Japanese bunkers and pillboxes, there was little to remind anyone that Kwajalein was one of those bitterly contested bits of land where half the world war had been won.

Still other improvements occurred. The medical facility, taxed by the arrival of so many wives and children, was expanded, and its services were upgraded. The George Seitz School opened in 1962, and a modest high school curriculum was established. The desirability of continuing education also led to the opening of a University of Hawaii extension program. Field Station personnel did much to bring about these welcome improvements in the community—especially in education—and the Field Station Director, already a man with much on his mind, also became an ex officio member of Kwajalein's school board.

Besides a variety of recreational facilities, there were more basic joys of island life to be savored. One of these was the novel but thoroughly practical code of dress—bermuda shorts for just about everything, including work.



Divers Visit "Prinz Eugen"

Furthermore, the necktie, sportcoat, and other trappings of stateside professional life were gleefully abandoned by most people. Social life was full. Friends were not hard to find since everyone shared the common denominator of island life and a genuine spirit of teamwork in doing something important. Hawaiian dress became standard attire for a night on the town, which included dinner at one of the two restaurants and a movie at the "Rich" or the "Longhouse" (Yokwe Yuk) theater.

Transportation presented no problem. Bicycles were the standard mode of transportation on the island, and at most times there were more bikes than people on the island. Bikes came in all sizes and shapes, and were equipped with infant seats, grocery baskets, and any number of customized accessories. There were some automobiles—mostly for project use—but taxi and bus service to all points on the island, were available free. On almost any vehicle, two- or four-wheeled, rust soon took its toll, and even the most conscientious maintenance did not prevent corrosion. New vehicles usually ended up in what came to be known as "Kwaj condition"—rusty and unsightly, but somehow still serviceable.

Local stores, understandably, could not hope to rival the offerings of stateside facilities, but the basics were available in the commissary, and there were especially good buys on cameras, jewelry, china, and other items in "Macy's." "Macy's West," the department store annex, stocked hardware, appliances, sporting goods, luggage, and other items.

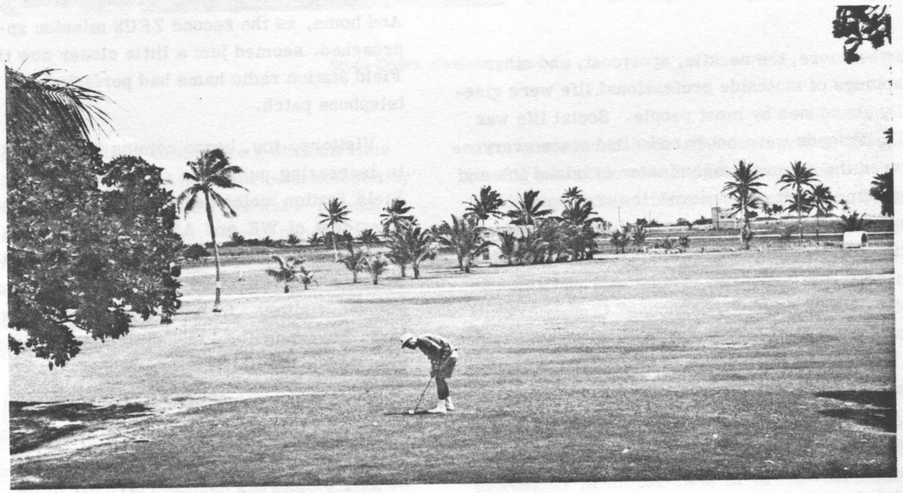
Inevitably, many necessities had to be ordered by mail, and Sears, Penney's, and military exchange catalogs were coveted possessions on Kwajalein. Mail ordering had its frustrations, however, and occasionally its ironies, too. One resident recalled ordering swim fins but received a pair of ice skates instead. If all else failed, there were "care" packages from home. And home, as the second ZEUS mission approached, seemed just a little closer now that Field Station radio hams had perfected the telephone patch.

Visitors, too, began coming from the states in increasing numbers. In mid-1962, the Field Station welcomed H. I. Romnes, Past President of WE and AT&T, accompanied by Bell Labs President James B. Fisk and Vice President W. C. Tinus. Many other distinguished visitors, including high-ranking military, governmental, and diplomatic officers also flew to Kwajalein.

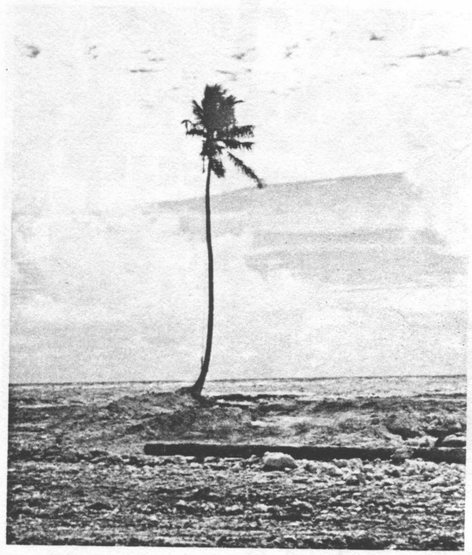
About this time, a notable change in Field Station organization took place with the creation of the NIKE-ZEUS Work Center, staffed by about 50 TCT employees assigned directly to the local Bell Labs Staff Department. The TCT



Reception, Country Club, March 1963, Capt. Paul Holmberg and R. W. Benfer at far left



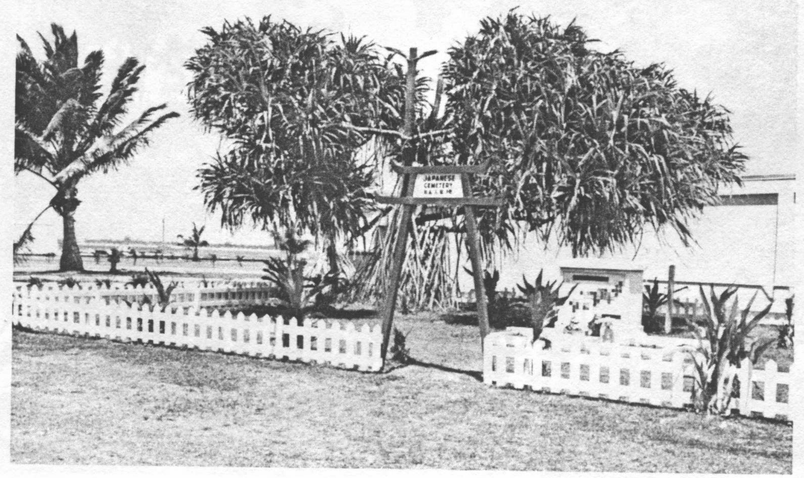
Holmberg Fairways



Lone Palm, Ocean Side, 1960



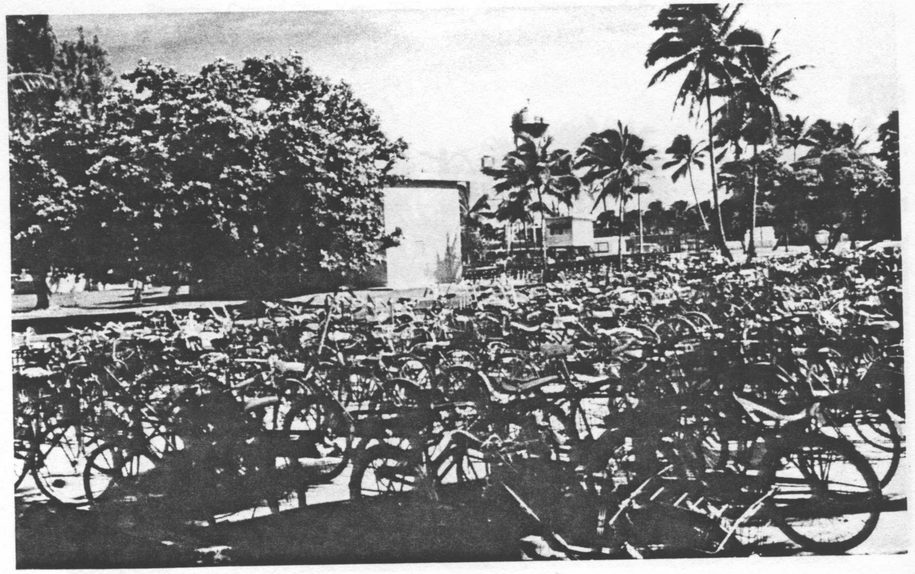
Lone Palm, 1972



Japanese Cemetery, Kwajalein



Longhouse (Yokwe Yuk) Theater, 1960



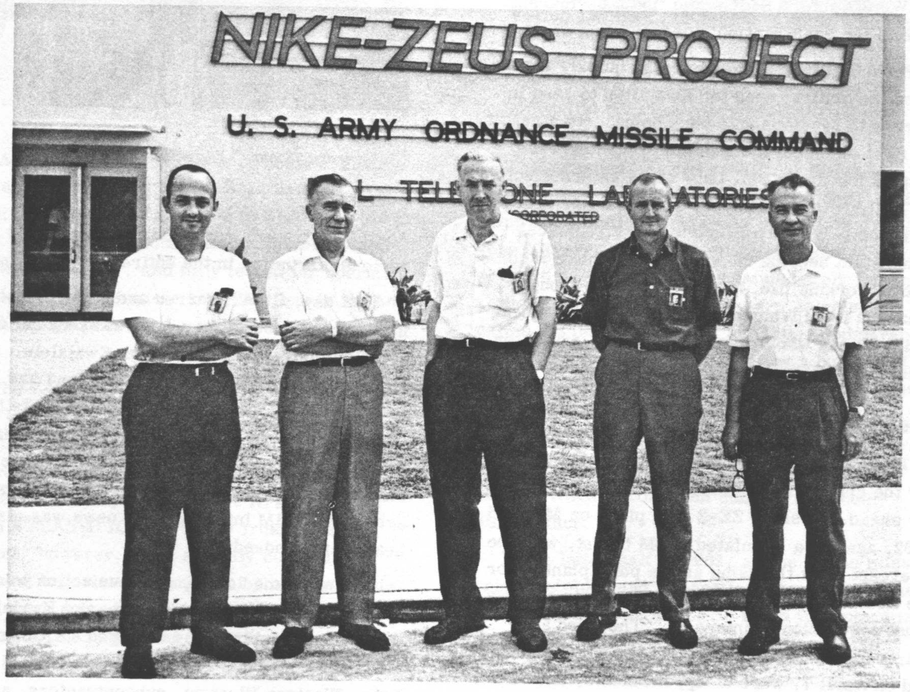
Wheels



"Macy's" Department Store

employees included carpenters, painters, electricians, auto mechanics, and other service and maintenance personnel. The addition of this group took place after many months of discussion involving J. G. Nordahl, G. A. Sharpe, and others from Bell Labs, Colonel Raines and Colonel Dooley from the Army's Pacific Field Office at Kwajalein, and Naval officers on Kwajalein and at Pacific Missile Range Headquarters at Point Mugu.

The Field Station proposed formation of the Work Center in the belief that efficient upkeep of the facilities was critical to the timely achievement of the technical mission itself. Once the Work Center was established, maintenance was performed directly under Bell Labs supervision by TCT employees, dedicated full-time to the



Left to right: M. L. Fox, W. C. Tinus, H. I. Romnes, J. B. Fisk, R. W. Benfer at "JTO," July 1962

ZEUS testing program. Work Center employees – from the start – demonstrated individually and collectively a wealth of talent, resourcefulness, and pride in their work. No less notable, perhaps, were the many lasting friendships formed over the years between Work Center and Field Station personnel. There were few Field Station employees, for example, who would not include such veterans as "Sammy" Tsuzuki among their most cherished acquaintances on Kwajalein. Sammy, George Kitajima, George Schupp, Harry Kalahiki, Herb Mitchell, Lloyd Brink, and others would serve the project continuously for many years.

As the Work Center took over general maintenance and service responsibilities, Burns and Roe, under separate contract, assumed control of plant engineering for power systems, air conditioning, and other ZEUS support facilities. Like the Work Center, B&R would find a permanent spot on the Field Station's organization chart.

Field Station management also quickly recognized the critical need for Kwajalein to keep in touch with developments back home. As a result, the first technical symposium programs were planned jointly by Bell Labs and Western Electric for Bell System employees at Kwajalein. The Bell Labs - Western Electric Joint Technical Symposium became an annual highlight of Field Station working life. Early programs brought speakers from Whippany and other project locations, among whom was E. P. Felch, who later became Field Station Director himself.

The First Intercept

In the first half of 1962, preparations continued for the critical system test for NIKE-ZEUS that lay ahead. Mission ZK-2 took place on March 5, 1962, against a simulated ICBM target, with the intercept point the same as the point planned for the first real ICBM. ZEUS performed perfectly from acquisition to intercept. The third and fourth missions, however, conducted on March 21 and on April 7, were disappointments, and on

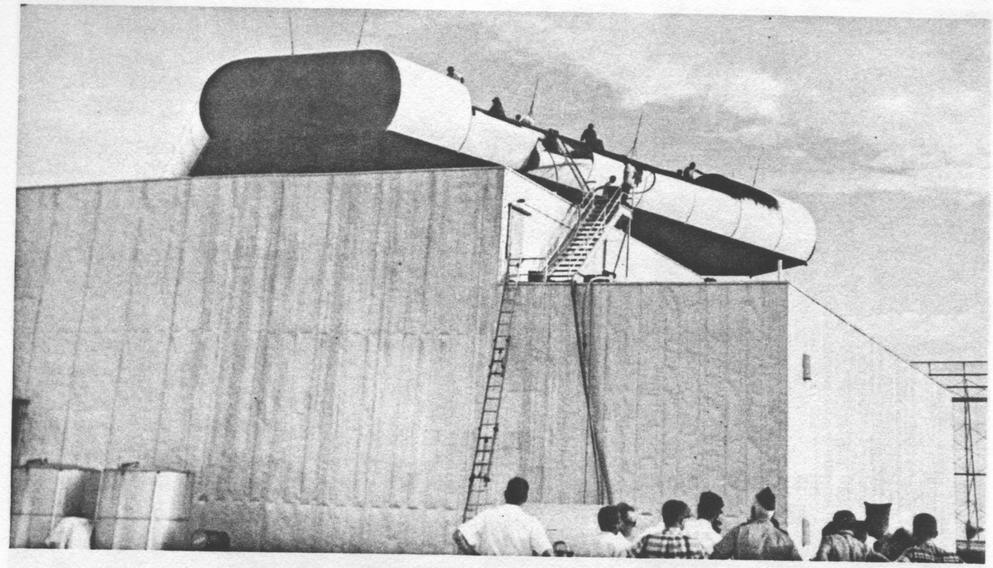


Isamu "Sammy" Tsuzuki and "Old Man"

April 23 a tragedy occurred that threatened a serious disruption in the entire test program.

That day, C. A. Warren and other project managers in New Jersey were awakened at 3:00 a.m. by distressing news from Kwajalein. The high-powered ZAR transmitter antenna had overheated and had caught fire. The blaze had broken out in one of the transmitting antenna polarizers, and all eight sections of it were destroyed. Coming only weeks before the first scheduled ICBM intercept, the news was disheartening, indeed.

Almost immediately, decisive action was taken at Whippany, White Sands, and Kwajalein. While disassembly of the damaged ZAR equipment was under way, special teams from Bell Labs, Western Electric, subcontractors, and



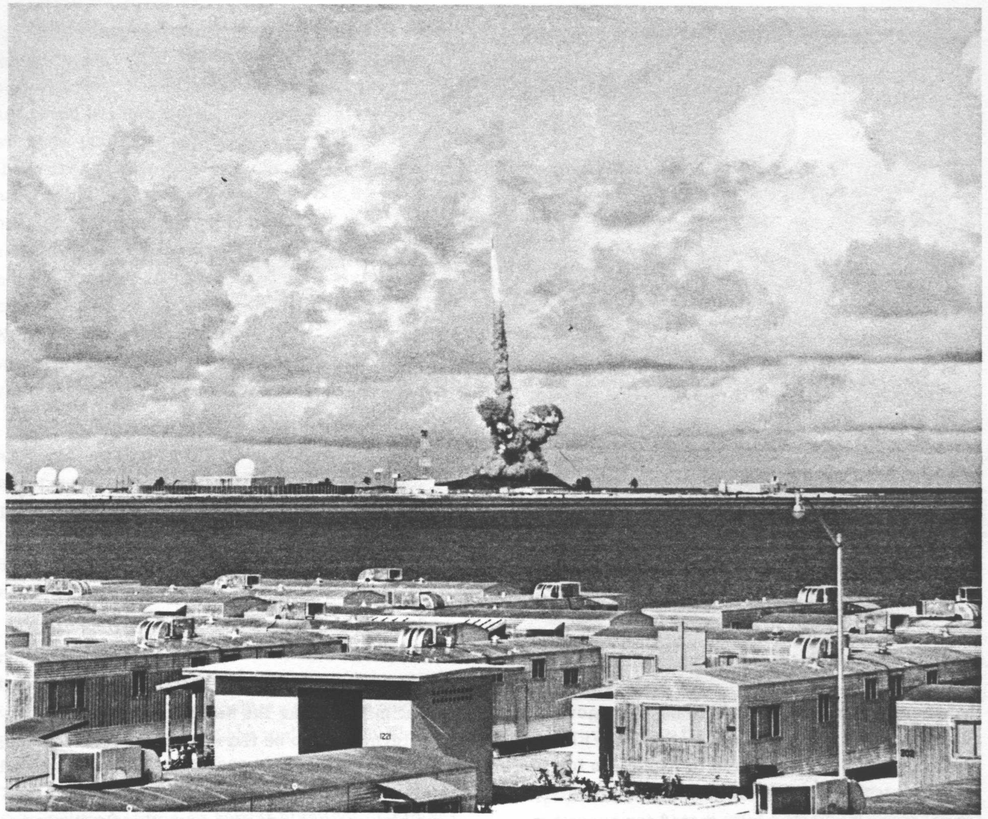
Fire-Damaged ZAR Transmitter Under Repair – April 1962

the Army met at White Sands to begin removing replacement parts from the ZAR there. Within a week the parts were airlifted to Kwajalein for installation. The antenna was completely repaired three weeks later, and fully tested for operation by May 22. Subsequent modifications to the antenna design prevented recurrence of the problem.

The ZAR was back on the air in time for the next two ZEUS firings, ZK-5 and ZK-6, but neither came up to expectations. The second of these, on June 26, was especially disappointing since it was planned as the first intercept of an ATLAS-D ICBM. Early frustration and failure, however, were actually constructive learning experiences – and one by one the problems were solved. Plans were made to pit ZEUS against ATLAS again on July 19, 1962.

That mission was the seventh at Kwajalein and it turned out to be the magic number. ZEUS came within lethal distance of an ATLAS-D nose cone traveling at 16,000 miles per hour. News of the historic success was immediately flashed around the world. One wire service release called the test a "majestic bullseye, comparable, some have said, to a bullet hitting a bullet." On Kwajalein, those who witnessed the reentry and intercept remember it as a "spectacular" show, and there were spontaneous celebrations all over the island. Six years of careful planning had brought NIKE-ZEUS from concept to accomplished fact.

In the latter half of 1962, as the Cuban missile crisis unfolded and international tension reached a new peak, two more ZEUS shots took place in November, followed by the second and third

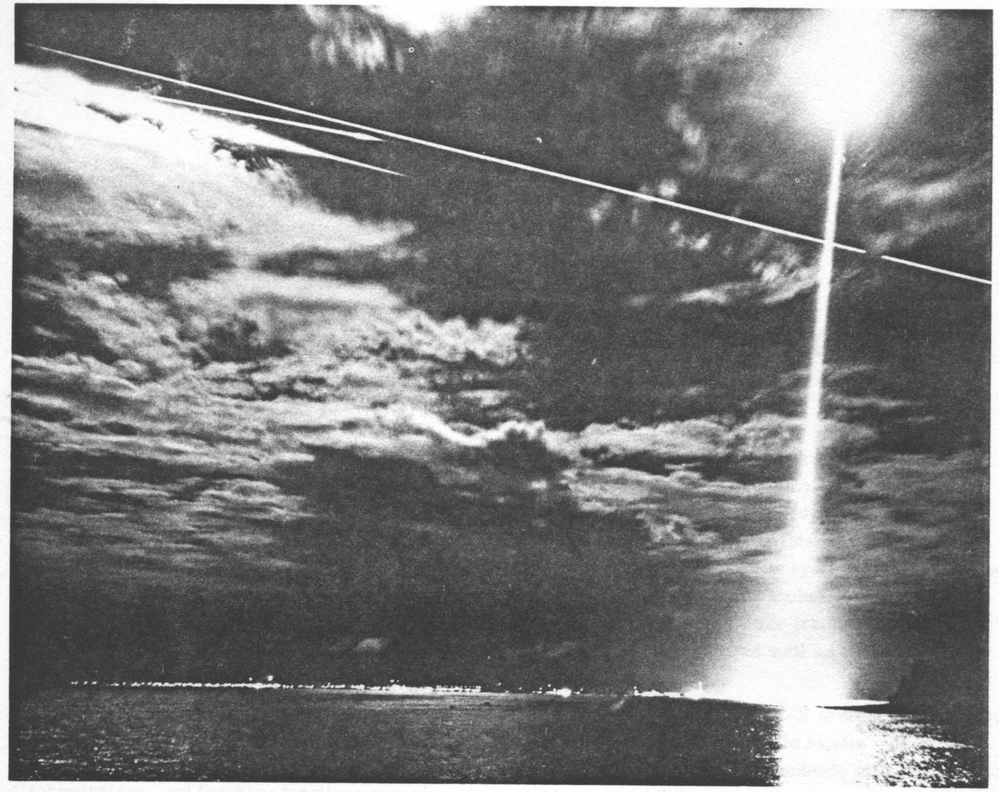


ZEUS Mission, Viewed from Residential Area

successful ICBM interceptions on December 12 and on December 22. These last missions in 1962 were two-missile salvo shots, the first such rounds in the antimissile missile program.

On May 23, 1963, another milestone occurred when NIKE-ZEUS successfully intercepted an AGENA D earth satellite. This was the 20th mission at Kwajalein and the 100th firing in the overall ZEUS R&D program. The antisatellite capability met a requirement placed on the NIKE-ZEUS system by Secretary of Defense McNamara one year before.

Mid-year 1963, like every year after it, was turnover time, and a major reorganization of the



Night Mission

Field Station was in process. Newer arrivals included W. B. Sage and N. Sharko on the technical side, and J. J. Naughton, who replaced G. A. Sharpe in the Staff Department. By September 1, W. T. Hunter succeeded P. C. Swan as head of the Douglas team, and J. A. Thompson followed M. L. Fox as WE Site Manager. New Bell Labs Department Heads were R. D. Johnson, Test Operations, and G. W. Riesz, responsible for integrating the Discrimination Radar into the NIKE-ZEUS System. J. L. Troe, heading the Test Plans and Analysis Department, extended his Kwajalein assignment for a third year. J. L. Gregory arrived as head of the new Kwajalein Public Relations Department, responsible for visitors, community relations, employee communications, photography, and film activities.

Completing this first of many "turnovers" was a "Hail and Farewell" party for the Field Station's Directors, at which Kwajalein said goodbye to R. W. Benfer, who returned to White Sands, and welcomed his successor, J. W. Schaefer.

A few months later, 1964 arrived and with it a new direction for the Field Station. On February 1, a second chapter in Field Station history began when NIKE-ZEUS officially became NIKE-X.

6

SOLVING FOR "X"

New Project, New Landlord, and a 32nd of October

The change, of course, came as no surprise. NIKE-ZEUS had proven that a bullet could hit a bullet, and early intercepts represented incredible advances in just a few short years. In the meantime, the ICBM threat had made incredible advances also, and ABM strategy in the early sixties clearly showed the necessity of revamping NIKE-ZEUS. In June 1961, studies were already in progress on electronically steered MARs*, which could perform the acquisition, discrimination, and tracking functions now shared by the ZAR, DR,† and TTRs‡ at Kwajalein. The MAR, a phased array radar, had no mechanical moving parts and no need for a rotating antenna, since its "eyes" could scan the heavens at the speed of light. In March 1962, a feasibility study was also completed on a new short-range interceptor missile that would allow more time for ICBM defenses to discriminate between warheads and harmless decoys. The new missile was called SPRINT and would be developed by the Martin Company, Orlando, Florida.

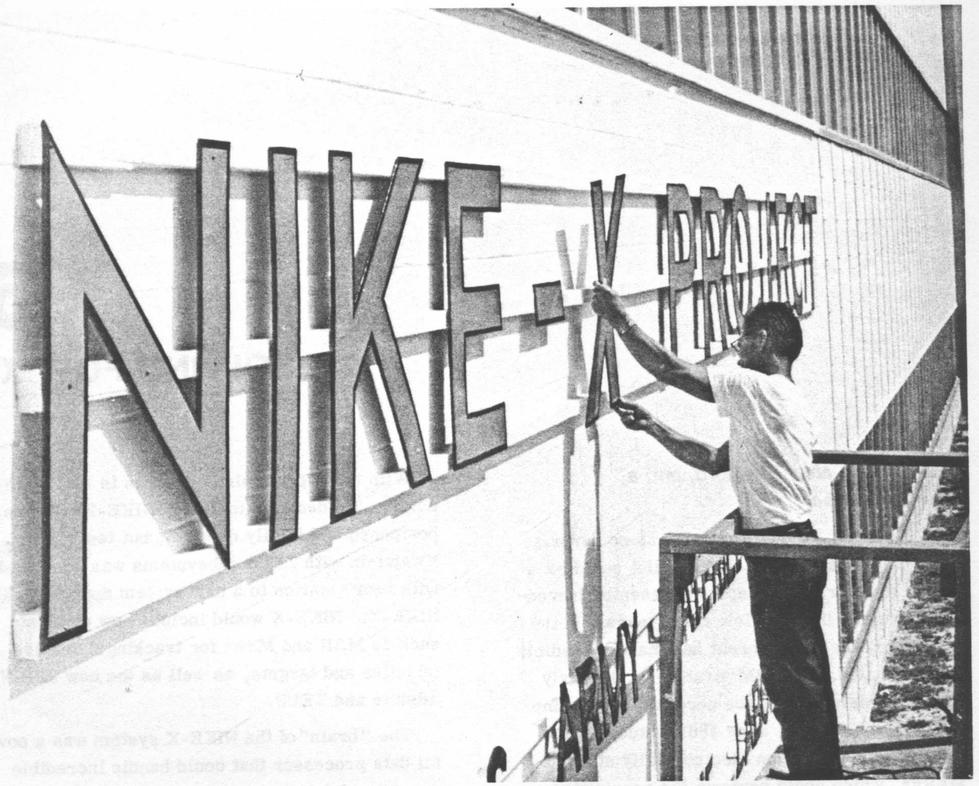
With these promising advances in ABM technology, the decision to deploy NIKE-ZEUS was postponed and finally dropped, but testing at Kwajalein with ZEUS subsystems was continued, with reorientation to a new system approach called NIKE-X. NIKE-X would include new elements such as MAR and MSR* for tracking defensive missiles and targets, as well as the new SPRINT missile and ZEUS.

The "brain" of the NIKE-X system was a powerful data processor that could handle incredible amounts of data to track hundreds of incoming targets and trigger appropriate responses. Bell Labs and Univac developed this computer, which featured a unique multi-processor capable of performing millions of calculations per second.

Extensive preparation for NIKE-X at Kwajalein began under Mr. Schaefer's direction. The plans called for a tactical MAR facility, and since the necessary real estate for this 10-story structure and its power plant did not exist, PMZ crews began dredging five and one half million cubic yards of fill from the lagoon, adding 55 acres of land to the western end of Kwajalein. Planners also

*MAR, Multifunction Array Radar
†DR, Discrimination Radar
‡TTR, Target Tracking Radar

*MSR, Missile Site Radar



NIKE-ZEUS Becomes NIKE-X – JTO Building, February 1964

decided that additional land should be added to the northern end of the island as "contingency" fill. NIKE-X, it was felt, might well occasion another dramatic jump in Kwajalein's population, requiring more family housing. The "contingency" fill added another 38 acres to Kwajalein, bringing the island's total to 741 acres. The landfill operations were completed in 1964.

Range planning also focused on another part of the atoll, as a small island called Meck, 19 miles north of Kwajalein, was chosen as the spot for testing the MSR and NIKE-X missiles. Until then, Meck had attracted particular attention from just about no one at Kwajalein. Even the word "Meck" itself (pronounced "Make" by the Marshallese) was obscure, but apparently indicated the island's proximity to Eniwetak Pass. Few Marshallese had resided there, and during the battle for Kwajalein, Army patrols found no Japanese on the island during mop-up operations. Meck was untouched – lush and beautiful, and coconut palms and breadfruit trees were plentiful there at the time clearing and grading for NIKE-X began.

At this time also, plans were made to direct incoming missiles into Kwajalein's lagoon, where splash detection radars and other devices could



MAR Fill, West End of Kwajalein, August 1964

pinpoint the site of impact. Recovery teams, including professional divers staging from a modified LCU* and a two-man submarine, would search the lagoon bottom for the reentry vehicle and debris. This material would then be analyzed to yield valuable additional data. To avoid potential harm to Marshallese residing in this "Mid-Atoll Corridor," nearly 400 residents of eleven islands in the impact area had to be relocated to Ebeye.

As part of NIKE-X, a major effort at Kwajalein was organized to study ballistic missile reentry phenomena. The program known as the NIKE-X RMP† became a sizable effort for several years.

*LCU, Landing Craft, Utility

†RMP, Reentry Measurements Program

In the first phase of the project, RMP-A, essential data were acquired on target vehicles as they reentered the earth's atmosphere. The DR, and TTRs 4 and 5 were modified for this new role, and a special EC-121K aircraft also took part. This plane, with a distinctive "dome," was a Lockheed Super-G Constellation with sensors for gathering optical and infrared data. It was a converted Navy radar search plane, and was flown by a Douglas Aircraft Company crew. Its instrumentation was operated by a team of engineers and technicians from AVCO Everett Research Labs.

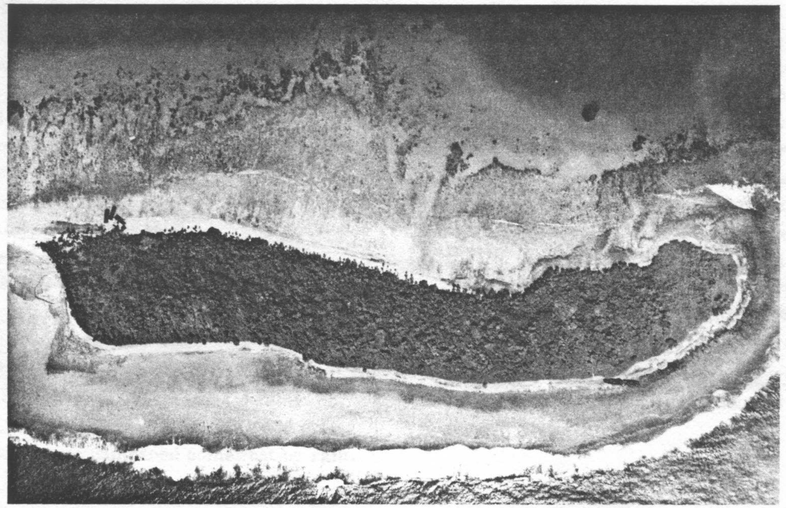
In December 1963, the first issue of the Interceptor, the project newspaper, was published under the editorship of J. L. Gregory. Its appearance was timely, since Mr. Shaefer's



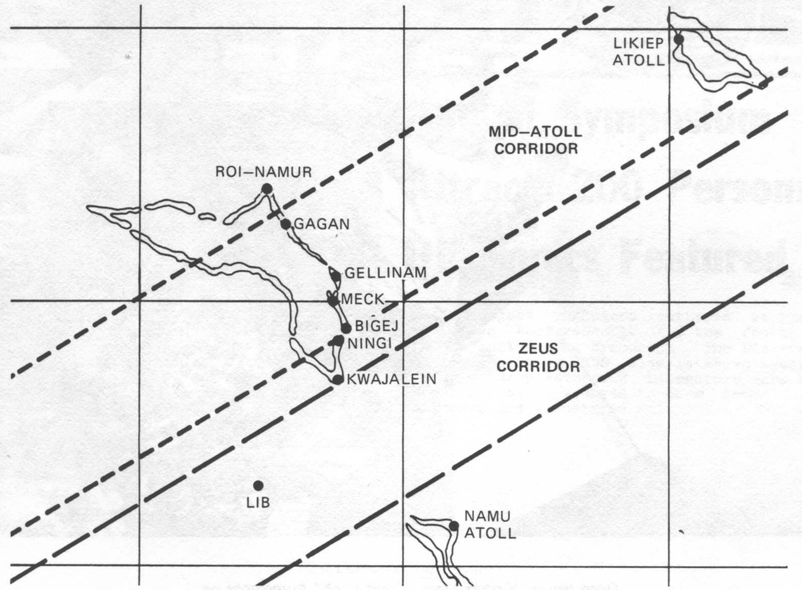
"Contingency" Fill (Later Location of "Silver City"), 1965



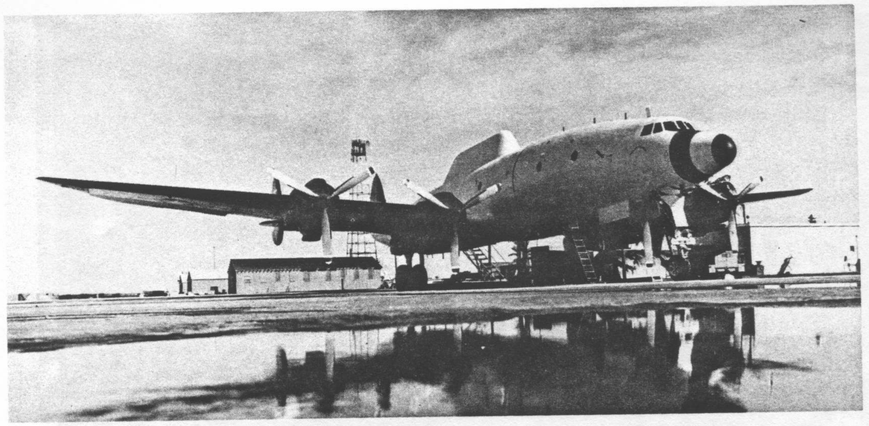
Kwajalein, February 1965, Showing MAR (left) and Contingency Fill (top)



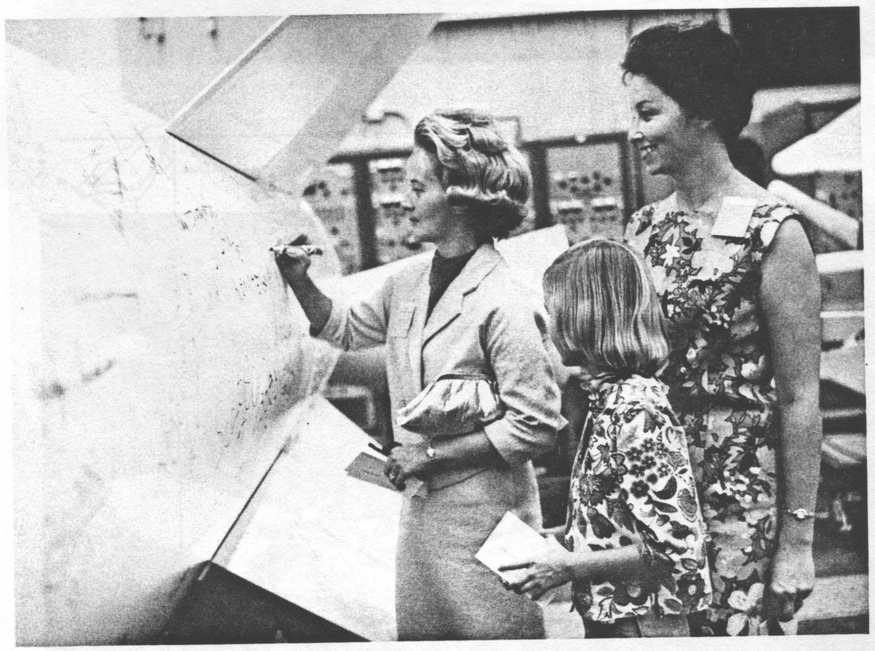
Meck Island, 1963



Reentry Vehicle Trajectories, Kwajalein



EC121K Aircraft

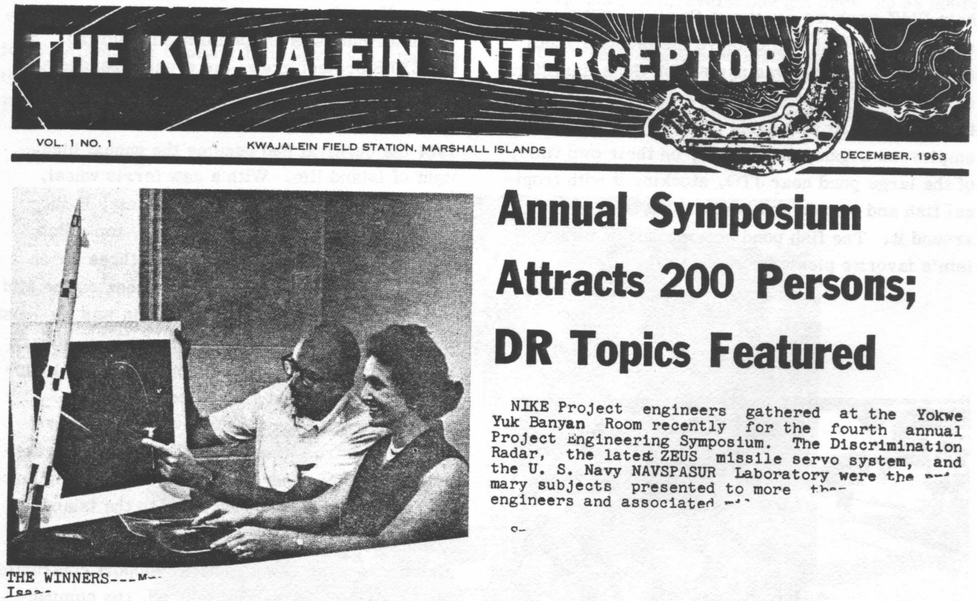


Open House, Visitors Place "Good Luck" Autographs on NIKE-ZEUS Missile

tenure at Kwajalein, from 1963 to 1965, was particularly rich in memorable events. The newspaper proved an instant success, covering people and activities of interest at the Field Station and supplementing the Hourglass as a chronicle of island life. The Interceptor also brought something new to journalism in the Marshall Islands—photographs. This was no simple achievement, since the paper first had to be prepared at Kwajalein and shipped to Honolulu for printing.

In the kickoff issue of the Interceptor, the fourth Bell Labs-Western Electric Symposium and a NIKE-ZEUS open house were among the featured stories. Both events were notably successful, though the spirits of some 530 open house visitors were dampened somewhat by rain.

Subsequent issues brought the interests and activities of Field Station personnel into sharper focus. Project softball, bowling, square dancing, chess, and basketball leagues were formed, and the NIKE-X Yacht Club and the NIKE-X Flying Club were also operating. The latter group, formed largely through the efforts of C. L. Hastings and R. D. Johnson, had begun with a ground school early in 1963. For some time, club members remained "grounded" until they negotiated purchase of a 1960 Cessna "150" from the Hickam Flying Club in Honolulu. With this acquisition, membership quickly soared. In later years, the flying club listed scores of members from many island organizations and enlarged its fleet to several planes.



THE KWAJALEIN INTERCEPTOR

VOL. 1 NO. 1 KWAJALEIN FIELD STATION, MARSHALL ISLANDS DECEMBER, 1963

THE WINNERS---M--
Isaac

Annual Symposium Attracts 200 Persons; DR Topics Featured

NIKE Project engineers gathered at the Yokwe Yuk Banyan Room recently for the fourth annual Project Engineering Symposium. The Discrimination Radar, the latest ZEUS missile servo system, and the U. S. Navy NAVSPASUR Laboratory were the primary subjects presented to more than engineers and associated

First Edition of Interceptor

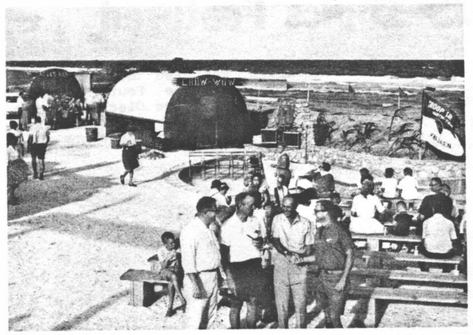


Flying Club Members with First Plane, 1964



Fish Pond Near JTO

Other employees gave their time and talent to help PMZ workers construct Camp Hamilton, the scout facility that would serve the island's youth so well. The camp was named for Gene Hamilton of PMZ, who coordinated the volunteer construction efforts. At this same time, Work Center employees began construction, on their own time, of the large pond near JTO, stocking it with tropical fish and turtles and landscaping the area around it. The fish pond became one of Kwajalein's favorite picnic spots.



Opening of Camp Hamilton, April 1964

Nothing, perhaps, would symbolize community life on Kwajalein as much as the annual carnival, which already was an established tradition. As the ZEUS project grew, the event expanded as new booths, amusements, and rides sponsored by Field Station organizations were added. By 1964 the carnival had become the annual highlight of island life. With a new ferris wheel, the carnival parade and queen contest, Father Hacker's Boys' Band from Majuro, top-notch entertainment from Honolulu, and three dozen concessions doing a booming business on the Midway, carnival weekend on Kwajalein was the most exciting thing going on anywhere between Hawaii and Australia. Proceeds from the carnival supported charities and also helped Kwajalein residents themselves. Carnival profits were used to construct the community center, basketball courts and other facilities, and to bring much needed entertainment programs to the island.

Just before the 1964 carnival, Global Associates became the new logistical support contractor for Kwajalein. Based in Oakland, the company succeeded TCT* on March 1. But not long after,

*TCT, Transport Company of Texas

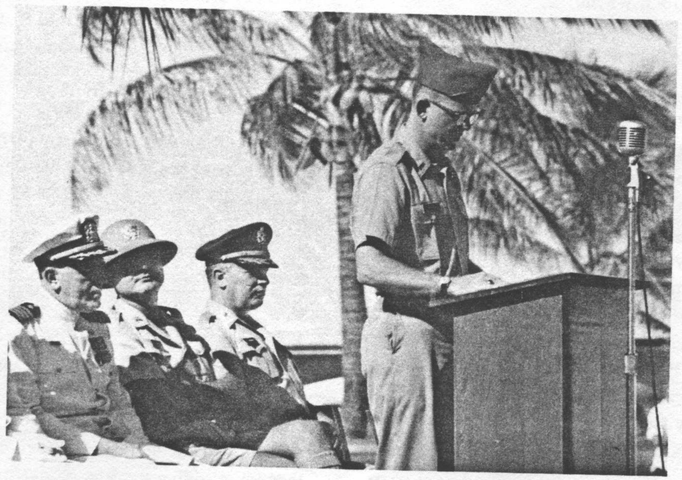
an even more important event occurred—the Army assumed control of the island.

The Army had proposed the change of command some months before in Washington, offering some obvious reasons for the transfer. The real mission of the island was now antimissile missile development, and most of the facilities were dedicated to the NIKE-X project. Additionally, the Army argued, base operations would be more efficient and economical with both technical and support functions under Army control.

Defense Secretary McNamara agreed. "Since the operations are dominantly Army," he wrote, "the support provided through the Pacific Missile Range is an unnecessary expense to the Navy, as well as a drain on Navy personnel. It is appropriate to place this burden on the consumers of range services and to enable them to control the resources essential to support their own operations."

In an official ceremony on July 1, 1964, Capt. H. D. Allen, the island's 18th Naval CO, passed the command to Col. Glenn Crane, NIKE-X Field Office Project Chief, who became the Army's first Commanding Officer at Kwajalein. Kwajalein also received a new name that day—as "Pacific Missile Range Facility, Kwajalein" became "Kwajalein Test Site." It was assigned to the NIKE-X Project Office at Redstone Arsenal, Col. Ivey O. Drewry commanding.

Another significant-and unusual-event occurred a few months later, when Kwajalein "jumped" the International Dateline. This decision, resulting from discussions between Field Station Director Schaefer and Colonel Crane, put Kwajalein on the same five-day work week with Whippany and Vandenberg AFB, eliminating many frustrations in mission scheduling and routine communications back home. To make the change, an extra day was added to Kwajalein's calendar, falling between October 31 and November 1, 1964. It was called simply "Kwajalein Day." As the Hourglass noted, everybody got back the 24 hours he had lost on arrival at Kwajalein. "Additionally," the Hourglass philosophized, "never in recorded history have so many individuals been privileged to live through an eight-day week."



Change of Command, July 1, 1964 — Capt. H. D. Allen, Outgoing Naval CO; Col. Glenn Crane, New Army CO; Col. I. O. Drewry; Lt. Kelly Hawkins, Reading the Orders

Special Services staged many one-of-a-kind events for Kwajalein Day, including a picture-taking sail around the atoll on the Ebeye Ferry. Young opportunists quickly realized that the extra day in October might also mean an extra Halloween, and the island's trick-or-treaters took to the streets a second time. Meanwhile, Mr. Schaefer and others were apprehensive on October 32 for another reason: "We held our breaths all that day for fear that one of the 30 expectant mothers on Kwajalein would produce a baby," he later remembered.

On Sunday, November 1, Kwajalein began observing the same date as CONUS.* Project personnel still found themselves wondering what time it was at Whippany, but at least they no longer had to worry what day of the week it was. Shortly after Kwajalein received a new date, it also received a new address. The island was assigned its familiar APO Zip Code, 96555.

The following year, 1965, the old "Roxy" Theater for dependents was refurbished, air-conditioned, and renamed the "Ivey" Theater in honor of Colonel Drewry. Residents turned out in force for the theater's premiere, Circus World, starring John Wayne.

New Horizons, a Farewell to NIKE-ZEUS

With a fully developed sense of "community" on Kwajalein, island residents began developing closer ties with their Marshallese neighbors. Excursions to Ebeye and the outer islands were frequent, and get-togethers were often festive occasions. Kwajalein's religious organizations and the school system did much to promote mutual understanding among Kwajalein and Ebeye residents, as did the Yokwe Yuk Women's Club, which opened the handicraft shop in the Air Terminal in 1963. Proceeds from handicraft sales provided scholarships for Micronesian youth. Many other activities, such as scouting and softball, also did much to develop good will.

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*CONUS, Continental United States

On September 8, 1964, Kwajalein and Ebeye residents christened the symbol of Ebeye's unique commuter culture, the "Tarlang" ferry. Eight hundred people from Kwajalein jammed the "Tarlang" for its maiden voyage to Ebeye and were met by hundreds of Marshallese for dedication ceremonies. A "name the boat" contest gave the ferry its unusual name, which means "storm-proof" in Marshallese. The "Tarlang" began transporting several hundred Marshallese commuters to and from Kwajalein each day, and over the years it has provided millions of passengers miles of safe, reliable service.

The horizons of NIKE-X people also stretched well beyond the atoll. The adventurous took vacations to Japan, Hong Kong, the Philippines, Australia, New Zealand, and the South Seas, and many others discovered the little-explored pleasures of Ponape, Palau, and the other Micronesian isles. More conservative vacationers were content to "settle" for a stay in the Hawaiian Islands.

Space available travel to Honolulu for dependents was introduced about this time. This welcome privilege ended the feeling of claustrophobia that naturally arose after many months on the island and also gave Field Station ladies a chance to catch up on shopping during their well-deserved "R&R's."

During 1965, Colonel Melvin Clark succeeded Colonel Crane as Commanding Officer, and H. W. Cosgrove was the Staff Department Head. J. J. Bulla had become WE's Site Manager, and H. D. Hurlbut assumed control of the reentry measurements effort from G. W. Riesz. W. L. Shaffer followed R. D. Johnson in the Test Operations Department, and M. S. Sholar became the new Douglas Test Manager.

During Mr. Schaefer's stay on Kwajalein, the NIKE-ZEUS system continued to mature. More successful intercepts took place, and the ZEUS System continued to meet more difficult challenges, yielding knowledge essential for NIKE-X. But there were signs everywhere that the ZEUS era was coming to an end. The ZAR was retired



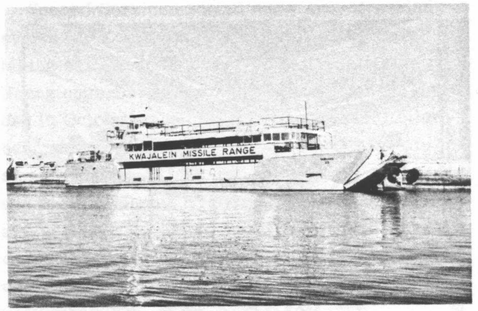
APO 96555



Micronesian Handicraft



Ebeye



Tarlang Ferry, Kwajalein Harbor

in late 1964 "with great ceremony and with the sadness of a funeral for a faithful friend," as Mr. Schaefer recalled. The ZAR had performed admirably, but with the availability of the DR, and preparations under way for the new MAR on Kwajalein, the ZAR became the first piece of equipment to complete its role and retire with honors. Others followed, yielding one by one to more sophisticated successors. A monument to these early achievements in the ABM project—the fully-scaled ZEUS missile erected on Lagoon Road—was dedicated shortly after the ZAR closed down.

At the Country Club, 150 Field Station employees, their spouses, and guests turned out for another farewell, for J. G. Nordahl, chief of Kwajalein liaison at Whippany. On that occasion, and in a full round of dinners and cocktail parties held in his honor, Mr. Nordahl was officially declared Kwajalein's "Mayor." His final flight from Kwajalein in September 1965 marked his 20th round trip voyage between CONUS and the atoll.

Mr. Schaefer himself, whose work in the 1940's with command guidance and "controlled projectiles" (later known as "guided missiles") had led more or less directly to the entire family of NIKE air defense systems, left Kwajalein also. He turned direction of the Field Station over to Russell C. Newhouse, its third Director.



Maj. Gen. J. G. Zierdt, C. G. Army Missile Command, Col. Glenn Crane, and J. W. Schaefer, Field Station Director, 1963 – 1965, outside "JTO"

NIKE-X was progressing steadily, but its design was still far from frozen. Elements of the initial NIKE-X system at this time included the MAR, the MSR, and the SPRINT and ZEUS missiles.

All of these, except ZEUS, were state-of-the-art developments. It shortly became clear, though, that even ZEUS would not survive—at least in its original form. Strategic requirements for NIKE-X called for the use of a larger warhead for intercepts at very long ranges, where ground effects would be negligible. As a result, designers began work on a larger, improved successor to ZEUS, dubbed DM 15X-2 in 1965 and renamed Spartan in January 1967. The new missile, also developed by Douglas, retained basic ZEUS technology and components but could deliver the much heavier payload.



ZAR Complex (Receiver in foreground, Transmitter at rear)



Completing ZEUS Missile Monument, Lagoon Road, January 1965



"Mayor" J. G. Nordahl Departs Kwajalein for the Last Time, September 1965

RMP studies, as well as the successful continuation of ZEUS firings at Kwajalein,* comprised the bulk of the technical effort during Mr. Newhouse's tour of duty, from mid-1965 to mid-1967. In June 1966, the first phase of RMP-A was concluded and was followed by RMP-B. Reentry studies in RMP-A had emphasized the

*Sixty-one ZEUS missiles were launched from Kwajalein between 1961 and 1966, when the ZEUS firing series ended.



R. C. Newhouse, Field Station Director, 1965 – 1967

"slick" conical vehicle, considered difficult to discriminate and measure because of its reduced atmospheric resistance. RMP-B would study RVs* of varying shape, size, and material as well as secondary payload such as chaff.

Caribou and Reindeer Visit the Tropics

Up at Meck Island, clearing and grading were completed, and work on MICB† and other facilities began in June 1966. The construction program at Meck was no less ambitious than that on Kwajalein six years before—and perhaps more so since personnel and material had to travel by boat to the island.

*RV, Reentry Vehicle
†MICB, Meck Island Control Building

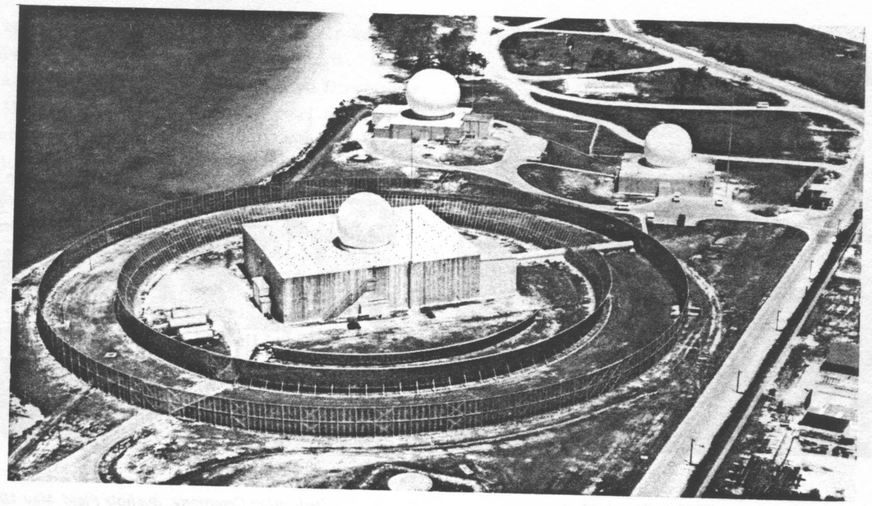
Meck also presented another problem—planning commuter transportation for Field Station people who would work there. On April 1, 1967 an airstrip at Meck was completed. For a while, though, this accomplishment seemed only the beginning of the problem, since FAA* representatives inspecting the strip refused at first to certify it. The strip was short—1500 feet—and its alignment required takeoffs and landings in crosswinds considered hazardous for most aircraft.

The solution came out of the blue, so to speak, when three Caribou aircraft arrived at Kwajalein in 1967. These aircraft, built by De Havilland Canada, proved more than a match for the short but difficult commuter run to Meck.

The Caribou, as thousands of Meck commuters would learn, possessed remarkable ruggedness and reliability. It could fly comfortably on only one of its two engines, and it could operate on frozen lakes or deserts, on beachheads, jungle airstrips, cow pastures, auto highways, ordinary runways like Kwajalein's, and not-so-ordinary runways like Meck's. The plane could land on a 500-foot runway and take off on only an 800-foot strip. This sort of versatility made the Meck runway seem not only adequate, but ample.

The Caribou, with its powerful Pratt-Whitney engines, could carry thirty-odd passengers, or four and one half tons of cargo. It could also be converted from the passenger to the transport mode in a matter of minutes by a single man. It boasted great maneuverability—its turning radius of 29 feet was less than that of most automobiles. Cruising at something over 100 mph, the plane cut travel time to Meck to about ten minutes—50 minutes faster than the two new personnel boats, SPRINT and SPARTAN, could make the trip. The capabilities of the ungainly but efficient Caribou were convincingly demonstrated to Mr. Newhouse, Colonel Healy (who succeeded Colonel Clark in

*FAA, Federal Aviation Administration



Reentry Studies Radars – DR (foreground), TTRs 4 and 5

mid-1966), and others during flight demonstrations in 1967, shortly before the first members of the Meck team arrived.

Prior to the Meck build-up, Kwajalein's population had dropped somewhat. However, high-level visitors, important events, and continuing turnover were continual reminders for all that this was a period of build-up, and not decline.

Among the events often recalled during this time was the Independence Day celebration of 1965. On that evening, island residents crowded Emon Beach for a fireworks display, in which 200 skyrockets streamed out over the lagoon and exploded with spectacular results. The event resurrected vivid memories of the battle of Kwajalein among older Marshallese, but the younger set was no less fascinated than the younger Americans on Kwajalein.

Out on the coral reef, shell collectors enjoyed a rare bonanza in March 1966, as a 0.0 tide occurred at Kwajalein and the ocean almost disappeared from view. "Everything from scorpion, cowrie and finger shells to varicolored anemone and sea urchins were lying about waiting for collectors to pounce," reported the Interceptor.

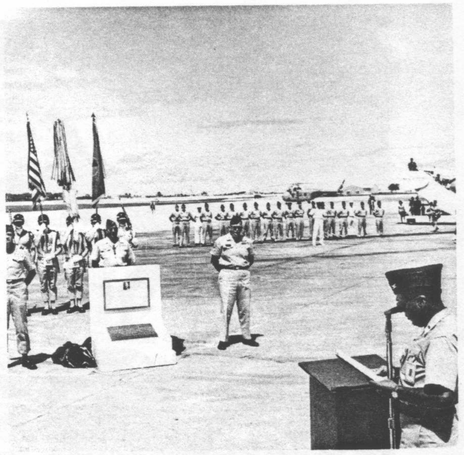
Over at Special Services, W. M. Johnson of Bell Labs and others introduced FM radio programming for island residents via the local AFRS station. This was an imaginative and welcome addition to the entertainment scene. The build-up for NIKE-X also occasioned more construction near "downtown" Kwajalein, where ground was broken for the Palm and Shell BOQ's, which opened in 1967.

At the air terminal, 2,000 residents of Kwajalein and Ebeye gathered in May 1967 for a special Memorial Day service. With the 264th Army Band from Honolulu on hand, and the color guard from the 7th Infantry Division in Korea attending, the Army officially dedicated Kwajalein's airfield to honor Private First Class Fred H. Bucholz, who lost his life heroically during the final hours of battle in 1944.

At the Field Station, World Airways retired its familiar WE charter plane, DC-6 N-90783,



Reefing at 0.0 Tide, March 1966



Dedication Ceremony, Bucholz Field, May 1967



Palm B Q

which had logged over five million miles to and from Kwajalein. Another DC-6 replaced it. In February 1966, D. P. Ling, Executive Director of the Military Systems Research Area, was the featured speaker at the eighth Bell Labs-Western Electric Joint Technical Symposium.

Toward the end of that year, Kwajalein's youngsters awaited the arrival of St. Nick and wondered if his reindeer could handle the long flight from the North Pole to the tropics. Santa, like everyone else at Kwajalein, had to improvise. In 1966, St. Nick (alias Wally Smith, Sr., of Bell Labs) touched down at Bucholz Field in a helicopter. In other years, he arrived in a Cessna (courtesy of the NIKE Flying Club), and on one occasion he was spotted sailing serenely into Kwajalein's harbor in a Yacht Club CAL-20.



D. P. Ling Addresses 8th Joint Technical Symposium Audience, 1966



"Distinguished Visitor", December, 1971

Santa's arrival, the excitement of "Macy's Toyland," and special religious services all made the holiday season something extraordinary. But the holidays were also the time when home and family suddenly seemed more remote than ever, and despite the novelty of Christmas in the tropics, there were few who did not long for a touch of frost on their windows as the holidays came and went.

7

COUNTDOWN AT MECK

The Team and the Task

By the Spring of 1967, solutions for 'X' had been postulated, and the spadework at Kwajalein and Meck had begun. That summer, Mr. Newhouse returned to Whippany. In his place Thomas W. Winternitz was promoted to the Field Station Directorship from his Department Head position at Whippany. He was the first of four Field Station directors whose job it was to demonstrate that years of NIKE-X planning rested on solid foundations.

The arrival of the Meck team occasioned the most dramatic period of growth in Field Station history. It began with an across-the-board change in Field Station technical management. Three new Department Heads—S. C. Rogers,



At left, T. W. Winternitz, Field Station Director 1967 - 1969, with visitors T. W. Stephens and G. Crane, McDonnell Douglas, Brig. Gen. I. O. Drewry, Col. D. B. Millar, and C. R. Able, McDonnell Douglas, October, 1968

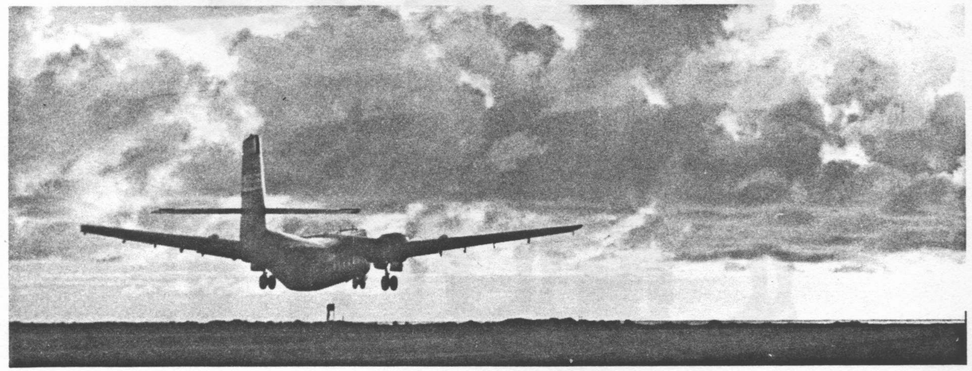
R. O. Sinclair, and C. R. Swanson—came with Mr. Winternitz. Mr. Rogers managed the upcoming Spartan R&D test firing program at Kwajalein. Mr. Sinclair followed Mr. Hurlbut in the ongoing discrimination measurements effort, while Mr. Swanson undertook the complex task of putting the Meck System together. W. L. Teulings, who succeeded H. W. Cosgrove as Head of Staff a year before, was the sole Bell Labs Department Head to remain. Elsewhere, Glenn Crane, formerly the island's Commanding Officer, returned as a civilian and succeeded R. H. Klamt as chief of the Douglas contingent. W. E. Ratcliff followed J. J. Bulla as Western Electric Manager, and H. G. Marsh became the first Resident Manager for Raytheon, developer of the MSR, and the newest member of the Field Station team.

"Think Meck" became the watchword in the summer of 1967, as planeloads of NIKE-X newcomers arrived at Bucholz Field. Many newcomers barely had time to unpack their "hospitality kits" before returning to the terminal for flights to Meck Island. Caribou service began on August 3rd, and before long as many as 350 Field Station employees were taking a plane ride to work.

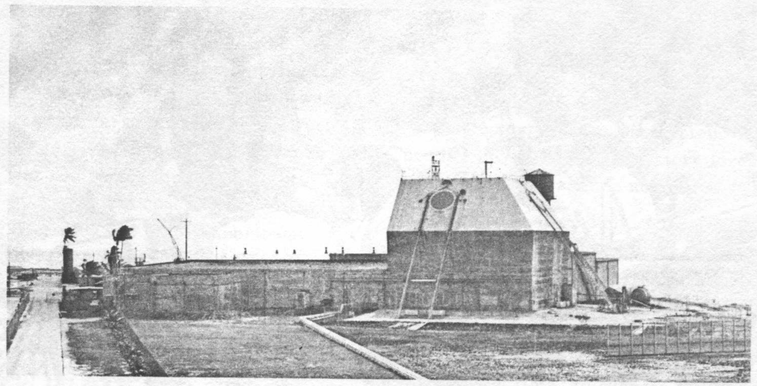
Flying north from Kwajalein past Ebeye, Gugeegue, and Bigej, commuters were given their first look at Meck from the south at 500 feet. The island was not difficult to identify. Meck had been completely swept of vegetation. Dominating the island were the MICB, the missile assembly area, the launch complex and power plant, all of which were either under way or nearing completion.

The Meck System was more complex than its NIKE-ZEUS progenitor. Its command center, the MICB, housed the MSR and its associated MSDP*. The MSR was an advanced radar whose mission, in simple terms, was battle management. It was a precision target-tracking and interceptor-guidance radar capable of handling high traffic. The MSR was also capable of autonomous search and target acquisition up to several hundred miles. As a phased-array radar, the MSR antenna did not rotate—its antenna scanned the skies by electronically shifting the radar beams almost instantaneously. Each of the two faces had 5001 elements. A high-power transmitter and klystron tubes supplied the radar's tremendous electrical force. In the

*MSDP, Missile Site Data Processor



Early Bird Special



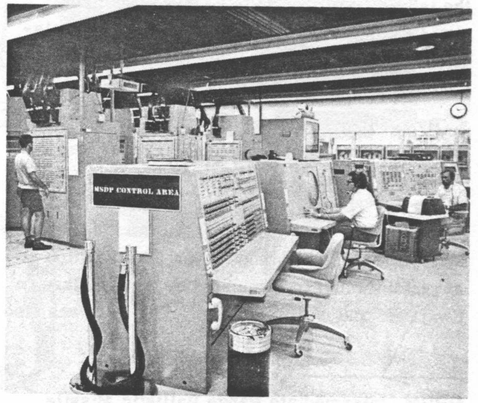
MSR, Meck Island

"turret" area of the MSR, this energy was fed through two "anechoic chambers" to the antenna faces, then radiated outward into space.

In an engagement, the MSR would find and track targets and also automatically launch and guide the defensive missiles to intercept them. The brainpower for this task was furnished by one of the world's largest computers, the MSDP, with several central processors, operating in parallel, performing millions of operations per second. The MSDP was the heart of the system.

The "nerve center" of the MICB was the Mission Control Room, where the test director and his team would conduct carefully planned countdowns (lasting as long as five or six hours) for each test. In the Test Coordination Room, members of the management team would have mission displays and communications networks at their fingertips, while an observation booth accommodated visitors and key personnel not directly involved in the test.

Depending on the mission, either SPRINT personnel from Martin Marietta or SPARTAN personnel from McDonnell Douglas controlled the missile subsystem from the Launch Monitor Room, bringing the missile to a "ready" condition for launch. Adjacent to the Launch Monitor Room was the Meck Data Center, housing an IBM support computer for software analysis and raw data reduction. Meeting the vast power requirements for the Meck System was the critical job of the Meck Island Power Plant, with nine diesel engine-generator units located next door to the MICB.



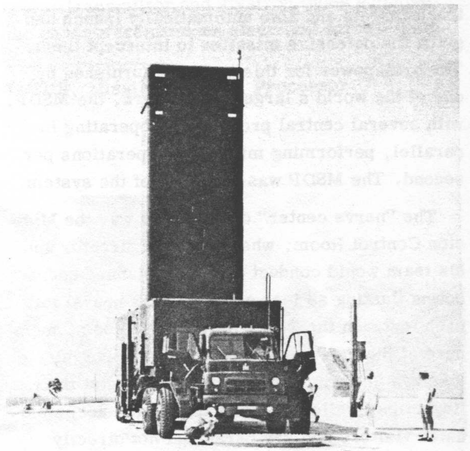
MICB Interior



Mission at Meck

Missile components for Meck testing were flown to Kwajalein, shipped to Meck by boat, and brought to one of the two Missile Assembly Buildings for checkout. A specially designed transporter-loader would actually install them in their cells atop the launch hill at the northern end of the island. SPRINT and SPARTAN would be pitted against ICBMs, IRBMs* and Polaris missiles. In many respects, the Meck System was a complete tactical prototype—almost.

By 1968, development of a new long-range detection and target identification radar was well under way. This was PAR,† designed by General Electric. Though planned as part of the tactical system, PAR would be tested only in the United States. (For test purposes, the PAR function at Kwajalein would be simulated by other radars on Kwajalein and on Roi-Namur.) The PAR was also



Missile Transporter – Loader, Meck Island

*IRBM, Intermediate Range Ballistic Missile
†PAR, Perimeter Acquisition Radar

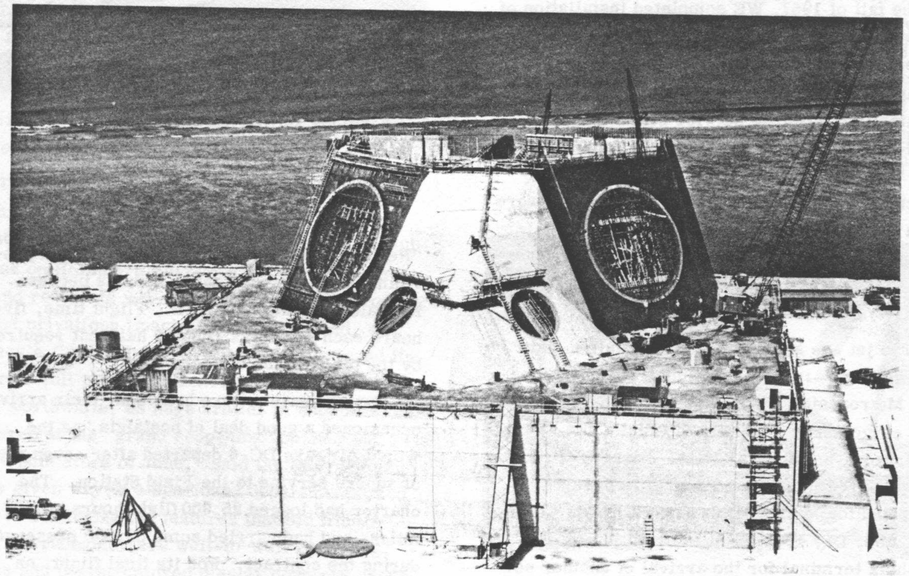
a phased array radar, operating at a different frequency than the MSR. Since the PAR could provide long-range surveillance and tracking at less cost than MAR, early in 1968 the MAR was deleted from the tactical program and construction on the TACMAR* facility at the western end of Kwajalein was redirected toward installation of CAMAR.† CAMAR was conceived as an advanced reentry studies and radar experiment program sponsored by ABMDA,‡ but this project was subsequently cancelled in the summer of 1969.

The NIKE-X system thus included the PAR, MSR, SPARTAN and SPRINT, the deployment of which could be tailored to meet a variety of potential threats. The new capabilities of NIKE-X led to the historic decision to proceed with actual deployment of a "thin" ABM System designed to counter the development of the ICBM by Communist China. The system would also protect United States retaliatory forces and defend the country against accidental ICBM attack.

On November 3, 1967, NIKE-X was redesignated SENTINEL; on November 15, Lt. Gen. Alfred Starbird was named SENTINEL System Manager. In April 1968, Kwajalein Test Site received a new name, Kwajalein Missile Range, and the anti-missile missile test program was now geared, for the first time, to support actual production and deployment. As one Meck commuter recalled, "The pressure was really on."

Much progress had already been made at Meck. In December 1967, installation of a minimum data processing system was completed. In June 1968, MSR installation was finished and power

*TACMAR, Tactical Multifunction Array Radar
†CAMAR, Common Aperture Multifunction Array Radar
‡ABMDA, Advanced Ballistic Missile Defense Agency



CAMAR Construction, August 1969

was turned on. By March 1969, the Meck team had achieved full power radiation, and the basic radar tests were finished. The following month, the computer operating system was demonstrated in a multiprocessor configuration, and in May, checkout of the Meck Phase Zero (M-0) Software Process began. This series of tests was designed to exercise various radar system functions. On June 24th, a milestone occurred as the MSR, under M-0 Software Control, tracked a sphere suspended from a balloon for 25 minutes. In the meantime, the SPARTAN component of SENTINEL was tested on Kwajalein island. On March 2, 1968, the first shot was attempted—unsuccessfully—but it was soon followed by many others, which proved SPARTAN's promise.



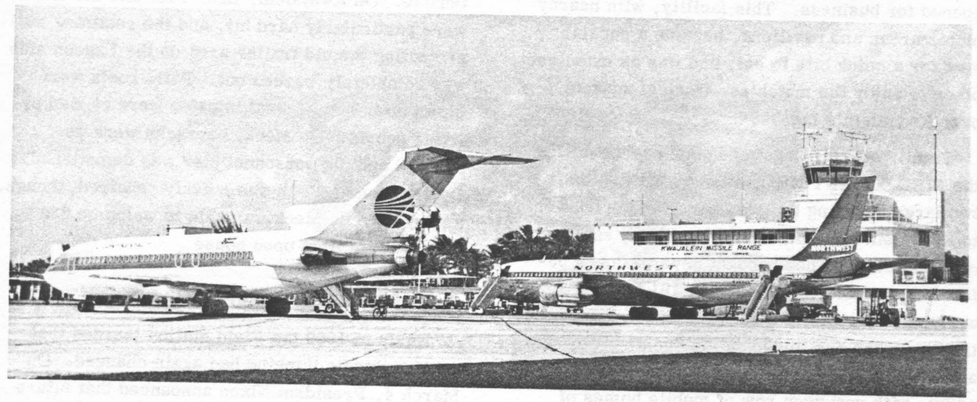
SPARTAN Launch, Kwajalein, 1968

Island Life: Even Better

With Meck testing, SPARTAN firings, and the reentry measurements program in progress simultaneously, Kwajalein again flourished. Among the most needed improvements were steps to modernize Kwajalein's communications systems. In the fall of 1967, WE completed installation of a new No. 5 crossbar switching facility—a decided improvement over the aging step-by-step equipment in service. In August 1968, communications satellite service began between KMR and CONUS, ending years of frustration and "hollering" over the high frequency radio circuits. The satellite also provided a software data transmission link between Meck and Whippany, permitting vital project information to be transmitted in a matter of hours—rather than days or weeks by mail.

The jet age also arrived at Kwajalein—late but welcome—in 1968. In June, Continental/Air Micronesia pioneered commercial passenger and cargo service between Honolulu, the Trust Territory, and the Far East. "Air Mike" flew graceful red, white, and gold 727s specially modified for Micronesia's many coral airstrips. On Labor Day 1968, a huge crowd jammed Bucholz terminal for the arrival of another new jet—a Northwest 707. Better known as the "Redtail," this MAC-charter plane began providing passenger and cargo service between Kwajalein and Hickam AFB. Flight time, five hours each way, was roughly half that required by the prop planes of years past.

Though the jets were heralded, their arrival occasioned a good deal of nostalgia, as the World Airways DC-6 departed after seven years of superb service to the Field Station. The charter had logged 25,000 flight hours—6,200,000 miles—and had carried some 50,000 passengers during the contract. For its final flight, on September 28, a ceremonious farewell was prepared. At boarding time, however, Kwajalein's legendary "little black clouds" rolled in, drenching passengers and spectators alike.

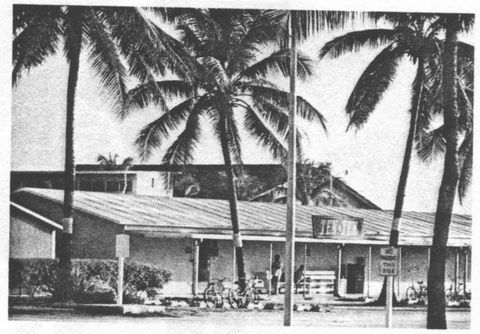


Continental Air Micronesia 727 and Northwest "Redtail" 707, 1969

At the Field Station, W. E. Foster of Martin Marietta had arrived in January 1968, and was the first employee from that company assigned to Kwajalein. At mid-year, W. H. Bauer succeeded W. L. Teulings as Head of Service Operations and Colonel D.B. Millar replaced Colonel Healy as Commanding Officer.

The year brought much that was new on the community scene, including the Community Center on Lagoon Road and the Golf Course Clubhouse on Holmberg Fairways. Also that year, island residents were forced to endure one of the worst privations imaginable on the island, as "Macy's," the only department store, closed its doors a full month for renovation. But the wait was worthwhile, as huge crowds of shoppers discovered at the "grand reopening" on July 29. "The one-room store of June," said the Interceptor, "has given way to a spacious, departmentalized store. . .Among the features that old timers will not recognize are wall-to-wall carpeting, glass and pastel-colored display counters, separate entrance and exit, more mirrors in the clothing sections—and, all in all—almost a 100 percent facelifting."

A year later, the merchandising picture brightened even more with the opening of the Ten-Ten variety store near "Macy's West." The store's name reflected its hours of operation. Noted the Hourglass: "housewives who need a can of milk at night and bachelors who need a box of razor blades can now rejoice!" About the same time, the Tradewinds Snack Bar at Emon Beach

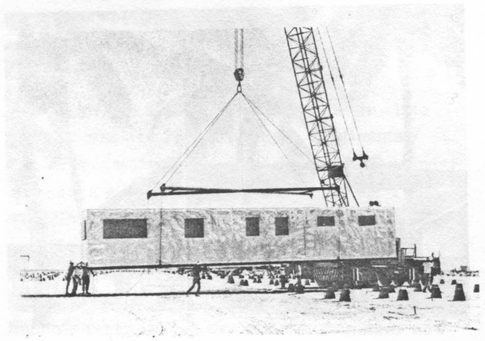


Ten-Ten Variety Store

opened for business. This facility, with nearby picnic areas and pavilions, became a popular spot for a quick bite to eat, and was an excellent place to enjoy the matchless tropical sunsets over Kwajalein's lagoon.

Family quarters again became scarce during the NIKE-X/SENTINEL build up, but in 1968, two large seagoing barges, carrying the answer to Kwajalein's latest housing problem, appeared off Echo Pier. They brought several dozen 55-foot house trailers, the first of 191 trailers that arrived on Kwajalein by the end of the year. The trailers were positioned on the "contingency" fill at the north end of the island. This new trailer camp, with row upon row of mobile homes of gleaming aluminum promptly became known as "Silver City."

The new wave of Kwajalein arrivals had hardly settled when something occurred that gave everyone something to write home about. In January 1969, Tropical Storm Phyllis swept through the western Pacific, and en route paid a courtesy call to Kwajalein. Phyllis left behind what KMR records note as "the worst damage suffered here in the history of the Army." Winds up to 80 knots stripped all of the foliage on the outer islands of the atoll. Roi-Namur and Kwajalein were among the few islands not completely overrun by water, but damage was nonetheless extensive. On Kwajalein, Echo Pier and the Marina were particularly hard hit, and the retaining wall protecting the old trailer area on the Lagoon side was completely washed out. Patio roofs were blown down and several injuries were caused by flying debris. On Meck, barracks were destroyed and the personnel pier was demolished. Destruction at Meck was quickly repaired, though, and by March, Meck was able to welcome 338 guests at its first open house.

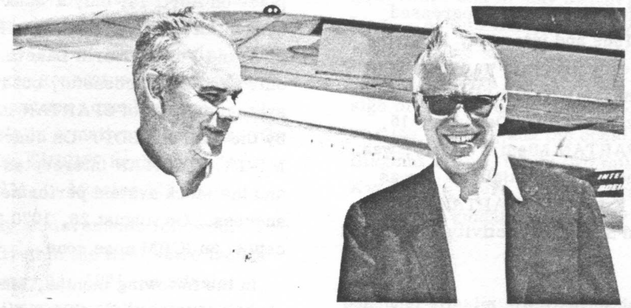


First Trailers for "Silver City," August 1968

From SENTINEL to SAFEGUARD

Early in 1969 the Field Station learned that ABM strategic thinking had again changed. On March 4, President Nixon announced that future deployment of the ABM system would be confined to defense of certain United States Minuteman ICBM sites, as opposed to more expansive "area" defense of United States cities. Ten days later, SENTINEL became SAFEGUARD. Before long, major changes in project management occurred. Brockway McMillan replaced W. C. Tinus, who had served as Vice President for Military Development for 17 years. Mr. McMillan made his first trip to Kwajalein in late June. Also, Brig. Gen. Ivey O. Drewry, Commanding General of SAFEGUARD and frequent visitor to Kwajalein, retired and was succeeded by Brig. Gen. Robert C. Marshall. As mid-year approached, Global Associates won a second contract to serve as Kwajalein's Logistical Support Contractor.

In mid-1969, the first phase of Meck testing was drawing to a close, and T. W. Winternitz prepared to return to New Jersey. During his tour, Kwajalein had come of age. "The Weapons System Contractor staff doubled," he recalled, "and the island had enlarged its original support role to become the major downrange component of the Pacific Missile Range. . . The Field Station grew from a ZEUS Test Station of projected two or three years' life to a NIKE-X/SENTINEL/SAFEGUARD Station with a coordinated reentry measurement capability, plus its important ABM test mission."



C. A. Warren and B. McMillan, June 1969

On July 1, 1969, these responsibilities fell to Charles Willhite, the Field Station's fifth director. Other arrivals at this time included W. R. Matson, succeeding W. E. Ratcliff for WE, and E. F. Weinburg, who followed H. G. Marsh as Raytheon Site Manager. A. C. Price, Jr., replaced R. O. Sinclair in the Discrimination Measurements Department, and H. L. Rosier arrived to follow S. C. Rogers in Missile Operations.

C. R. Swanson, on extension, began his third year as head of the Meck effort, which now approached its important M-1 Phase. In M-1, beginning in April 1970, basic system concepts would be verified and integration of hardware subsystems would be evaluated. In other terms, M-1 meant that the MSR, MSDP, SPRINT and SPARTAN, after years of development and refinement as NIKE-X elements, would be brought to-



Left to right: R. F. Froehlke, C. C. Willhite, Field Station Director 1969-1971
Colonel Millar, Dr. John L. McLucas at Meck Island, December 1969

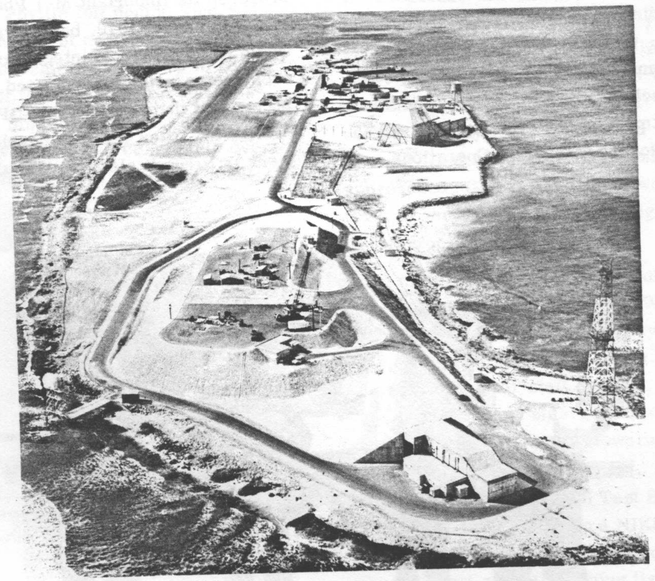
gether and tested as a system, including actual interception of targets launched from Vandenberg AFB.

As preparation for these tests progressed through the fall of 1969 and into early 1970, the Reentry Measurements Program was also carrying out its important mission and SPARTAN testing continued at Kwajalein. On December 15, Mission KT-15, SPARTAN Missile 800017, was successfully launched from Kwajalein. It was the last shot in the Kwajalein SPARTAN Development Program, and SPARTAN activity now moved north to Meck.*

*KT-15 was the last antiballistic missile launched from Kwajalein, but the most memorable of these tests occurred in August when a SPARTAN booster plummeted back to earth on Kwajalein and buried itself several feet into the coral soil near Mount Olympus. Though the point of impact was within safety parameters, the odds against such an occurrence were later estimated at 10,000 to one.

Starting in the spring of 1970, a series of milestone missile firings took place at Meck. The first firing at Meck, Mission M1-1, took place on April 14, only a week after ground was broken for the first SAFEGUARD tactical site at Grand Forks, North Dakota. The effort was only partially successful, but it did verify the system concept of SPARTAN launch and guidance by the MSR & MSDP. On June 24, in mission M1-1A, SPARTAN intercepted a fixed spacepoint, and the Meck system performed with complete success. On August 28, 1970 SPARTAN intercepted an ICBM nose cone.

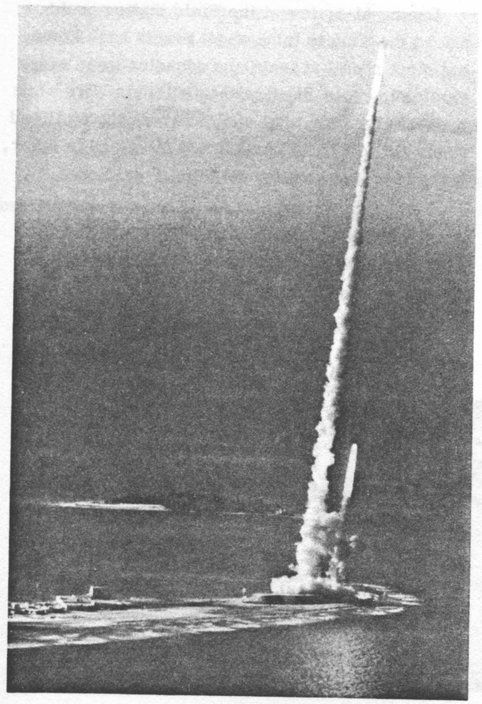
In the following months, Martin Marietta employees prepared for SPRINT testing at Meck. The 27-foot SPRINT was a short-range interceptor that complemented SPARTAN's long-range capability. As a terminal, low-altitude weapon, the main requirement placed on SPRINT was speed. To withstand projected acceleration loads



Meck Island, February 1970, Showing MSR and Launch Complex

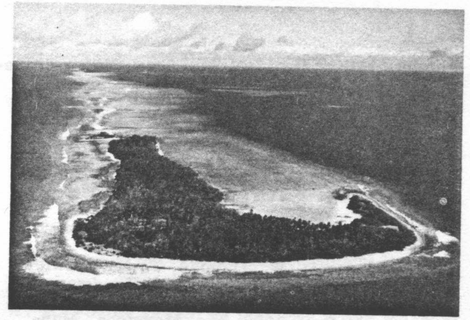
in excess of 100g's, revolutionary advances in propellants, shielding, structure, and electronics had marked SPRINT development from the start. After 42 flight tests at White Sands, SPRINT was ready to fulfill its promise. The missile, popped from its cell by a gas generator, accelerated so fast that it could overtake a machine gun bullet fired simultaneously in a matter of seconds. On December 23, 1970, SPRINT made an historic intercept of an ICBM, in Mission M1-12.

More noteworthy achievements followed. Two SPARTANS were fired in the first salvo launch from Meck on January 11, 1971, in mission M1-30. One missile successfully intercepted an RV, the other a spacepoint. On March 17, two SPRINTS, launched almost simultaneously



First SPARTAN Salvo, Mission M1-30, January 1971

in M1-13, also achieved a successful salvo firing. In April SPARTAN intercepted an IRBM for the first time, and in May SPRINT met a similar challenge. At this time, as Mr. Willhite recalled, "with M-1 we were learning to walk, but with M-2 coming we were also getting ready to run." A sign of the approach of the M-2 series of tests was the clearing and the construction activities at Illeginni Island, thirty two miles northwest of Kwajalein, where the Meck System's remote launch and guidance capability would be tested.



Illeginni "Before"

M-1: Memorable Events

During the M-1 Test Program, the population of Kwajalein reached its all-time high, 4,754 at the end of 1970. The SAFEGUARD Project Field Station reached its peak of about 750 at this time. An unending stream of visitors also journeyed to Kwajalein for a look at SAFEGUARD in action. Though never in short supply, distinguished figures now came with unprecedented frequency—legislators, government officials, generals, even diplomats and members of the United States negotiating team at SALT,* which began with the Soviet Union in 1969. Among these visitors were Robert F. Froehlke, Assistant Secretary of Defense for

*SALT, Strategic Arms Limitation Talks



C. C. Willhite, J. P. Molnar, T. H. Crowley, August 1970



C. R. Swanson with L. W. Morrison at Meck April 1970

Administration; Dr. John McLucas, Under Secretary of the Air Force; Robert L. Johnson, Assistant Secretary of the Army for Research and Development; Lt. Gen. A. W. Betts, Chief of Army Research and Development, and many others.

From Bell Labs came such Executives as J. P. Molnar, D. W. Thomas, T. H. Crowley, L. W. Morrison, C. A. Warren, and L. H. Kellogg. In April 1970, Mr. Morrison, Managing Director of Defense Systems, made his final trip to Kwajalein and announced his plans to retire on July 1 of that year. "For once," he told an appreciative audience at a reception in his honor, "you people at Kwajalein can tell the folks at Whippany what's going on."

During M-1, few at the Field Station could afford the time to think about events back home, but most recall at least one occasion when every Kwajalein resident missed television. "We were probably the only total community in the civilized world not to see Neil Armstrong, live and in color, make his giant step for mankind," said one.

Without question, the social event remembered most clearly at this time was the Field Station's tenth birthday party, attended by 700 guests at the Kwajalein Country Club on October 9, 1970.



10th Anniversary Reception, October 1970

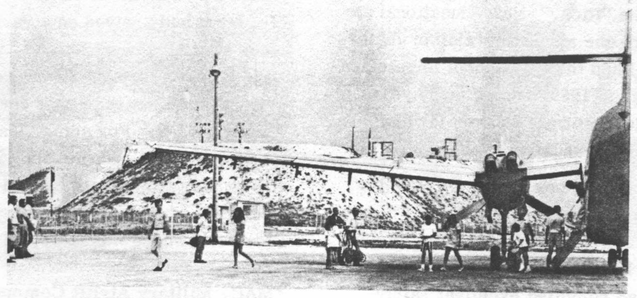


Reunion of Field Station Directors at Kwajalein, 1970
Left to right: Messrs. Benfer, Schaefer, Newhouse, Winternitz, Willhite

The celebration featured, among other things, the largest birthday cake ever baked in the Marshall Islands—130 pounds. On hand were members of the Field Station, many island guests, and a number of distinguished visitors, including all of the Field Station's past directors, Messrs. Benfer, Schaefer, Newhouse, and Winternitz. Other programs veterans, like M. L. Fox from WE and J. L. Bromberg from McDonnell Douglas, were also there. This was truly a night for nostalgia among those who paused to look back on a decade of technical progress.

A few months later, early in 1971, Meck opened its doors for another family day, and 1,000 guests turned out. For youngsters, the occasion was memorable—it meant a ride in the fascinating Caribou aircraft, and a firsthand look at Meck, where all the "Daddies"—and at least several Moms, too—flew off to work.

New arrivals during M-1 included D. R. Brincka, who succeeded Glenn Crane at Douglas in December 1969 and Don Meikle, who followed W. E. Foster as Martin Marietta's Site Manager. C. J. Lind replaced W. H. Bauer in Service Operations in mid-1970, and D. L. Casulli assumed responsibility for the Meck Systems and Software Department, replacing C. R. Swanson in the summer of 1970.



Dependents Arrive by Caribou for Meck Open House, 1971



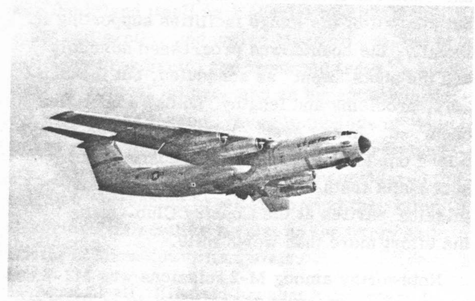
Jr. — Sr. High School and "Silver City"

In the community, jogging became one of the most popular pursuits on the island. The "Lyceum" series of cultural entertainment programs, sponsored by the University of Hawaii, also came into its own at this time. Under the direction of Rev. E. M. Buck, Marshallese from Ebeye and other islands staged "an Evening in Micronesia" for Kwajalein residents, featuring native songs and dances that captivated an overflow audience at the "Rich." New educational facilities, including the modern Kwajalein Junior-Senior High School and the Ivey school for elementary pupils, opened in 1969, ending many years of effort to provide first-rate schools for hundreds of Kwajalein's youngsters.

Not all events were happy ones. On May 18, 1971, the island was shocked by the deaths of two WE employees in a diving accident on the "Prinz Eugen." Though Kwajalein's scuba, flying, and yacht clubs had compiled excellent safety records over the years, this fact served only to emphasize the tragedy on the "Prinz" that day, and the Field Station felt the loss keenly for some time. The "Prinz" was declared off limits, but the silhouette of her stern, barely visible across the lagoon on Kwajalein island, became a haunting reminder of the lives she had claimed.

At mid-year, the Field Station braced itself for a record turnover as M-2 testing began. The M-1 team had arrived on a variety of MAC* carriers—the Northwest Redtail, the Air Force C-141, Starlifters, and a World Airways 707. Most departed on the newly chartered Saturn Airways DC-8. For some, leaving Kwajalein meant going to North Dakota, where SAFEGUARD was moving from a testing to a real-time environment, and where, it was said, the white stuff seen everywhere was not coral sand.

*MAC, Military Airlift Command



C-141

M-2: More Milestones

From April 1970 to late summer 1971, more than fifteen Meck System tests were controlled by M-1 software in a heartening string of successes. The Meck team accomplished the three major objectives of the series: integration of the various subsystems, demonstration of basic SAFEGUARD concepts, and collection of data to support program design and evaluation. The next step was M-2, a more ambitious series of missions designed to test the fully integrated system. In M-2, increasingly complex tracking and intercept situations would be explored as more sophisticated elements of the tactical software were introduced into the Meck System. Additionally, the important hardware capability of remote launch would be tested at Illeginni.

With M-2, the Field Station's organization chart changed almost completely. On July 7, 1971, Edwin P. Felch succeeded Mr. Willhite as Director. About the same time, the MSR and Missile Operations Department, headed during M-1 by H. L. Rosier, became two departments, with E. L. Getchell managing the MSR and C. E. McQueary heading SPARTAN and SPRINT Missile Operations. J. B. D'Albora, Jr. became the new WE Resident Manager. Martin Marietta, McDonnell Douglas, and Raytheon also appointed new Site Managers who were, respectively, H. M. Ireland, J. L. Cuba, and



Saturn Airways DC-8, Bucholz Field, 1972



L. M. Gambrill, Field Station Director 1973-1975, and E. P. Felch, Field Station Director, 1971-1973

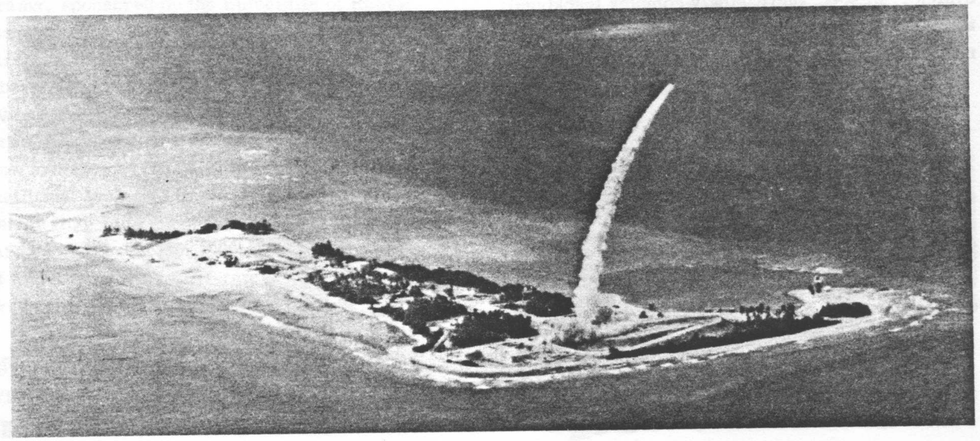
J. C. Holmy. In mid-1972, as the first year of M-2 tests came to a close, L. Bernstein followed D. L. Casulli in the Meck Systems and Software Department, and J. T. Stepp succeeded C. J. Lind as Head of Staff. At KMR, Col. Jesse Fishback was in command.

M-2 testing followed the same pattern of success that had marked M-1. On August 27, 1971, the first mission (M2-1) saw a SPARTAN intercept a TITAN II. A long series of progressively more difficult missions followed, which met the various threats SAFEGUARD had been designed to counter. There were numerous SPRINT and SPARTAN firings, singly and in salvos, against spacepoints and TITAN, Minuteman and Polaris missiles. Many targets of opportunity were also tracked.

The pace quickened at the Field Station during M-2. Missions sometimes came twice in one week (which meant, among other things, that the Meck team would be treated twice to the famed "box lunches" distributed to everyone on mission day). A typical test at Meck required days—even weeks—of preparation, including a thorough "dry run" shortly before the actual test. Dry runs and missions involved not only the Meck team, but also all of the Range facilities supporting it. Usually, the countdowns progressed normally and the shots "went" as scheduled, but inescapably, problems and lengthy "holds" sometimes occurred. In any event, mission day was always a long one and usually quite exhausting, but successful tests—and those memorable post-mission parties at the Country Club—made the effort more than worthwhile.

Noteworthy among M-2 missions was M2-7 on March 16, 1972. This test, the first at Illeginni Island, saw SPRINT successfully intercept an ICBM. SPRINT was launched and was guided remotely by the MSR at Meck Island, 17 miles across the lagoon. This and other tests at Illeginni demonstrated the soundness of the remote-launch concept—to enhance system performance and reduce vulnerability by dispersing SPRINT and SPARTAN defensive missiles, while keeping them under centralized MSR control.

Illeginni, shaped something like a squared-off fish hook, had a special mission in SAFEGUARD development, and those who worked there remember the island itself as a special place. It was quiet and exotic, and unlike Meck, it boasted of coconut, breadfruit, and ironwood trees, a good deal of tropical foliage, and an especially beautiful view of the lagoon. Even in periods of peak activity, Illeginni somehow retained its tranquility. Visitors and residents there considered the island a refreshing break from what they often described (in relative terms) as the hurry and bustle of "downtown" Kwajalein.



SPRINT Launch, Illeginni Island

Most of all, Illeginni brought helicopters to mind. As newcomers quickly noted, if anything seemed more unusual than commuting by Caribou to Meck, it had to be catching the morning chopper to Illeginni. The ride up the west reef in the UH-1D "Huey" chopper was an unforgettable one, providing panoramas of sea, sky, and reef that were nothing short of spectacular. Like Caribou travel, commuting by helicopter was probably safer than driving an automobile to work in the states. Global Associates' pilots transported some 67,000 passengers to and from Illeginni without a single mishap.

If the Field Station had come of age during M-0 and M-1, it was now fully mature with M-2. Though test activity reached a peak and Field Station population remained high—somewhere about 650 through mid-1973—there were some early signs that the end of the Kwajalein experience might be coming into view.



"Huey" Helicopters for Illeginni Commuters

In September 1971, the reentry measurements program, known as KMP*, came to a conclusion after nearly seven years of successful participation in hundreds of tests. DR was also shut down, and the TTR-4 was assigned to support the MSR at Meck. The TTR-5 had closed down some time before.

The weekly visitor list was also shorter, but not by much. Visitors included Gen. W. P. Leber, SAFEGUARD System Manager; Gen. William C. Westmoreland, then Army Chief of Staff; David Packard, Deputy Secretary of Defense, and Air Force Gen. Bruce K. Holloway,



Gen. William C. Westmoreland with D. L. Casulli at Meck Island, October 1971

Commanding General of SAC.† Such dignitaries, of course, were accompanied by a sizeable official entourage. "On one occasion," Field Station Director Felch recalled, "we counted no fewer than 27 'stars' at Meck on a single afternoon."

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*KMP, Kwajalein Measurements Program
†SAC, Strategic Air Command

From the Bell System came Harvey B. Mehlhouse, President of Western Electric, with Executive Vice Presidents Arthur P. Clow and J. S. Herbert, and Vice President W. L. Opdyke. From Sandia Corporation came President John A. Hornbeck. Bell Labs visitors ranged from special guests like Vice President George C. Dacey, a speaker at the 15th Technical Symposium in 1972, to more frequent arrivals like G. H. Baker, A. A. Currie, A. E. Ellis, D. L. Huff, and H. M. Jackson II. Nobel Prize winner Dr. Walter A. Brattain, retired Bell Labs physicist and one of the inventors of the transistor, captivated an audience of 250 during the 16th Symposium. One of the most important "visitors" during the period was Lejolan Kabua, King of the Marshallese people. With Director Felch and others, King Kabua flew to Meck and Illeginni to survey the SAFEGUARD facilities.

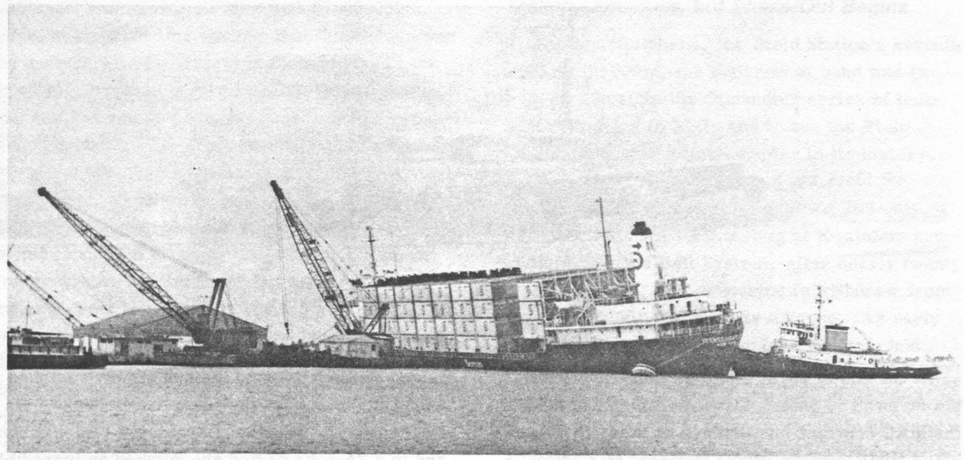


King Lejolan Kubua with E. P. Felch, March 1972

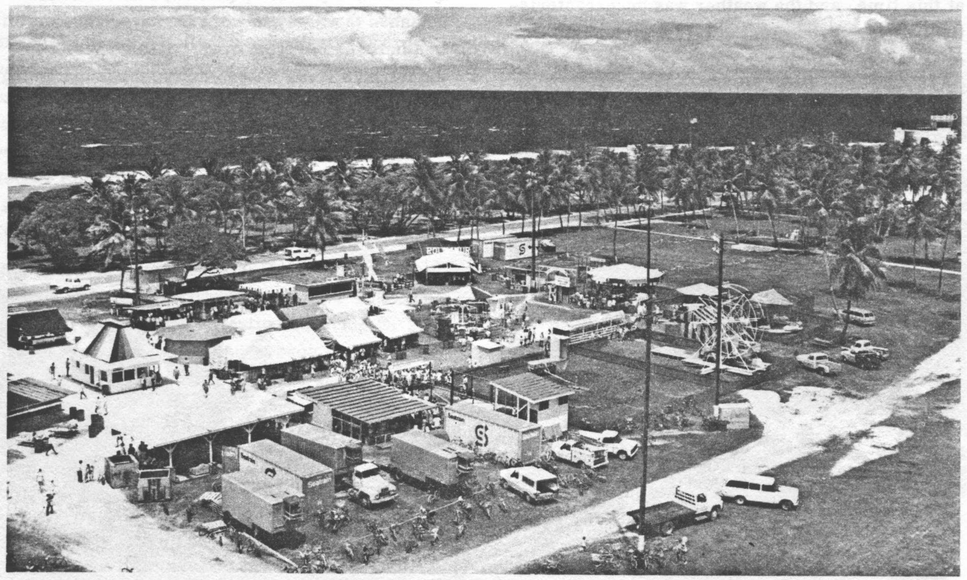
From mid-1973 onward, fewer visitors came to Kwajalein, and more and more people travelled to the SAFEGUARD tactical site at Grand Forks, North Dakota. This was the sole deployment site for the SAFEGUARD System, the United States and the Soviet Union having agreed to curtail ABM production in May 1972. Limiting tactical deployment of SAFEGUARD to a single site seemed to some people as an anticlimactic end to many years of effort, but it was clear that the dramatic success of SAFEGUARD testing had helped to make the overall strategic arms limitation agreements possible. In this sense, Kwajalein Field Station employees could be credited with a significant contribution toward world peace. Furthermore, the many data packages on ICBM and IRBM missions over the years were critically important to the evaluation of our own offensive capability.

Life in the 1970's

Life on Kwajalein in the early 1970's, like the test program, was far different than a decade earlier. It was far better. Travel and communications were vastly improved. New conveniences, like the fresh fruit brought by the seatrains, could now almost be taken for granted. The entertainment scene also brightened considerably. Concerts by the Honolulu Symphony and military bands brought capacity crowds to the Richardson. The Kwajalein Community Theater staged excellent performances of such difficult productions as "Fiddler on the Roof" and "Man of La Mancha." The scouting program expanded still more. In 1972, Kwajalein and Ebeye Scouts staged the first long-term campout ever held in Micronesia, on South Loi Island. The Kwajalein carnival was as colorful as ever, and added new attractions like the Marshallese Stick Dance. In 1972, one of Kwajalein's former carnival queens was crowned Miss Hawaii and represented the "Aloha State" in the Miss America Pageant. She was Marlene Kalahiki, daughter of Harry Kalahiki, the Field Station's well-known travel coordinator.



Seatrain, Echo Pier, 1974



Kwajalein Carnival, 1972



Capitol Airways DC-8, January 1, 1973

At the end of 1972, Field Station travelers bid farewell to Saturn Airways—which had held the MAC contract for eighteen months. In Saturn's place came another DC-8, operated by Capitol International Airways. The new plane touched down on Kwajalein for the first time on New Year's Day, 1973.

The real news at Kwajalein was the weather at this time, and the weather was uncharacteristically bad. From August 1972, the island experienced the longest westerly storm front in its recorded history. For nearly two months, 40-knot winds and driving downpours whipped the island continually, and the sun simply vanished until October, when the front finally broke. On December 15, Tropical Depression Violet arrived, and in a 24-hour period she dumped an incredible total of 17.04 inches of rain on the island. This, too, was a record. The sight of Lagoon Road under three or four feet of water was one that few people on the island would forget — especially those who pedalled, plowed, and otherwise splashed their way to work that day. The erratic weather was far from over. Though Violet left the island's fresh water storage tanks brimming with 15,000,000 gallons of water, and the water



Lagoon Road After Tropical Storm Violet, December 1973

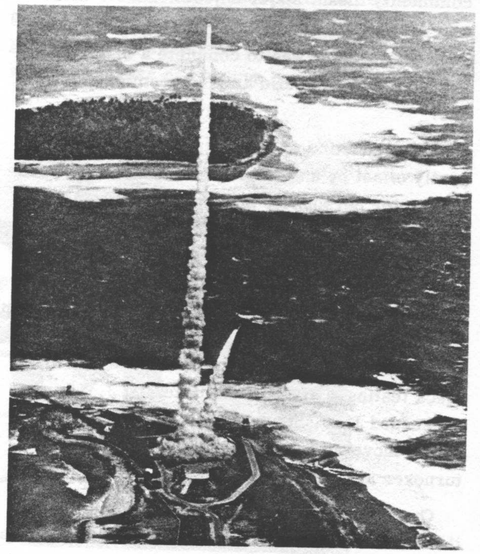
catchment basins overflowing with 5,000,000 more, it soon became obvious that this deluge was the best Christmas present the island could have hoped for, because before long the record downpours of December promptly gave way to a prolonged drought. The first quarter of 1973 was one of the driest in Kwajalein's history. As April approached, fresh water reserves on the island dipped to dangerously low levels, tropical greens turned to autumn browns, and a water conservation program—not the first, but among the most austere—went into effect. The island's salt water distillation equipment ran continuously and utility department employees worked 12-hour shifts, seven days a week, to produce fresh water. In May the drought finally broke, as the wet season typically arrived just in time to soak the midway at the 1973 carnival.

With summer, the traditional turnover came. R. C. Preuitt followed J. B. D'Albora, Jr. as WE's Resident Manager. By the year's end, J. M. Wuerz headed the Meck Systems Department, and with the departure of C. E. McQueary and E. L. Getchell, Radar and Missile Operations were again consolidated in a single department under W. H-B. Perry. J. R. Caswell assumed control of Raytheon operations. The island also welcomed a new commanding officer, Colonel Robert Russell, who succeeded Colonel Fishback as the Army's sixth Commanding Officer at Kwajalein.

In October more than 400 Field Station employees and guests crowded the Yokwe Yuk Club for a hail and farewell reception honoring E. P. Felch and welcoming his successor, Larner M. Gambrill. Mr. Felch became one of the few employees to retire directly from Kwajalein. Under his direction, thirty-odd M-2 missions had taken place, with 90 percent judged completely successful. He left the island with the Army's Outstanding Civilian Service Award and many fond memories of what he called the greatest experience in his life. "After Kwajalein," he said, "any other closing for a Bell System career would have been anticlimactic."

Testing Continues, but Phase-Out Begins

For Mr. Gambrill, the Field Station's seventh and last director, the task now at hand was two-fold—to complete the demanding series of tests still remaining in M-2, and to see the Field Station through the final chapter in its history. By November 1973, the end of the Field Station's mission was clearly in view. Not only was completion of R&D testing at Kwajalein now in sight, but the Bell System, after nearly twenty years of effort, was preparing to withdraw from the field of ballistic missile defense. As early as 1970, Bell Labs and Western Electric had begun planning a long and gradual phaseout involving the reassignment of hundreds of employees from SAFEGUARD to telecommunications work. This carefully planned reduction was already under way when Mr. Gambrill arrived at Kwajalein, and it increased in tempo at Kwajalein, in New Jersey, and in North Carolina even as new SAFEGUARD challenges were met at Meck.



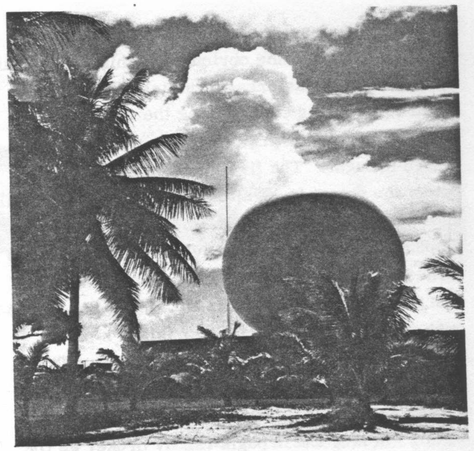
SPRINT Salvo, Mission M2-41, February 1973, Meck Island

In the latter part of 1973 and the first half of 1974, a series of particularly demanding tracking missions took place. These verified SAFEGUARD's ability to perform in environments where target tracking and identification might be confused by many incoming objects and by ionized wakes. These tests, concluded successfully in the summer of 1974, marked the conclusion of nearly five years of SAFEGUARD R&D testing at Meck. Another milestone, the final Meck System intercept of a live target, also took place in the first part of 1974. Activity at Meck, however, was still far from over. Several firings of production missiles remained, as well as a special "follow-on" development and data gathering effort known as BMDTP,* after completion of M-2 tests.

In the final stages of SAFEGUARD testing at Meck, Field Station personnel decreased markedly in number. At the end of 1974, Bell Labs and WE employees totalled only a quarter of those at Kwajalein only two years earlier. "Naturally," recalled Mr. Gambrill, "the declining population of the Field Station and its reduced profile in the community meant major adjustments for those who remained until the end. We were the first ever whose job it was to complete a mature program rather than build a more promising new one."

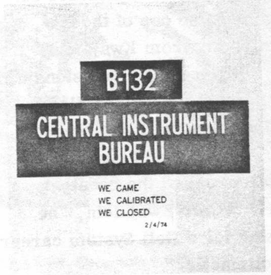
This reduction of Field Station employees was partly offset by an increase in the number of subcontractor personnel, many of whom replaced Bell Labs and Western Electric employees. Noteworthy among Field Station subcontractors at this time was IBM, sending increasing numbers of software specialists to the island. Roy Klaskin, who arrived in the summer of 1974, served as IBM's Site Manager during the final period of Meck testing. At the same time, P. J. Azarelo succeeded J. T. Stepp in Service Operations. These moves marked the end of management turnover at the Field Station.

One did not have to look far to realize that the end was approaching. For the first time in



TTR-4, February 1974

eight years, empty houses and trailers were evident at the northern end of the island. At the western end, the last operational NIKE-ZEUS facility, the TTR-4, bowed out in February 1974, after thirteen years of service in a variety of testing programs. In the "SSC" (SAFEGUARD System Contractor building, formerly the "JTO"), Western Electric's Central Instrument Bureau, one of the first organizations established at the Field Station, also closed shop. A sign of the times, posted on CIB's doorway, was a fitting epitaph: "We came, we calibrated, we closed—2/4/74."



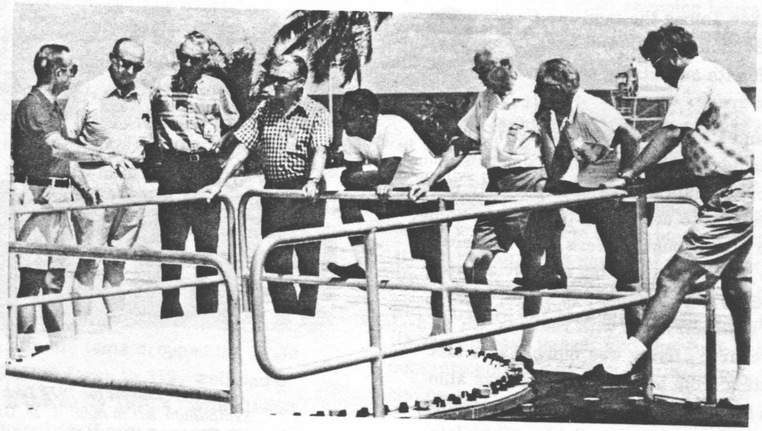
Sign of the Times, 1974

*BMDTP, Ballistic Missile Defense Test Program

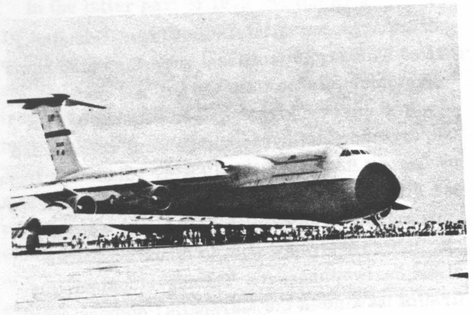
In the final stages of M-2 testing, Field Station employees, like millions of people stateside, felt the effects of soaring inflation and funding cutbacks. Adding to the general uneasiness were specific problems like the fuel crisis, which forced sharp reductions in interisland flights and in the number of motor vehicles available to support the technical effort. Such problems affected job flexibility to a great degree but there was no measurable effect on the quality of the Field Station's overall performance. Energy constraints caused delayed shipments of supplies and merchandise, and urgent pleas for energy conservation were published almost daily in the Hourglass. Early in 1975, island residents were also urged to conserve fresh water, as the year's first quarter, bringing only 1.44 inches of rainfall, proved to be the driest in island history.

By and large, the character of island life remained the same. In several ways, it actually improved. Introduction of cassette television, for example, had finally brought the "tube" to Kwajalein. Though still not the real thing, the videotaped programs shown at the Crossroads, the Yokwe Yuk Club, and elsewhere quickly acquired large and faithful followings. Something called hydroponic (soilless) gardening also came to Kwajalein at this time and brought something new to the island—fresh-grown vegetables. In two experimental hyroponic gardens constructed by Lagoon Road near the TTR-4, volunteers from the Field Station and other organizations successfully raised large quantities of tomatoes and cucumbers that were sold to island residents at the Surfway market. This development, the first of its kind in the Marshalls, demonstrated that substantial amounts of food might conceivably be raised locally on other coral islands in the area.

Old and new airplanes arrived. In November 1973, Saturn Airways again took over the MAC Charter flight, replacing Capitol after its ten-month stint. Among the last visitors Capitol brought to Kwajalein in 1973 were Bell Labs Executive Vice President Kenneth G. McKay, Vice President H. W. Collier, and Executive Director C. A. Warren. In December virtually the entire population of Kwajalein turned out to get a firsthand look at the world's largest airplane—the C5-A Galaxie. Only on Kwajalein, where airplanes had always been something



Left to right: C. M. Bailey, L. M. Gambrill, J. T. Stepp, K. G. McKay, H. W. Collier, W. H-B. Perry, C. A. Warren, and D. E. Cochran Inspect Launch Cell at Illeginni



Open House, C-5A Galaxie

special, would so many people turn out to examine an aircraft. And only on Kwajalein, would the spectators carry such an impressive array of photographic gear to preserve the memory. There were hundreds on hand—from wide-eyed kids with Brownies and Instamatics to "grown-up" kids with Nikons and Spotmatics —and everybody was busy zooming in, stopping down, and clicking away at the C5-A. Rarely on Kwajalein was a single object the focus of so much attention. The plane's dimensions were, indeed, awesome. With a wingspan of 223 feet, the 364-ton bird looked decidedly out of place among the familiar Caribou and C-54's at Bucholz Field. But once under way, she took off with surprising ease and flew with astonishing grace.

The island's long-time fascination with aircraft was understandable. People depended on planes to bring them to Kwajalein, to take them on vacation, and to eventually bring them home. The planes also brought letters, newspapers, magazines, holiday gifts, and eagerly awaited catalog orders. The planes, in short, were Kwajalein's primary link with reality. On Kwajalein, of course, flying was more than a fast way of getting from here to there—it was also fun. With ideal weather, a convenient airport, and excellent instruction available, Kwajalein probably produced more licensed pilots than any other community its size in the world. Aircraft, too, were a routine part of daily life for hundreds of others who commuted to Meck, Illeginni, and Roi-Namur.

It was the WE and MAC charter flights, though, that meant most to Field Station people over the years, and no publication enjoyed more avid readership than the passenger manifest posted at the travel office on "plane day."

For nearly 15 years, the Field Station relied on World DC-6's, a Northwest 707, Air Force C-141's, and Saturn and Capitol DC-8's to transport most personnel and large amounts of project cargo to and from Kwajalein. WE transportation records show that 75,000 Field Station passengers made the trip to Kwajalein over the years, and that approximately 19.5 million pounds of cargo were airlifted between Kwajalein, Hawaii, and the Continental United States.

The End in Sight

Throughout 1974, some traditional Field Station events occurred for the last time. Among these events were the 17th and final Bell Labs-Western Electric Joint Technical Symposium, held in September. Participants included Bell



Hosts and Speakers for 1974 Technical Symposium, left to right: L. M. Gambrill W. P. Slichter, E. F. O'Neill, V. C. Clarke, Jr., M. I. Cohen, W. L. Opdyke, R. C. Preuitt

Labs Executives E. F. O'Neill and W. P. Slichter, WE Assistant Director M. I. Cohen and Vice President W. L. Opdyke. V. C. Clarke was a guest speaker from the Jet Propulsion Laboratory.

Another Field Station trademark, the Interceptor, appeared for the last time in June 1974, completing more than a decade of continuous publication, with a special history of the battles for Kwajalein and Roi-Namur and a final photo-essay on island life and facilities. In its farewell to readers, the paper noted the obvious reason for halting publication: "With more and more people bidding farewell to Kwajalein as the months go by, the decision to stop publication at this time is a realistic and timely one—however reluctantly it may have been made."

Despite these manifestations of the Field Station's approaching close, technical effort continued intensively at Meck throughout 1974 and 1975. At the end of 1974, major modifications were made to the MSR Hardware and to the associated Software Process in preparation for the BMD Test Program. These modifications provided new radar wave forms for gathering data to support future designs of ballistic missile defense systems.

The modified MSR, operating in its earlier SAFEGUARD modes, was used for the final, successful missile firings in April 1975. At the same time, preparations for BMDTP saw the new radar modes used, ahead of schedule, to gather data on targets of opportunity. The successful first BMDTP mission, DG-1, followed in June. Other dedicated missions, as well as data gathering on additional targets of opportunity, then remained to complete the Field Station's responsibilities. Project planning now called for the station's closing at year end, 1975.

As Meck's technical effort continued, completion of the missile tests dropped the Field Station's total work force to 312, well under half its peak in the early 1970's, with almost all of the technical staff now concentrated at Meck.

Those leaving the island during the Field Station's final "countdown" would travel by Continental/Air Micronesia 727 or special Charter, since the MAC DC-8 was finally discontinued in March 1975. With the last of the departing Martin Marietta and McDonnell Douglas personnel was Douglas' Jerry Cuba, who had fought with the Marines at Roi-Namur in 1945, and who alone had witnessed the start of the Field Station's missile programs in 1960 and their conclusion in 1975.

Other matters, too, approached full circle. Just as personnel assignments, transportation, household moves, and facilities enjoyed priority attention in 1961, these same matters—in reverse—now posed special problems fifteen years later. The overall Kwajalein community also experienced a sharp reversal of its long-standing pattern of population growth, expansion of facilities, and improvement of community services. By mid-1975, the effects of declining population were already marked. Many houses and trailers were vacant, with a number of "Silver City" units awaiting removal. Service curtailments included fewer movies, elimination of regular "PM"* visits to quarters, and the closing of once familiar landmarks such as the Crossroads Club. Shortened retail shopping hours led some to suggest that the "Ten-Ten" variety store be renamed the "Eleven-Nine."

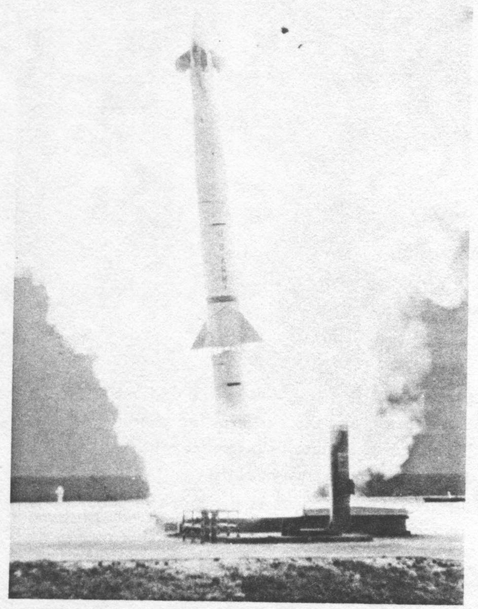
By the summer of 1975, the end of fifteen years at Kwajalein was almost at hand. The SAFEGUARD tracking missions were completed, the last missiles were fired, and the concluding technical effort was devoted to gathering new data essential to the effective design of future BMD systems. At home, the tactical SAFEGUARD system in North Dakota had long since been turned over to its operational users, and the Bell System's commitment to SAFEGUARD had been fully honored.

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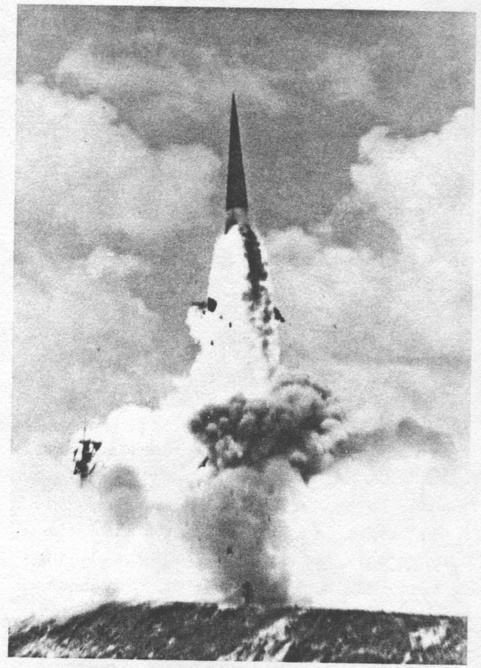
*PM, Preventive Maintenance



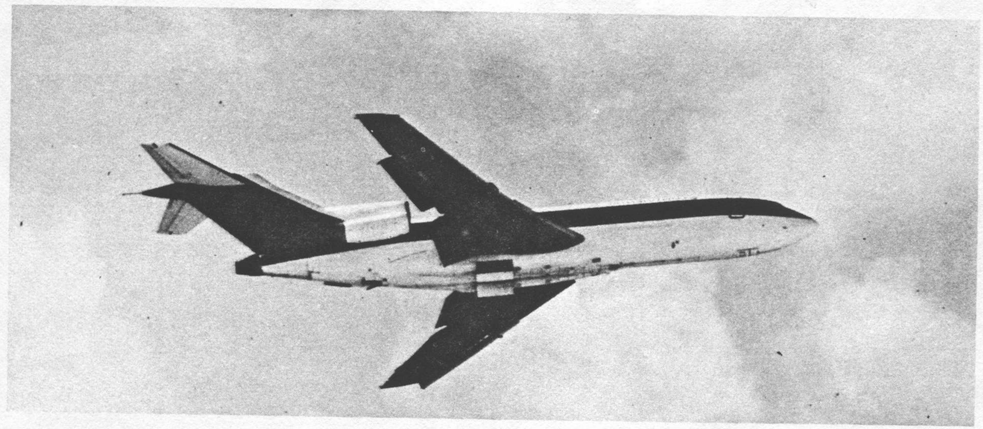
A Decade of Field Station News –
Ten Years of the Kwajalein Interceptor



SPARTAN Firing, April 3, 1975



Final SAFEGUARD Firing,
SPRINT, April 30, 1975



"Air Mike" Leaving Kwajalein



Sunset, Small—Boat Marina

In a personal tribute to the test teams that helped make SAFEGUARD a reality, Field Station Director Larner Gambrill observed:

"In the end, as at the beginning of the Field Station's work, the demands of mission planning and operations were remorseless. Only those who made the missions 'go' over the years can fully appreciate the size and complexity of the system, the months and even years of preparation, and the very small margin for human or equipment error. Almost everything has always depended on the thoroughness of planning and preliminary testing, and on the dedication, the experience, and the skills of the people involved. It is a great tribute to everyone who worked at the Field Station that we have had so few tastes of failure. Our success is the more memorable in light of the extraordinary setting where it took place. All of us will miss the unparalleled beauty of water, reef, palm trees, and tropical sky. These remote coral islands, platforms for our space age miracles, will never be forgotten by those of us who were fortunate enough to live and work here."