MARINES AND HELICOPTERS
1946-1962

HISTORY AND MUSEUMS DIVISION
HEADQUARTERS, U.S. MARINE CORPS
WASHINGTON, D.C.

MARINES AND HELICOPTERS 1946 - 1962

By
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FOREWORD

This history, which traces the development of helicopters in the Marine Corps from 1946 to 1962, offers a tribute to the creative vision and planning of a handful of Marine officers who conceived of the vertical assault concept in amphibious operations at a time when suitable aircraft to make it work did not exist. The story of the subsequent struggle to procure and develop those aircraft, to refine a doctrine for their employment, and to familiarize the Marine Corps with their use is an interesting and vital part of modern Marine Corps history. The documentary basis for this monograph was primarily the official records of the Marine Corps and Navy Department, but considerable use was made of interviews and correspondence with key individuals involved in all phases of helicopter development.

The author, Lieutenant Colonel Eugene W. Rawlins, received his Bachelor of Arts degree in history from California State University at Fullerton. His experience in Marine Corps aviation includes tours in fighter, attack, transport, and helicopter aircraft. During a period of separation from the Marine Corps he was employed by Sikorsky Aircraft as a production test pilot and later flew for San Francisco and Oakland Helicopter Airlines. After returning to the Marine Corps, Lieutenant Colonel Rawlins served in Vietnam with HMM–361 and –364 in 1963–1964. Three years later he returned to Vietnam for a tour with HMH–463. In 1971 after an assignment as Commanding Officer, HMH–361 at Santa Ana, he came to the History and Museums Division where he remained until July 1973.

Comment copies of the manuscript were sent to many individuals involved with both the conceptual and operational aspects of Marine helicopter development. Major William J. Sambito incorporated these comments and edited the manuscript for printing. Major Sambito earned his Bachelor of Arts degree in psychology from Colby College, Maine, and is an experienced helicopter pilot who served with HMM–262 and –165 during the Vietnam War. After attending the Armed Forces Staff College in January 1975, he was assigned to the History and Museums Division.

The History and Museums Division welcomes any comments on the narrative and additional information or illustrations which might enhance a future edition.

Reviewed and approved:
31 December 1976

E. H. SIMMONS
Brigadier General, U.S. Marine Corps (Retired)
Director of Marine Corps History and Museums

PREFACE

. . . the evolution of a set of principles governing the helicopter employment cannot wait for the perfection of the craft itself, but must proceed concurrently with that development. . . .

COLONEL VICTOR H. KRULAK, USMC
1948

During the early stages of helicopter development, when helicopters were able to lift just slightly more than their own weight, the military services were eagerly seeking to obtain a variety of larger, more useful helicopters. The youthful helicopter industry expressed optimism, although at times unrealistic, in its ability to meet the military requirements.

The development of the helicopter program within the Marine Corps was sparked by the foresight and imagination of the officers of the period. While early helicopters provided stepping stones for an orderly progression of the program, the slowness of the technical advances and the periods of financial austerity after World War II and Korea prevented the Marine Corps from developing the vertical envelopment concept as rapidly as desired. The program gained interest and momentum, however, as a result of the success of helicopters in Korea. As Lieutenant General Gerald C. Thomas stated: "Indeed, the helicopter gave clear evidence, from its first tactical employment, that a major advance in combat was at hand."

The division owes a special debt of gratitude to those who commented on the manuscript and provided valuable insight and assistance. Particularly helpful were the responses of General Vernon E. Megee, USMC (Ret); Lieutenant Generals Edward A. Craig, USMC (Ret) and Victor H. Krulak, USMC (Ret); Major Generals Norman J. Anderson, USMC (Ret), George S. Bowman, Jr., USMC (Ret), Frank H. Lamson-Scribner, USMC (Ret), and Noah C. New, USMC; Colonel George W. Herring, USMC (Ret); and Mr. Robert L. Sherrod.

Appreciation is also extended to the many government and military historians and archivists who assisted in the collection of the reference material. An additional note of gratitude is extended to Mr. Benis M. Frank and Mr. Jack Shulimson of the Historical Branch for their help and encouragement.

The monograph was produced under the editorial direction of Mr. Henry I. Shaw, Jr., Chief Historian of the History and Museums Division. The manuscript was typed and indexed by Miss Cathy Stoll and prepared for publication by the Production Editor, Mr. Douglas Johnston. Most of the photographs used in this monograph are official Department of Defense (Marine Corps) photographs from the History and Museums Division. Other photographs were provided by the U.S. Naval Historical Center, Kamen Aircraft Corporation, and the U.S. National Archives.

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Lieutenant Colonel, U.S. Marine Corps

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INTRODUCTION

Early Helicopter Developments

The commissioning of Marine Helicopter Squadron 1 (HMX–1) in 1947 at Quantico, Virginia, is often cited as the official beginning of rotary-winged aviation within the Marine Corps. Interest by the Marine Corps in the capabilities and potentialities of rotary-winged machines, however, dates back some 15 years prior to the commissioning of HMX–1. It was in the early 1930s that the Marine Corps evaluated the Pitcairn OP–1 autogyro to determine its potential military value. Field tested in Nicaragua during 1932, the four-bladed, stubby-winged aircraft was found suitable only for liaison purposes and medical evacuation of the lightly wounded. Considered by those in Nicaragua as unsafe to fly when carrying loads in excess of 200 pounds, the OP–1 soon disappeared from active Marine Corps inventory. Three years later the Marine Corps tested another autogyro, the Kellett OP–2, a wingless version similar to the OP–1, and found it to be equally unsatisfactory due to its small payload capability. The epitaph of the autogyro as a useful Marine Corps rotor-winged aircraft was written in 1936 by Lieutenant Colonel Roy S. Geiger, an early pioneer in Marine aviation who had served as a pilot in World War I and in the ground forces in Nicaragua, the Philippines and China. In a memorandum for his brigade commander, Geiger said, in his position as Commanding Officer, Aircraft One, Fleet Marine Force, Quantico, Virginia, in relation to the autogyro:

> To date no type of autogyro has been demonstrated which will carry a reasonable fuel supply and military load and at the same time retain its peculiar characteristics of taking off and landing in a restricted area and hovering over a given spot. Until such time as this type aircraft can carry a satisfactory military load and retain its flying characteristics its use [by] the Marine Corps is not recommended.[1]

Although the autogyro contributed substantially to rotary-wing development, a useful configuration of a helicopter continued to elude designers and inventors. It was not until 1939 that Igor I. Sikorsky, a Russian-born aircraft designer and builder, successfully test flew the first practical helicopter in the Western Hemisphere.* This was the Vought-Sikorsky 300 (VS–300),** [2] a 28-foot, 3-bladed main rotor helicopter with an open cockpit and powered by a 4-cylinder, 75-horsepower engine.

The Pitcairn Autogyro was the first rotary-winged Marine aircraft. Field tested in Nicaragua, it soon disappeared from the active inventory (Marine Corps Photo 515209).

The building of a rotary-winged machine and

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* The world's first practical helicopter appeared in 1937 in Germany. This was the Focke-Achgeles 61a which had two main rotors mounted side-by-side on outriggers extending from an airplane-type fuselage. The FA–61 had good control; it was once flown inside a 100-by-300-foot exhibition hall in Berlin by a woman pilot, Henna Reitsch.

** In 1929 Sikorsky Aviation Corporation became a subsidiary of United Aircraft which in turn merged the Sikorsky and Chance Vought Divisions in 1939 to form Vought-Sikorsky. Still later, in 1942, Vought-Sikorsky was separated, with Chance Vought remaining in Stratford, Connecticut, and Sikorsky Aircraft Division moving a short distance away to Bridgeport.

subsequent success with the VS–300 were not surprising in view of Igor I. Sikorsky's previous experimentation in the field. As early as 1910, while still in Europe, he had designed and built a coaxial helicopter with a 25-horsepower engine driving two 16-foot contra-rotating rotors through a concentric shaft. Unfortunately, the machine could lift only its own weight. Consequently, Sikorsky turned his talents to designing fixed-wing aircraft.

In 1919, six years after building the world's first successful four-engine aircraft, Igor Sikorsky emigrated from Russia and settled in Connecticut where he continued to pursue the manufacturing of large land and seaplanes. Then, in 1938, he again turned his talent to the field of rotary-wing aircraft and began the most difficult construction of all helicopter designs—the single rotor. While his past experiments had been with the coaxial configuration, Sikorsky preferred the single lifting rotor with a small anti-torque tail rotor. He considered it to be the best rotor arrangement for a helicopter rather than the more popular side-by-side or tandem lifting rotors.

Realizing the potential value of Sikorsky's new helicopter, the U.S. Army Air Corps awarded a contract to Vought-Sikorsky * on 10 January 1941 for an experimental machine, the XR–4, which was to be built on an expanded scale of the VS–300. Exactly one year later the first R–4 flew at the Sikorsky plant, with subsequent improved versions, the R–5 and R–6, taking to the air in August and October of 1943.

Enlarged in size to suit a 450-horsepower engine, the R–5 eventually proved to be the most successful of the three types. The R–4 and R–6 were powered by 175- and 245-horsepower engines, respectively. Later, the two-passenger R–5 (HO2S–1) was further redesigned to meet civilian and mili-

* The Air Corps was acting under a 1939 interservice agreement which gave the Army the initial responsibility for the development of all U. S. helicopters.

The robot OP–1 never got past the testing stage (National Archives Photo 80–G–215856).

tary requirements and became, in August 1946, the first helicopter to be sold to a commercial operator. This three-passenger version of the R–5, while retaining its 450-horsepower engine, was designated by Sikorsky as the S–51 and by the Navy in 1946 as the HO3S–1.

While Sikorsky was the first designer to build a practical helicopter, other American designers soon produced successful and useful rotary-winged machines. In 1943, Frank N. Piasecki, a Pennsylvania engineer, founded the P-V * Engineering Forum at Sharon Hills, Pennsylvania. Piasecki started his company at age 21 with a wealth of knowledge gained by working on various designs of autogyros while employed by the Platt-LePage Aircraft Company in Eddystone, Pennsylvania. He built a small, 3-bladed, single-rotor helicopter, the PV–2, which made its first flight in April 1943. The 1,000-pound gross weight, single-place machine was the first helicopter to incorporate cyclic control and to have dynamically balanced blades. Both of these features were major advancements to the flight control system of a helicopter. Although the PV–2 was Piasecki's first helicopter to achieve flight, it was also the only single rotor design the company would build since advanced designs of other types were already on the company's drawing boards.

A third helicopter manufacturer appeared on the scene in the early 1940s, the Bell Aircraft Corporation, of Buffalo, New York. An established fixed-wing aircraft manufacturer, Bell began helicopter development early in 1942 in a garage located in Gardenville, New York. To the thousands of employees at the nearby fixed-wing plant in Buffalo, the secret project was known only as "Gyro Tests." The goal was to develop and construct a two-place helicopter. Within the next three years the independently operating group had successfully developed three single rotor helicopters. The first aircraft, designated Bell Model 30–1, was a 1,300-pound, single-place, cigar-shaped craft with an open cockpit. The second machine, Model 30–2, was a two-place, closed-cockpit design, with the

* Piasecki-Venzi. In 1946 the company's name changed to Piasecki Helicopter Corporation, to Vertol Aircraft Corporation in 1956, in 1960 to Vertol Division, Boeing Company, and in 1972 to the Boeing Vertol Company, a division of the Boeing Company.

The Sikorsky HO3S–1 became operational in 1946 (Marine Corps Photo 529985).

Lieutenant General Roy S. Geiger, an early aviation pioneer (Marine Corps Photo 1 130 65).

third configuration, Model 30–3, having a three-place capacity.

The Model 30 proved to be so successful that the president, Larry D. Bell, who began his career in 1912 with the Martin Aircraft Company, approved production of a refined version of the third experimental machine. By 1946 Bell had constructed 10 helicopters of the new version and designated them as the Bell Model 47, one of which was issued a Type Certificate H–1 by the Civil Aeronautics Administration on 8 May 1946. This was the first commercial license to be issued to a helicopter.

These three manufacturers (Bell, Piasecki, and Sikorsky) most directly influenced the development of both the Navy's and Marine Corps' helicopter programs. Other manufacturers, though, were actively engaged in experimental helicopter design and construction. Few, however, would produce a model suitable for military use, and those not until the next decade.

Initial Procurements and Designs

As one observer stated, "before Igor Sikorsky flew the VS–300 there was no helicopter industry; after he flew it, there was." [3] Without military procurement of helicopters, prompted by World War II, it is doubtful that the industry as a whole would have blossomed so rapidly. Navy procurements of Sikorsky helicopters followed closely those made by the Army Air Forces, and in some instances, joint procurement of the same machine was made by the two services. Both the R–4 and R–6 models were accepted by the Navy during World War II, with a significant number of R–5s under contract. With the end of the war, however, the Navy cancelled production of the R–5 except for two aircraft. By the end of 1946, the total number of helicopters in Navy inventory was 20: 7 R–4s (HNS), 9 R–6s (HOS), and 4 Sikorsky commercial Model S–51s (HO3S–1).[4] The four HO3S–1s were procured "off the shelf" in November and December of that year for use in the Antarctic on Operation HIGHJUMP. This low inventory figure was only temporary as the manufacturers were eagerly working on improved models designed to meet present and future military requirements.

HRP–1 Development

All the small Sikorsky helicopters and the Piasecki PV–2 lacked the lifting capacity necessary to perform a rescue mission involving the carrying of more than one person, but more lifting ability and passenger space meant a larger helicopter. One method of obtaining a larger design, was to take a "proven" configuration and multiply it by 1½ or 2 times its original size. At this time, however, the Navy's Bureau of Aeronautics (BuAer) wanted to stay within the scope of existing component development and eliminate as many unknown areas of design and construction as possible.[5] Therefore, BuAer decided to approve the design of a helicopter with two smaller lift rotors, each approximately 40 feet in diameter rather than attempt construction of a larger rotor system (60 to 70 feet in diameter) which was still in the early design stage.[6]

In May 1943, prior to the flight of the PV–2, Piasecki had discussed with BuAer a design for a helicopter with two main rotors in tandem, one forward and one aft.[7] The power plant would drive the two 37-foot diameter rotors through reduction gearing and shafting. It would carry a useful load * of about 1,800 pounds,[8] by far the best

* Useful load is defined as the difference between the empty weight of the aircraft and the overall gross (maximum) weight at take-off. Useful load includes the weight of the pilot, fuel, oil, any other special equipment, and the payload. Payload, however, is quite variable. It is not only a function of distance but also of many other factors including altitude of operation, fuel load, temperature, humidity, and wind conditions.

lifting capability of any helicopter to that date.

Piasecki's May 1943 proposal conformed somewhat to BuAer's desire, although there was considerable doubt as to whether a tandem machine could be made to fly—mainly because of the interference of the air-flow to the rear rotor and the problem of longitudinal control. After almost a year of negotiations and study, BuAer awarded Piasecki a contract in early 1944 for the tandem rotored machine, the XHRP–X. This was the Navy's first experimental helicopter, a design arrangement which never received serious attention by any of the leading helicopter manufacturers except Piasecki.[9]

Development of the XHRP–X into a final design acceptable for Navy use was slow. The policy of BuAer required the contractor to produce a full-sized flying model without Navy inspection or interference, with the idea that the contract would be cancelled if the model did not prove successful.[10] The plan also required the test aircraft, XHRP–X, or "Dogship," to be flown by the contractor prior to commencing construction of the first production type HRP–1.

The "flying banana," as the HRP–1 was later nicknamed, and also referred to as the "sagging sausage," was designed to be powered by a 600-horsepower engine driving the two 41-foot rotors. With a full fuel load and a crew of two, it was to carry 900 pounds and cruise at 75 miles per hour. The cargo space could accommodate seats for 10 passengers and would measure 14 feet long and 5 feet wide.

Within one year after receiving the contract, Piasecki built and successfully flew the PV–3 (XHRP–X). The March 1945 flight of the "Dogship" paved the way for design and construction of the 6,400-pound gross weight HRP–1. Unfortunately, the first production aircraft would not be

The HRP–1 by Piasecki was also called the "flying banana" and became operational in 1948 (Marine Corps Photo A–55644).

Marines disembark from HRP–1 during a demonstration at Quantico, Va., on 30 November 1948 (Marine Corps Photo 528063)

The HRP–2 replaced the HRP–1 and provided greater payload and higher speed (Marine Corps Photo 529983).

delivered to the Navy for almost two years after BuAer approved the contract.

The HJP–1 Utility and Rescue Evaluation

Since the Army Air Forces was supporting the single main rotor configuration, the Navy turned to other types of rotor arrangements, not being sold on any one design in particular.[11] In an effort to obtain the best ship-based helicopter for spotting, rescue, and utility missions on board battleships and cruisers, the Navy, in 1946, contracted with both Sikorsky and Piasecki for two helicopters from each company. The competitive contract resulted in Piasecki developing the PD–14 (XHJP–1), the first overlapping tandem-rotor helicopter, while Sikorsky entered the S–53 (XHJS–1), a design using many components of the R–5 (HO2S–1). According to preliminary characteristics and design performance requirements, both machines were to be configured for a gross weight of less than 5,000 pounds including two passengers.

After comparative evaluation, the Navy selected the Piasecki XHJP–1 over the Sikorsky XHJS–1. One major reason for the selection of the XHJP–1 (later redesignated by the Navy as the HUP–1) was that the Sikorsky model required a ballast change in order to accommodate a change in the loading.[12] Sikorsky designed another helicopter to correct the ballast problem but was too late for entry into the utility evaluation. The HUP–1 was finally developed for the Navy with a 600-horsepower engine and seats for four passengers. The helicopter was restricted to a gross weight of 6,000 pounds and an air speed of 104 knots.

The HTL–1 Trainer

With Piasecki's XHRP–1 in production and the XHJP–1 in the design stage, the Navy took further steps to acquire a suitable trainer and settled upon the Bell Model 47. Late in 1946 Bell Aircraft Corporation was awarded a contract for the first of a long series of Navy HTLs, a slightly modified version of the Model 47.

Designs for the Future

As early as the summer of 1944, the Navy had awarded a contract to the McDonnell Aircraft Corporation, St. Louis, Missouri, for the world's first twin-engine helicopter to operate in the 10,000-pound gross weight class and to provide "greater insight into the problems of helicopter design." Variations of rotor diameter, roto-engine gear ratio, and control sensitivity were possible in the large helicopter. The Navy-designated XHJD–1, which first flew in August 1944, cruised over 100 miles per hour and carried a useful load of more than 3,000 pounds. The two 46-foot rotors which turned in opposite directions were arranged side-by-side and were powered by two 450-horsepower engines.

At the same time, another experimental model, the Piasecki-designed PV–15 (XH–16), was also being developed for the Army Air Forces as a long-range transport and rescue aircraft. This helicopter was to have a direct influence on the progress of the Marine Corps' forthcoming helicopter program. It appealed to all services because it had a gross weight of 46,000 pounds and a useful load capability of 14,000 pounds or 40 passengers. The tandem design XH–16, with two engines driving the two 82-foot diameter rotors, was the largest helicopter in the world. Although development of this gigantic helicopter was started by Piasecki in 1946, almost concurrent with the HJP–1, its first flight would not occur until more than seven years later.

Helicopter Applications

During the early part of World War II, the Navy Department initially visualized the helicopter as an aid in combating German submarines which were seriously menacing United States and Allied shipping. Original plans called for the helicopters, piloted by Coast Guard flyers, to accompany ocean convoys and operate as scout aircraft from platforms constructed on the merchant ships.[13] The Navy accepted delivery of its first helicopter, the R–4 (HNX–1), on 16 October 1943 and assigned it to the United States Coast Guard, Coast Guard Air Station, Floyd Bennett Field, Brooklyn, New York. Testing of the helicopter's suitability as an antisubmarine weapon began the following month. At first, the HNS–1 appeared promising, but open sea shipboard trials in January 1944 showed the helicopter to be too difficult to handle and the operation was deemed too hazardous with the present state of the helicopter's development.[14]

During the course of the trials, the Chief of Naval Operations (CNO) approved, on 18 Decem-

The extended rotor idea of the McDonnell XHJD-1 never proved workable as the aircraft was unstable (National Archives Photo 80-G-395920).

ber 1943, the Coast Guard Air Station at Floyd Bennett as a helicopter training base and assigned the Coast Guard the entire helicopter program.* The training portion was to be "under the supervision of the CNO's Aviation Training Division, Op-33," and the development program remained under the Bureau of Aeronautics.[15]

Helicopter operations continued at Floyd Bennett Field until March 1946 with the Coast Guard training its own pilots as well as Navy and Civil Aeronautics Administration personnel. A number of British pilots were also trained at the field during this period.

During the latter years of World War II, a few Sikorsky helicopters were used by the Navy in a utility role on board ships for shuttling very light loads between ships, from ships to shore stations, and occasionally for rescue work. Most operations though were confined to evaluating the helicopter at Floyd Bennett for possible future military application.

* On 1 November 1941, the United States Coast Guard by Executive Order 8929 was transferred from the Treasury Department to the Navy, where it operated during World War II as an integral part until 1 January 1946.

After the war, the Navy's first operational helicopter unit was formed for participation in the Bikini atomic bomb tests in July 1946. Four HOS–1s (R–6s) transferred personnel, recovered film records, and performed other utility missions.

Two months prior to the Bikini tests, a helicopter development program had been initiated by the Navy on 16 May 1946,[16] when the CNO directed the commissioning of Helicopter Development Squadron Three (VX–3). In his letter, the CNO stated that the Secretary of the Navy had approved a development program to provide for comprehensive service trials and experimentation with existing types of helicopters.[17] On 1 July, VX–3 was officially commissioned at Floyd Bennett Field. By this time, the Coast Guard had moved its helicopter operations from Floyd Bennett to Elizabeth City, North Carolina.

Assigned as operations officer of the Navy's new development squadron was World War II fighter pilot and Navy Cross winner, Marine Major Armond H. DeLalio.[18] Two years previously, Major DeLalio had received helicopter flight instruction from the Coast Guard [19] at Floyd Bennett and on 8 August 1946 he became the first Marine

to be designated as a naval helicopter pilot.* [20] When VX–3 moved to Naval Air Station, Lakehurst, New Jersey, in September, Major DeLalio remained as operations officer of the squadron.

At Lakehurst, the unit functioned as the Navy's sole activity for helicopter training and development until its decommissioning in early 1948. During that short period, however, VX–3 became well known to future Marine helicopter pilots for it was through its training program, under the supervision of Major DeLalio,** [21] that many of the Marine Corps' pioneer helicopter pilots were introduced to the controls of a helicopter.

Early Outlook

Throughout this early period, rotary-wing manufacturers were enthusiastic about producing machines of larger gross weights than those already designed or flying. Igor I. Sikorsky, for example, gave his views on improvement of future helicopter designs and capabilities:

> The largest commercially successful helicopter built up to now [1946] has a gross weight of 5,000 to 6,000 pounds. Helicopters with a gross weight of 10,000 to 20,000 pounds can well be produced in the immediate future, on the basis of information already available and along any of the configurations that have already been tested. This gross weight could undoubtedly be doubled within the next five to ten years. There is no doubt that still larger helicopters could be produced in the more remote future.[22]

Sikorsky's predictions for the immediate future were overly optimistic, but it was this type of optimism that enticed the services, not only during the immediate postwar period but later, in the 1950s and 1960s, to contract for rotary-winged aircraft with performance characteristics considerably beyond the state-of-the-art. Yet, optimism on the part of the manufacturers was further bolstered by the eagerness of the services to obtain a variety of larger, more useful helicopters. Unfortunately, helicopters produced for the military in the late 1940s were far from an acceptable service aircraft —all Army and Navy test reports declared the machines to be unsatisfactory for load carrying purposes.[23] The HNX–1 (R–4) and HOS–1 (R–6) required the aid of ground effect * or a good wind before hovering was possible at the designed gross weight.[24] However, these early aircraft, limited as they were, proved to be the true stepping stones in an orderly, but slow, helicopter developmental program.

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* Major DeLalio is listed number 16 on the chronological list of qualified helicopter pilots with the date of qualification as 8 August 1946.

** Lieutenant Colonel DeLalio was killed in 1952 at the Naval Air Test Center, Patuxent River, Maryland. As a test pilot, he was attempting to test the thrust augmentation of a 1000-pound jet-assisted take-off (JATO) rocket attached to an HO4S-1 helicopter when the rocket came detached from its mount and caused the helicopter to become uncontrollable.

* Ground effect, or ground cushion, is experienced when the helicopter is hovering within a height from the ground equal to or less than its rotor diameter. The maximum lifting capability of the helicopter is derived when hovering closest to the ground.

CHAPTER 1

THE ADVENT

The Quest For An Alternative

After the disappointing performance of the autogyro during the 1930s, Marine Corps interest in rotary-winged aircraft was not fully revived until 1943. During that year Marine officers from Division of Aviation (DivAvn), Headquarters Marine Corps (HQMC) sat as members of a joint Navy-Coast Guard-Marine Corps board to discuss formation of a program for the use of Sikorsky R–4 and R–6 helicopters.[1] It was not until June 1946, however, that the first official action to institute a Marine Corps helicopter program began when General Alexander A. Vandegrift, Commandant of the Marine Corps (CMC), established a billet for one officer and three enlisted men within his headquarters.[2] Although there was no mention in his letter to the CNO of forming a developmental helicopter squadron as the Navy had done, General Vandegrift did state that the Marine Corps was particularly interested in the evaluation of the helicopter and requested that his staff be kept informed as to its application.

General Alexander A. Vandegrift, 18th Commandant (Marine Corps Photo A413197).

Nothing significant was accomplished by the Commandant's newly established program until September of that year when Lieutenant General Roy S. Geiger, Commanding General, Fleet Marine Forces, Pacific (CGFMFPac) viewed the atomic bomb tests at Bikini Lagoon as the Commandant's personal representative. During World War II, General Geiger had commanded the III Amphibious Corps which took part in operations on Bougainville, Guam, Peleliu, and Okinawa. He also became the first Marine to command a force on the army level when he led the Tenth Army to a successful conclusion of the Okinawa operation. In his report of 21 August, he expressed to the Commandant his opinion concerning the effects the atomic bomb might have on Marine Corps doctrine during the post-World War II period. General Geiger stated that "since our probable future enemy will be in possession of this weapon, it is my opinion that a complete review and study of our concept of amphibious operations will have to be made." General Geiger went on to say, "It is quite evident that a small number of atomic bombs could destroy an expeditionary force as now organized, embarked, and landed . . . I cannot visualize another landing such as was executed at Normandy or Okinawa." In his final paragraph he urged the Commandant to "consider this a very serious and urgent matter [and that the Marine Corps] use its most competent officers in finding a solution to develop the technique of conducting amphibious operations in the Atomic Age." [3]

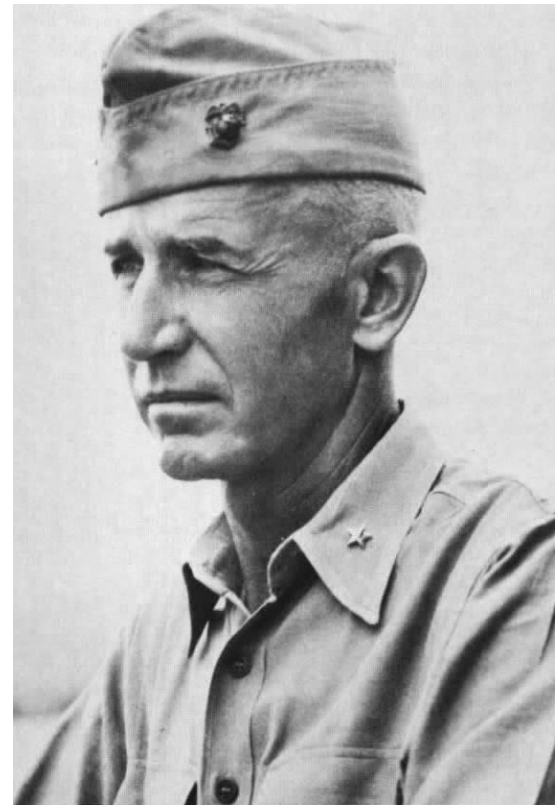
The Commandant acted swiftly by referring General Geiger's letter to a special board composed of three major generals: Lemuel C. Shepherd, Jr., Oliver P. Smith, and Field Harris. General Shepherd had commanded the 1st Provisional Marine Brigade at Guam and the 6th Marine Division on Okinawa and in China. General Smith had been

General Lemuel C. Shepherd, Jr., 20th Commandant (Marine Corps Photo A46471).

the Assistant Division Commander of the 1st Marine Division in the Peleliu campaign and had served as Deputy Chief of Staff with the Tenth Army for the joint Army-Marine Corps Okinawa operation. General Harris served as Chief of Staff to the Commander, Aircraft, at Guadalcanal; as Commander, Aircraft, Northern Solomons; and as the Director of Marine Aviation. The Commandant's instructions to this special board, stressed that "general principles must be determined in order to orient the effort of the Marine Corps away from the last war and toward the next." The final paragraph gave specific instructions as to what the board was to accomplish:

> . . . the Special Board . . . is directed to propose, after thorough research and deliberation, the broad concepts and principles which the Marine Corps should follow, and the major steps which it should take, to fit it to wage successful amphibious warfare at some future date . . . .[4]

General Shepherd's special board was staffed with a Secretariat of three officers—Colonel Merrill B. Twining, Colonel Edward C. Dyer, and Lieutenant Colonel Samuel R. Shaw.* [5] All three were then on duty at Marine Corps Schools, Quantico, Virginia and like the generals on the Commandant's board, had held responsible assignments during World War II and were well qualified to undertake their new task. Colonel Twining had served as the Assistant Chief of Staff, G–3, of the 1st Marine Division during the Guadalcanal campaign and later in the Solomons as Assistant Chief of Staff, G–3, I Marine Amphibious Corps. Colonel Dyer, a naval aviator, saw duty in the Pacific as operations officer of the Strategic Air Force, Pacific Ocean Areas, as Chief of Staff to the Commander, Air, Northern Solomons, and finally as commanding officer of Marine Aircraft Group 61 in the Philippines. Having taken part in the defense of Pearl Harbor on 7 December 1941 as Company Commander, Marine Barracks, Lieutenant Colonel Shaw saw combat as commanding officer of the 6th Pioneer Battalion, 6th Marine Division on Okinawa and later served as Assistant Chief of Staff, G–4, of the same division at Tsingtao, China.



Brigadier General Oliver P. Smith (Marine Corps Photo 94702).

* The name of Lieutenant Colonel Clair W. Shisler appears as the original third member of the Secretariat with Lieutenant Colonel Shaw assigned as his replacement when Lieutenant Colonel Shisler became ill. Shaw signed the Secretariat's report as the third member after Colonels Twining and Dyer.

Brigadier General Edward C. Dyer (Marine Corps Photo A401815).

The three-member Secretariat agreed that the mass destructive capability of the atomic bomb and the vulnerability of a massed amphibious landing force made dispersion a necessity—but only at the risk of defeat through slow and piecemeal commitment of forces ashore. In order to disperse the landing force sufficiently and still, equally important, have a reconcentration of forces at the point of contact with the enemy, a new mode of assault was needed as a supplement to the existing amphibious landing craft.

To solve this problem, the committee considered a variety of means to achieve a rapid buildup of assault forces ashore including transport aircraft, gliders, and parachutists. Transport aircraft would require prepared airfields which, in most cases, would not be available within the objective area. Gliders likewise required a clear and flat area in which to land and discharge troops. Assault by employing parachutists was discarded because of the difficulty in maintaining unit integrity. The use of troop and cargo carrying submarines appeared to offer a better solution than any of the airborne methods previously mentioned. The Secretariat also considered the employment of the helicopter which, appearing to be superior in its characteristics to all other assault vehicles, offered a practical means of overcoming the effects of dispersion while concurrently reducing exposure of the amphibious task force. The Secretariat members knew that the performance of the helicopter was discouraging, but the relative primitive state of helicopter development did not deter their enthusiasm for its application.

Before committing themselves to the employment of the helicopter as a vehicle for a new method of assault, the Secretariat acquainted themselves firsthand with the capabilities of the helicopter. Colonel Dyer visited Sikorsky Aircraft Company and discussed with Mr. Sikorsky the Secretariat's concept. Colonel Dyer stated that the Marine Corps was thinking along the lines of lifting 5,000 pounds by helicopter, with Mr. Sikorsky replying that the plan "was a magnificent idea and that there was no problem, that we [Sikorsky] can do that now, this is within our present knowledge. We can build an airplane [helicopter] that will carry 5,000 pounds. We can build an airplane that will carry much more than that. We know how to do it. Take my word for it." [6] After receiving the rather optimistic report from Mr. Sikorsky, Colonels Dyer and Twining visited the Piasecki Aircraft Corporation on 14 November 1946 where Mr. Piasecki again expressed his opinion that there was "no problem" [7] in constructing a helicopter capable of lifting a 5,000-pound payload.

After their return to Quantico, the members of the Secretariat corresponded frequently with the two helicopter manufacturers.[8] Sikorsky Aircraft presented its developmental ideas and Piasecki pointed out the possibilities of the 10-passenger HRP–1 transport, and the giant 40-passenger XH–16 rescue and transport helicopter as ample evidence of its capability to fulfill the requirements of the Marine Corps for an assault transport helicopter. Colonel Dyer related that the helicopter:

> . . . seemed to be our source of action, but we didn't do much. It sort of died. We went off on other [related] projects, until one day [Lieutenant Colonel] Marion [E.] Carl,* a test pilot at Patuxent, flew a helicopter to Marine Corps Schools to demonstrate it to the students. I'll never forget—he hoisted [Lieutenant Colonel Victor H.] Brute Krulak on a hoist and pulled him off the ground about 15 feet and pulled him into the cockpit. Twining and I were standing by the window and watching, and I said, 'Bill, lets go with this thing [helicopter] and quit fooling around.' He said 'Okay . . . so he wrote the theory . . . principles . . . background . . . reasoning . . . and I wrote a program.[9]

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* Lieutenant Colonel Marion E. Carl was a World War II ace with 18 Japanese planes to his credit. He was on duty at NAS, Patuxent River, Maryland, where as a test pilot, he had taught himself to fly a helicopter.

The idea of using large assault transport seaplanes also received considerable attention by the Secretariat—a sort of "flying LST." But like the helicopter, a seaplane of the size needed for carrying troops and their equipment was not in existence. The Secretariat, nevertheless, concluded that a mixture of these large flying boats and helicopters would be the most promising combination, with the helicopter appearing to be the real "answer to the amphibious prayer." [10]

In early December 1946, the study had progressed to the point where the principal recommendations could be foreseen and the Secretariat sent their report to the Special Board for approval. The Special Board submitted to the Commandant on 16 December an advanced report, recommending that "two parallel programs be initiated which would provide for the development of both the transport seaplane and a transport helicopter." Organization of a Marine helicopter experimental squadron was also recommended at the "earliest practical date for the training of pilots and mechanics and for the practical development of helicopter tactics and techniques for a ship-to-shore operation." Finally, it was suggested that the "Marine Corps Schools be directed to submit a tentative doctrine for helicopter employment." [11]

General Vandegrift concurred with the board's recommendations and on 19 December 1946, only three days after the report arrived at HQMC, it was endorsed and sent to the Marine Corps Schools (MCS) with a statement by General Vandegrift directing that steps be taken to implement the development programs outlined therein.

Concurrently, General Vandegrift sent a letter to the CNO with the Special Board's report as an enclosure. His letter was the first in a long series of correspondence between the two services on the subject of future amphibious operations and was the first service document known to propose the use of helicopters as a tactical vehicle for the transportation of combat troops from a naval vessel to a landing area ashore. General Vandegrift briefly defined the Marine Corps' plan for what later became known as the Vertical Assault Concept for Amphibious Operations and the premises upon which it was based. "Carrier-based transport helicopters," the Commandant stated:

> . . . offer all the advantages of the conventional airborne operation but few of the disadvantages. They can be operated from aircraft carriers now in existence with cover and preparatory fires on landing areas provided by their aircraft from the same force.[12]

General Vandegrift continued:

> With a relatively unlimited choice of landing areas, troops can be landed in combat formations and under full control of the flanks or rear of a hostile position. The helicopter's speed makes transport dispersion at sea a matter of no disadvantage and introduces a time-space factor that will avoid presenting at any one time a remunerative atomic target. It should be noted also that transport helicopters offer a means for rapid evacuation of casualties, for the movement of supplies directly from ship to dump and for subsequent movement of troops and supplies in continuing operations ashore.[13]

A Helicopter Program for 1947

In order to give the new program its initial impetus, the Commandant recommended to the CNO that implementation begin immediately on the two programs recommended in the Special Board's report. He also urged that the corresponding development of tactics, techniques, and organization be given the same consideration so that all areas would be developed concurrently.

The Bureau of Aeronautics was tasked by United States Naval Regulations for the design, development, testing, procurement, and production of Marine Corps Aircraft. Therefore, in aircraft related matters the Commandant had to submit his recommendations to the CNO for his approval.

A series of five recommendations were made to the CNO for the helicopter program in 1947 and three for the following year. During 1947, the Commandant recommended that the Marine Corps organize one developmental aircraft squadron equipped with 12 helicopters of the first available type, with the second recommendation that the Marine Corps study the employment of helicopters in amphibious operations, and the third that it establish the military characteristics of such an aircraft. He also recommended that the Navy begin procuring 48 HRP–1 helicopters for delivery to the Marine Corps in 1948, the Navy accelerate the development of transport helicopters, and the Navy and Marine Corps conduct a token ship-to-shore operation by helicopter at the earliest practicable date. The plan for 1948 contained recommendations to organize one additional developmental helicopter squadron, for the Navy to initiate procurement of a suitable transport helicopter for delivery in 1949 and 1950, and finally, that the Navy and Marine Corps conduct a small-scale ship-to-shore exercise employing helicopters during fleet maneuvers.

Overall approval of the Commandant's program was not immediately forthcoming as various de-

partments within the office of the CNO were required to comment upon the new proposals. The recommendations by General Vandegrift were considered, in general, to be sound and practical although certain phases of the time schedule appeared to be optimistic. On 17 March the CNO's Air Planning Group determined that it was "impracticable to set aside funds in the budget years 1947 and 1948 for the procurement of helicopters for the Marine Corps"; however, it was agreed to "include requirements for Marine Corps helicopters in the 1949 budget." The group "approved tentatively that Piasecki helicopters (HRPs) would be furnished to the Marine Corps for development of techniques and tactics for employment of such aircraft" and to "permit familiarization of Marine pilots with the Piasecki helicopter by sending them to VX–3 at Lakehurst for helicopter training." [14] "Formation of a helicopter developmental squadron and initial design studies of a large transport type helicopter" were approved with "procurement of an assault transport helicopter to be dependent upon results of the developmental squadron's evaluation" of the new technique.[15]

The Chief of the Bureau of Aeronautics, Rear Admiral Harold B. Sallada, commented primarily on the technical aspects of the plan. He mentioned that various helicopter designs were under development and due to a lack of established requirements there was no large transport helicopter included in the Navy's program. Development of a large helicopter by the Army Air Forces, the XH–16, was being followed closely by his bureau. An assault helicopter could be developed, upon receipt of the required characteristics, commensurate with the assigned priority and budgetary considerations. The speed of the program would depend not only on the funds available, but also on the unproven ability of design personnel in the new field; therefore, no assurance was given that an acceptable military requirement could be met by any specified date. "The procurement of 48 additional HRP–1 helicopters for delivery in 1948," the letter read, "would involve the expenditure of approximately $11,000,000. These funds can only be obtained by reducing or eliminating aircraft procurement programs now planned." [16]

Assault Helicopter Characteristics and Design Problems

Meanwhile, at Marine Corps Schools, the Committee of the Academic Board headed by Colonel Robert E. Hogaboom submitted its first report on 10 March 1947 on the desired characteristics for an assault transport helicopter in response to the Commandant's directive of 19 December. Colonel Hogaboom had taken part in combat during World War II on such Central Pacific islands as Makin, Kwajalein, Saipan, Tinian, Guam, and Iwo Jima. During the Saipan and Tinian operations he served as the Assistant Chief of Staff, G–3, Northern Troops and Landing Force, and later, on Iwo Jima, he was Chief of Staff, 3d Marine Division. Entitled "Military Requirements of Helicopter for Ship-to-Shore Movement of Troops and Cargo," Colonel Hogaboom's report stated:

> On the premise that the helicopter offers a valuable means of accelerating and dispersing the ship-to-shore movement, it is recognized that the complete replacement of all existing ship-to-shore conveyances may at some future date be desirable. Under such conditions, it would appear necessary that there be designed a relatively small type helicopter for transportation of assault troops, as well as large type helicopter capable of lifting all divisional loads. However, examination of current technical developments indicates that the latter type may not be practical for some time to come. Accordingly, it is considered more realistic to approach the problem in increments, establishing initially the characteristics for a purely assault conveyance . . . .[17]

It is apparent that the board was considering a helicopter similar to Piasecki's XH–16, which was still on the drawing board, as the large helicopter for lifting the divisional loads. As for the small assault helicopter, its requirements were in consonance with the stated abilities of the helicopter industry, but yet not entirely so, for the board was basing the desired capacity on a tactical consideration—maintaining integrity in the basic infantry combat unit. The report stated:

> Such a machine should provide seating space for 15 and a maximum of 20 infantrymen suitably armed and equipped to initiate combat. The lower figure, considered to be a practical minimum, will permit the transportation, as a unit, of the basic rifle squad plus two additional individuals from platoon or company headquarters. The maximum figure, considered to be far more desirable, will permit the transportation as a unit of the basic rifle squad, plus a skeletonized machine-gun squad or 60mm mortar squad, along with several individuals from platoon or company headquarters. A capacity in excess of 20 men is not desirable in an assault helicopter since the craft will undoubtedly be extremely vulnerable.[18]

"The ideal payload of 5,000 was a desirable optimum," the report stated, with 3,500 pounds quoted as the minimum acceptable load. The 5,000-pound capability would greatly improve the value of the assault helicopter during the ship-to-shore movement of light artillery. Other specifications

included a range of 200 to 300 nautical miles (500 miles with an auxiliary fuel tank), a cruise speed of 100 knots, a hovering ceiling of 4,000 feet, an external hook and hoist, and self-sealing fuel cells. One of the most critical considerations was vaguely addressed—the aircraft's dimensions—the report stating only:

> . . . the craft should be designed to meet the limiting dimensions of the hangar deck and elevators [of the CVE or CVL aircraft carrier].* However, if these restricting factors should cause a material reduction in payload or optimum dimensions of the helicopter, it is believed that steps should be taken to investigate possible structural modifications in the CVE.[19]

The Commandant reiterated the Academic Board's recommendations in a letter to the CNO on 24 March. He believed the Marine Corps Schools' report to be an excellent basis for direction of future developments in the helicopter program.

The Deputy Chief of Naval Operations (Air), (DCNO(Air)), Vice Admiral Donald B. Duncan, commented that the 20 combat troop and 5,000 pound requirements were considered feasible while only minor modifications were necessary in the airspeed and range specifications. The big obstacle rested in the limitations imposed by CVE and CVL elevators and hangar deck dimensions and "modification of CVE-CVL types to handle such an aircraft is considered to be a project of major proportions." [20] The DCNO (Air) was also concerned that "actual construction of such an aircraft could not be reasonably expected prior to 1951 and the imposition of the CVE-CVL restrictions would make the meeting of the minimum requirements [of the Marine Corps] very doubtful." In conclusion, it was stated that until the type of aircraft carrier to be used for helicopter operations was officially determined, further work on a design study which had begun in April in the Bureau of Aeronautics was being stopped.[21]

The DCNO (Operations), Vice Admiral Forrest P. Sherman, in a memorandum to DCNO (Air), recommended on 6 May that a two-step study be undertaken to determine exactly which size helicopter should initially be designed for the Marine Corps. In the memo, Admiral Sherman gave no assurance that a larger type aircraft carrier than a CVE or CVL could be assigned for an amphibious operation employing helicopters as one of the assault elements; therefore, he recommended that the DCNO (Air) investigate the practicability of alterations to hangars and elevators of either CVE or CVL types to handle the helicopter of 5,000 pounds capacity. "If this appears possible without excessive cost and loss of other characteristics of the type," the memo read, "proceed with the design and procurement of the 5,000 pound capacity helicopter." [22] The second recommended step was almost identical to the first, only the weight of the helicopter was changed to read 3,500 pounds in lieu of 5,000 pounds.

By 3 June 1947, Admiral Duncan had concluded the studies as recommended in the 6 May memorandum from Admiral Sherman. "It appears that the 5,000 pound helicopter would be of such dimensions both in length and height as to preclude modifying the CVE or CVL carriers except at exorbitant cost." Admiral Duncan continued:

> By overlapping the rotors in future designs it appears possible to . . . permit stowage of a 3,500 pound helicopter in the CVE–CVL class carriers without modification of the ship or elevators. . . . [therefore] the Chief of the Bureau of Aeronautics is being requested to obtain design proposals for a 3,500 pound payload helicopter.[23]

While the office of the Chief of Naval Operations was making every effort possible to resolve the CVL and helicopter compatibility issue, the Commandant was busily revising his original helicopter development program. The new program was in compliance with a request contained in the CNO's reply to the Commandant's letter written on 19 December 1946. The CNO reiterated Rear Admiral Sallada's (Chief of the Bureau of Aeronautics) contention that procurement of 48 additional HRPs for delivery in 1948 would involve approximately $11,000,000 which could only be obtained at the expense of programs already planned. "Therefore," he commented, "it is estimated that 1948 deliveries of HRP–1 helicopters to the Marine Corps will be sufficient only to bring the experimental squadron up to strength (12 aircraft). Additional procurement will depend on experience gained with this type." [24] The CNO concurred in general with the Commandant's recommendations but pointed out certain factors affecting the outlined time schedule and asked the Commandant for revised recommendations on his helicopter program.[25]

The revised program submitted by General Vandegrift on 4 June eliminated completely the

* CVE, Escort Aircraft Carrier; CVL, Light Aircraft Carrier. As an example, specifications are given here for the Casablanca Class CVE (*Thetis Bay*, CVE-90) and the Independence Class CVL (*Monterey*, CVL-26):

	Tons	*Length*	*Beam*	*Draft*	*Speed.*
Casablanca	7,800	512 ft.	108 ft.	22 ft.	19 kts.
Independence	11,000	622 ft.	109 ft.	26 ft.	32 kts.

request for the 48 HRP–1s and the additional developmental helicopter squadron. Accordingly the Marine Corps program for 1947 was changed to contain three elements: 1) A developmental squadron with as many helicopters as possible be provided; 2) A study of the techniques and tactics of ship-to-shore helicopter operations be conducted; and 3) A request be made to the Navy to accelerate the development of transport helicopters. The new 1948 recommendations sought to keep the one developmental squadron at full strength and to continue experimentation to determine the suitability of the type helicopter being used, while determining the additional specifications and characteristics of the helicopter desired for ship-to-shore movement. Based upon the results of the experimentation, the Navy was to initiate procurement of suitable transport helicopters for delivery in 1949 and 1950. A small-scale ship-to-shore exercise employing helicopters during fleet exercises was further recommended for 1948.[26] In the last paragraph of his letter to the CNO, General Vandegrift mentioned that the 12 HRP–1s proposed for the Marine developmental squadron would permit only a token exercise with a maximum of two platoons. "It is considered," he stated, "that this action will provide much desired information on the problems of tactics and logistics involved. Expansion of this operating force should be undertaken as soon as an improved helicopter is available." The Commandant concluded by "recommending that all remaining available funds be used to accelerate development of a service type helicopter." [27]

General Vandegrift recognized the HRP–1 as only a transition helicopter for experimental use and for the development of the ship-to-shore techniques and not suitable except for those purposes. The aircraft were very expensive and funds for helicopter development were limited. He considered the procurement of HRPs beyond the original 12, now authorized by the CNO for use in the developmental squadron, as undesirable and that the funds should be used in accelerating the development of a new assault helicopter.[28]

On 9 July the Commandant made another important change relating to the helicopter's characteristics by specifying only one size helicopter of a 5,000-pound minimum payload capability. It eliminated the requirement for the helicopter to be accommodated by the ship's elevator and stowed on the hangar deck and listed the overall dimensions as "small as possible." The cancellation of the design proposal for a 3,500-pound helicopter, as requested by the DCNO (Air) on 3 June, was not mentioned, although it is assumed that it was discontinued.

The elimination of the elevator and hangar deck requirement was initiated by the Chief of Military Requirements Section of DCNO (Air). A memorandum dated 3 June to the Assistant Chief of Naval Operations (Marine Aviation), (ACNO (Marine Aviation)), Major General Field Harris, recommended that the Commandant eliminate the stowage requirements for the assault helicopter as it imposed many undesirable design factors—the most pertinent one being "that a rotor overlap * of approximately 75 percent to 80 percent would be necessary in order to meet the elevator dimensions." The only helicopter closely meeting that criteria at the time was the small Piasecki XHJP–1 which was still in the design stage and, in addition, had a useful load of only 1,024 pounds, almost 4,000 pounds less than the required minimum. The Military Requirements Section memorandum further mentioned that rotor overlap of such magnitude imposed "a heavy unknown factor on the design." The requirement for the helicopter to be serviced (stowed, repaired, and checked) on the hangar deck of a carrier imposed the undesirable design factor thereby jeopardizing the success of entire proposal. In order to meet the optimum requirement for a 5,000-pound payload the memorandum mentioned flight deck servicing should be accepted in lieu of hangar deck "and many marginal design factors and difficult design limitations would be eliminated." [29] In addition, the Commandant specified to the CNO a tactical reason for the change:

> In order that the early landing may be provided with necessary continuity, it is necessary that communications vehicles, recoilless weapons, and initial resupply be provided at an early hour and, ideally, that these should be followed by artillery. This requires a payload of approximately 5,000 pounds.[30]

With the Commandant's 9 July revision to his original requirement of 24 March, the specifications for the design of the assault helicopter were temporarily settled. Following that, the CNO stated in a letter to BuAer on 4 November that the Navy's New Development Program for 1949 assigned a priority 3 to the Navy's antisubmarine warfare (ASW) helicopter development and a priority 2 to the Marine's assault helicopter. "In view of the limited funds available for helicopter development during fiscal 1949," the memorandum read, "it is requested that all [fiscal] 1949 funds

* A term used for a tandem-type helicopter to denote the percentage of overlap which occurs when the rear rotor blade passes over the lower forward rotor blade.

be concentrated on meeting the requirements of the assault helicopter as set forth in [my letter of 24 July]." [31] The redirection of funds in favor of the assault helicopter was taken to support the Marine Corps' helicopter program at a time when the Navy was eagerly seeking a suitable helicopter for ASW operations, and when both procurement and research and development funds were exceptionally low.

In spite of Admiral Sherman's directive concentrating funds on the Marine Corps' assault helicopter, progress in its development was doomed to be slow. The Chief of the Bureau of Aeronautics cast the assault helicopter transport program into the development doldrums by linking it with the Air Force's XH–16 program. The CNO was informed by BuAer on 24 December 1947 that additional studies indicated the development of a large helicopter meeting the requirements of the Marine Corps was feasible, but it would involve a four- or five-year program and require considerably more funds than could be obtained in view of the continuing budget curtailments. "It now appears," the Bureau Chief stated:

> . . . that the assault helicopter characteristics are very similar to those of the XH–16 helicopter contemplated by the Air Force . . . and insofar as the basic helicopter is concerned, are almost identical. In view of this fact, effort on the assault helicopter will be undertaken on the basis of joint Air Force/Navy development of the XH–16.[32]

The result of BuAer's action to combine the two projects, an economic necessity on the part of the Navy, delayed the development of a suitable assault transport helicopter and made the Commandant's program fall far short of its goal. Two and one half years later, essentially the same helicopter requirements would be presented to the CNO, and at that time, action would prove to be more responsive to the Marine Corps' request.

CHAPTER 2

CONCEPT DEVELOPMENT

Commissioning and Operations of HMX–1

While progress on the design of the Marine Corps assault transport helicopter was under way, Colonel Dyer also had been busy at Quantico preparing for the eventual organization of the new developmental squadron. The Commandant had appointed him to command the future squadron and concurrently relieved him of his assignment on the Secretariat.

As the prospective commanding officer, Colonel Dyer first had to find a suitable location. The air station at Quantico was chosen as the most advantageous site as it was relatively close to both helicopter manufacturers, Sikorsky and Piasecki, and was literally next door to the Marine Corps Schools. At the same time it was far enough away from FMF operations at Camp Lejeune and Marine Corps Air Station (MCAS), Cherry Point, to permit the squadron to work on purely experimental projects without being encumbered with the operational problems so common to the fleet units.[1]

For selection of personnel, Colonel Dyer turned to the student body of Marine Corps Schools. Addressing members of the Junior Course in session during early 1947, he briefed them on the helicopter and plans for its future employment in the Marine Corps. To the 60 officers present, Colonel Dyer displayed drawings of helicopters of the future, and charts depicting the speeds and payloads which helicopters were expected to achieve. Colonel Dyer later remarked about the results of the briefing:

> I described what our squadron hoped to accomplish and how we hoped to go about it. Then I said, "Now there is a large body of opinion in the Marine Corps that figures that helicopters aren't going any place, so if you are interested stay here, and I'll get your names. If you are not, don't waste your time or mine, just shove off right now!" At that I'd say about two-thirds of everybody there got up and left.[2]

Although still more dropped out later, the majority of the interested officers who stayed constituted the nucleus of Dyer's new squadron.

Plans for the commissioning of Marine Helicopter Squadron 1 (HMX–1) (often incorrectly referred to as Marine Helicopter Experimental Squadron One or Marine Helicopter Development Squadron One) were published in the CNO's Aviation Plan No. 57 on 23 June 1947. This plan tentatively scheduled the commissioning of HMX–1 for 1 July.[3] Unfortunately, at that early date, there was an insufficient number of helicopters available for assignment to HMX–1 and arrangements had not been made for helicopter pilot training, so the commissioning date was delayed. Then on 10 September, the CNO informed BuAer that plans had been made to form HMX–1 on approximately 1 January 1948. He additionally declared that the Navy had recently purchased 22 HO3S–1s from the Sikorsky Aircraft Company with the 9th, 12th, and 13th aircraft of the total package designated for delivery to HMX–1. The CNO further stated that the aircraft scheduled for HMX–1 would be retained and operated by VX–3 at NAS Lakehurst until HMX–1 was commissioned.[4] Two days later, the CNO proclaimed that the Navy was purchasing 20 HRP–1s from the Piasecki Helicopter Corporation with the 5th, 6th, and 7th HRPs going to HMX–1, and like the HO3Ss, these would be sent to VX–3 until HMX-1 was formed.[5] In view of this news, General Harris, ACNO (Marine Aviation),* proposed to the DCNO (Air) that HMX–1 be commissioned on 15 November. This would permit the Marine Corps to assemble the necessary personnel, establish administrative and supply channels, and have hangar space and area assigned so that the squadron would be capable of immediate operations upon receipt of the aircraft.[6] It was not until 22 November 1947, however, that the CNO directed the Commandant

* The Director of the Division of Aviation/Assistant Commandant of the Marine Corps (Air) concurrently held an additional position within the CNO's office as Assistant Chief of Naval Operations (Marine Aviation).

to form and commission Marine Helicopter Squadron 1 on 1 December 1947.[7]

In a related action two days later, the DCNO (Air) approved a plan for the decommissioning of VX–3 at NAS Lakehurst in April of 1948 and the concurrent formation of two fleet units, Helicopter Utility Squadron 1 (HU–1) and Helicopter Utility Squadron 2 (HU–2), with the latter assuming the training mission of VX–3. In the same plan, supplement No. 2 to CNO's Aviation Plan No. 57, it was explained that helicopter deliveries above VX–3's training requirements would be apportioned among the three prospective squadrons, including HMX–1.[8] This action by CNO essentially established a rotating basis upon which HMX–1 would receive its first group of aircraft.

Accordingly, HMX–1 was commissioned on 1 December 1947 at MCAS Quantico, Virginia, with Colonel Dyer as the commanding officer and sole member.[9] On 3 December six pilots joined Colonel Dyer's squadron: Major Russell R. Riley; Captains Paul J. Flynn, Charles D. Barber, and Robert A. Strieby; First Lieutenants Roy L. Anderson and Robert A. Longstaff. All officers except Captain Flynn and Lieutenant Longstaff had completed helicopter training on 11 November at Lakehurst and were designated Naval Helicopter Pilots.[10] Colonel Dyer was likewise a qualified helicopter pilot having earlier, in September and October, completed 40 hours of flight instruction at the Sikorsky plant in Stratford, Connecticut, under the guidance of Dimitry D. (Jimmy) Viner, Sikorsky's chief test pilot.[11] By 6 December, three enlisted men had arrived bringing the total complement of the squadron to 10 officers and enlisted men.

Three days after commissioning, HQMC published the squadron's missions and tasks. As originally issued, the two-fold mission was to: "Develop techniques and tactics in connection with the movement of assault troops in amphibious operations," and secondly, "Evaluate a small helicopter as a replacement for the present OY aircraft in gunfire spotting, observation, and liaison missions in connection with amphibious operations."[12] The six tasks assigned to the development squadron under the two general missions were to:

Igor Sikorsky visits with officers of HMX–1, MCAS, Quantico, Va., in 1948. The aircraft is a Sikorsky HO3S–1 (Marine Corps Photo A322389).

1. Develop a doctrine for the aviation tactics and techniques in the employment of the helicopter in amphibious operations as outlined in [the general missions].
2. Assist the Marine Corps Schools in the development of a doctrine covering the tactics and techniques of the employment of helicopters in amphibious operations.
3. Study the operations and maintenance of assigned aircraft.
4. Develop the flight proficiency of pilots and crewmen.
5. Develop and maintain the technical proficiency of mechanics.
6. Submit recommendations for tables of organization, equipment allowances, and related data for future helicopter squadrons.[13]

The squadron now had to prepare for the arrival of its first aircraft which were scheduled for delivery in January. The ultimate complement of aircraft had been established by the CNO on 28 November at 6 HO3S–1s and 12 HRP–1s, with 5 of each type expected to be assigned to the squadron by 1 June 1948.[14] Although the Marine Corps was hopeful of having helicopters operating in HMX–1 in January 1948, the first two Sikorsky HO3S–1s did not arrive from VX–3 until 9 February. Three more reached the squadron by the end of the month having been ferried directly from the Stratford plant. As indicated in the CNO's Aviation Plan No. 57, Supplement No. 3, the full complement of six HO3S–1s was not expected to be reached until 1 July 1949.[15] In the same aviation plan dated 6 April, it was indicated that only six HRPs were to be in the squadron's inventory by the same date. This announcement brought great disappointment to Marine Corps planners as they were expecting to have the complete complement of 12 transport helicopters by the July 1949 date.

Before HMX–1 received the HO3S–1, the Navy had used its first four, purchased from Sikorsky, on Operation HIGHJUMP during the winter of 1946. Later, as more were accepted, the HO3Ss were evaluated by the Navy for plane guard duty, mail delivery, personnel transfer, and also as training aircraft. The helicopter was a minor modification of the Sikorsky commercial model S–51, which was, in turn, a larger modification of the Navy's HO2S–1—a version in itself of the Air Force's R–5. A Wasp Jr. R–985–AN–5 450-horsepower engine turned a single three-bladed main rotor and torque compensating tail rotor. The aircraft could be equipped with dual controls and had accommodations for a pilot and three passengers. Originally, the helicopter weighed 3,788 pounds empty with a maximum take-off weight limited to 4,988 pounds. The model had a tricycle landing gear and differed from the standard commercial model by having an oil dilution system—needed for operation in cold weather—installed in addition to provisions for one 50-gallon fuel tank and a 300-pound capacity rescue hoist. Because of the limited instrumentation in the HO3S, the aircraft was restricted to day flying, visual flight rules (VFR), and a maxium airspeed of 90 knots.[16]

The Marines' new HO3Ss were primarily intended for utility use; however, the squadron at Quantico was not too concerned with the official mission description listed in the BuAer publications. The aircraft were first put to use in the training of the pilots and mechanics as an additional four officers and nine enlisted men had joined the squadron during January. The first mission of an operational nature, exclusive of training, was on 24 February when an HO3S was used to lead a salvage party to an amphibious jeep ("Weasel") that had become mired in a creek.

Improvement of pilot techniques continued through the month of March, and in addition, various flights were made to determine the value of helicopters for aerial photography, artillery spotting, reconnaissance, and wire laying. Many indoctrination flights were also given to ground officers for the purpose of familiarizing them with the helicopter's characteristics.[17]

In early April 1948, a Bell Aircraft representative and test pilot visited HMX–1 to demonstrate the company's new 47–D helicopter. Besides the demonstration, the Bell test pilot gave the squadron pilots some very helpful and eagerly sought after advanced flight instruction. The Bell team also demonstrated the 47–D, the equivalent of the Navy's new HTL–2, to members of the staff of MCS, Fleet Marine Force, Atlantic, and 2d Marine Division audiences.

Initial Request for an Observation Helicopter

Until 1948 there was not a helicopter specifically designed for military observation in actual production. In existence, however, was the Bell model 47E in flight test at the Bell factory and the one Sikorsky S–52, which had already completed flight test; both of which, it was believed, could easily be converted for military observation use. At the time though, the Navy's HTL–2, an im-

proved version of the HTL–1 which incorporated a larger engine and bubble canopy, was being produced in quantity for the Navy as a trainer and represented a close approximation to the final configuration of what could be expected in future observation helicopters. But until such time as either the experimental Bell or Sikorsky observation helicopters became operational and were available in quantity, considerable operational experience could be gained through operating a small number of the Navy's HTL–2s. With this thought in mind, and with a desire to comply with the squadron's second mission of evaluating a helicopter as a replacement for the OY fixed-wing aircraft, Colonel Dyer recommended, on 28 April 1948, that the Marine Corps procure three HTL–2 trainers.[18] The new Commandant, General Clifton B. Cates, who had relieved General Vandegrift on 1 January 1948, requested on 13 May that the CNO provide HMX–1 with the three HTL–2s.

General Cates, as well as his predecessor, appreciated the potential value of the helicopter as it applied to amphibious assault techniques. During World War II, he had commanded the 1st Marines in the 1942 Guadalcanal campaign and in 1944 was the commanding general of the 4th Marine Division in the Saipan, Tinian, and Iwo Jima campaigns. In the period between 1942 and 1944, General Cates was Commandant, Marine Corps Schools. Returning to Quantico in 1945, he became president of the Marine Corps Equipment Board for six months before being named as the Commanding General, Marine Barracks, Quantico, and ultimately, Commandant in 1948. On 23 May the CNO replied to General Cates' letter concurring with its content, but reduced the number allotted to two aircraft.[19]

General Clifton B. Cates, 19th Commandant (Marine Corps Photo 306430-A).

Bell HTL-2s on board the USS Valley Forge *in the early 1950s (National Archives Photo 80-G-424772).*

Approximately 10 weeks later, on 9 August, the squadron received the first HTL–2 from NAS Lakehurst, New Jersey. The Bell helicopter was two-place, dual controlled, and powered by a 178-horsepower engine driving a two-bladed main rotor. The cruising speed, similar to the HO3S, was 80 knots but unlike the HO3Ss, the gross weight was only 2,200 pounds.[20]

Since most of the pilots had received a minimum of 15 hours in the HTL–1 while undergoing training at HU–2, a familiarization syllabus was not necessary. Tests were immediately begun to compare the HTL–2 with the OY aircraft in artillery spotting, liaison, and aerial photography work. The results of the preliminary evaluations indicated that the HTL was superior in all respects to the OY, except that the OY's cruising speed was higher.[21]

By November the evaluation had been completed and the results sent to the Commandant by Colonel Dyer. Based upon Colonel Dyer's letter, on 24 November General Cates asked permission of the CNO to change the complement of a Marine observation squadron from its previously authorized eight OY aircraft to four OY and four helicopters. The Commandant stated that all of the helicopters observed and tested as replacements for the OY aircraft, the latest model Bell HTL–3 and the Sikorsky S–52 closely met the Marine

Corps' requirements of size, configuration, and gross weight, with the S–52 rated as the most desirable of all models.[22]

The Sikorsky S–52 was a two-place, three-bladed single-rotor-system utility helicopter built completely at Sikorsky's expense and concurrently with the larger and now practically defunct XHJS–1. The 2,100-pound gross weight of the S–52 permitted the aircraft to carry a useful load of approximately 1,000 pounds at a maximum airspeed of 91 knots. The HTL–3 trainer was similar in general configuration to the HTL–2 except that a 200-horsepower engine had been installed in place of the HTL–2s 178-horsepower engine which increased the useful load to approximately 706 pounds.

As an interim measure, therefore, the Commandant recommended that 12 HTL–3s or S–52s be procured for the Marine Corps to implement the change in the VMO's aircraft complement. As a long-range recommendation, he requested that the design and procurement of a light helicopter be initiated to meet specifically the requirements for a military observation helicopter.[23] At this point the Commandant's request for the interim helicopters "struck a snag when BuAer replied that the new machines of the desired type were not available"—for assignment to the Marine Corps.[24]

It was not until the next year that the CNO's Aviation Plan Number 21–49, dated 7 April 1949, outlined the plans for outfitting the VMO squadrons. The plan specified that the HTLs were considered satisfactory for Marine observation requirements and that as the HTL helicopters became available they would replace half the observation aircraft in existing VMO squadrons.[25]

Approximately three months after the 1949 aviation plan appeared, the Commandant submitted to the CNO the Marine Corps' specific requirements for the desired type of observation helicopter. The letter, dated 1 July 1949, mentioned that HMX–1 had conducted extensive evaluation of helicopters as replacements for the OY type aircraft for VMO squadrons and determined that some specific requirements were necessary if the aircraft were to be suitable for observation work. Generally, the specifications required that the helicopter carry a useful load of between 800 to 1,000 pounds, have dual controls, be capable of flight at maximum gross weight for a duration of four hours, and carry a pilot, observer, and one additional passenger. The requirements listing the maximum air speed and dimensions were omitted.[26]

One requirement which had been a problem in single-main-rotor helicopters was the need to shift the ballast inside the aircraft either fore or aft. This was necessary to keep the helicopter within its designed flight control parameters—for, should

The Bell HTL–3 was an improved version of the HTL–2 (Marine Corps Photo 529989).

the center of gravity change excessively, the helicopter would become uncontrollable in the air. In tandem-configured helicopters a change in the center of gravity was less critical due to the location of the lifting rotors. Therefore, the tandem rotor helicopter permitted a less stringent loading requirement—a feature which appealed to the helicopter pilots and loading crews. In this relationship, the new observation helicopter requirement stipulated that the aircraft should be capable of operations within allowable center of gravity limits at minimum and maximum loading conditions without having to resort to shifts in ballast, or equipment, to stay within operating center of gravity limits. In relation to size, the aircraft was to be small enough to lend itself to ease of concealment and transportability on a widely varied number of vehicles, and to be able to operate from small areas in the field.[27]

Published later, on 16 August 1949, was CNO's Operational Requirement AO-17503 (Liaison helicopter) which defined, in further detail, the requirements desired for such an observation helicopter. Seven such specifications were listed:

1. Maximum visibility.
2. Extreme maneuverability.
3. High rate of climb.
4. Performance and internal space sufficient to carry two litters or a limited amount of cargo.
5. Capability of sustained flight with all or part of one rotor blade missing.
6. Interchangeable and foldable rotor blade for simplicity of maintenance and stowage of aircraft.
7. Provisions for quick (five minutes or less) installation of television and electronic reconnaissance equipment.[28]

As a result of the favorable flight evaluation of the Sikorsky S–52, BuAer initiated a contract with Sikorsky for the S–52–2, a version of the original S–52 (Navy designation HO5S–1). When further modified and later delivered to the Marine Corps, it would be a four-place, 245-horsepower, three-bladed machine with a quadricycle landing gear. Official missions descriptions were listed as observation-liaison, reconnaissance, gunfire adjustment, evacuation of wounded, transportation of personnel, and general utility. As a medical evacuation aircraft, the copilot's seat could be removed and two litter patients carried internally, in addition to the pilot and attendant. An unusual feature, one which would later amount to a great impairment in its use, was that its take-off weight was limited to 2,769 pounds. With a pilot and observer, and a full fuel load of 222 pounds, the 245-horsepower engine would allow for a skimpy 157 pounds of payload![29] The delivery date for the first aircraft was scheduled for September 1951.*[30]

Operation PACKARD II

By the end of April 1948, HMX–1 had 12 officers and 32 enlisted men on duty with an additional four officers and eight enlisted men temporarily attached while undergoing pilot and mechanical training. Although the squadron had been operating helicopters for only three months, sufficient progress had been made by this date in both the operational and maintenance sections to the point where Colonel Dyer was receptive to a suggestion from Lieutenant Colonel Victor H. Krulak, Assistant Director of the Senior School, that HMX–1 participate in the MCS forthcoming training exercise, Operation PACKARD II.

The MCS amphibious command post exercises were held annually by joint Navy and Marine Corps forces to simulate a ship-to-shore assault landing against an enemy-defended beach. Operation PACKARD II represented an ideal opportunity for HMX–1 to implement one of the helicopter program objectives for 1948 and would present the first test in the movement of troops by helicopters in a ship-to-shore operation.

Lieutenant Colonel Krulak was extremely knowledgeable on the subject of amphibious operations. During World War II he commanded the diversionary landing at Choiseul to cover the Bougainville invasion and had served as Assistant Chief of Staff, G–3 for the 6th Marine Division then under the command of Major General Lemuel C. Shepherd Jr. Lieutenant Colonel Krulak earned the Legion of Merit for his part in the planning and execution of the Okinawa campaign. Colonel Dyer later remarked about the conversation he had with Krulak: "No one could ever characterize a flight of five helicopters carrying three Marines apiece as an overwhelming force, but Krulak felt —and I agreed—that we [HMX-1] should go on board ship and . . . make . . . a landing."[31] It was also planned that because of the many unknown factors involved, that only a minimum satisfactory performance should be sought rather than a maximum endeavor which might develop

* The Sikorsky S–52 would be the first production helicopter to have all-metal rotor blades. In view of the climatic effects and sand abrasion on wood and fabric rotor blades, this represented a basic improvement in durability and lifetime. During April 1949, the S–52 established a world's speed record at Cleveland, Ohio, of 129.55 miles per hour.

unforeseen difficulties and thereby jeopardize the operation.[32]

The squadron was given a list of objectives for PACKARD II, three of which were:

> 1. To take a positive step forward in the development program by making an actual landing of troops by carrier-based helicopters.
> 2. To gain experience in operating helicopters on board an aircraft carrier and experience in helicopter landing operations upon which a sound doctrine for these operations could be written.
> 3. To determine probable military requirements for landing force helicopters of the future.[33, 34 *]

As finally developed, and later executed, the operational plan, prepared by the MCS student staff, provided for an element of the landing force, the staff of a regimental combat team (RCT), and HMX–1 to be embarked in escort aircraft carriers (CVEs). For problem purposes, the regimental staff planned in full, and theoretically executed, the ship-to-shore movement of a constructive regimental combat team using a problem force of 250 HRP–1 helicopters operating from four CVEs. This movement and subsequent employment of the helicopter-borne force was part of, and integrated with, the overall attack plan of the naval attack force and landing force. The RCT staff also planned the actual ship-to-shore movement of the regimental headquarters and this was executed in reality by five HO3S-1 helicopters, consistent as far as practicable with the theoretical plan.[35] The squadron spent the early part of May 1948 making plans and preparations for PACKARD II and on 18 May departed Quantico for Norfolk, Virginia, where it flew on board the USS *Palau* (CVE-122).

As the operation began on 23 May at 0930, the five HO3S-1s took off from the USS *Palau*, anchored off Onslow Beach at Camp Lejeune, North Carolina, and proceeded in formation to the designated landing zone a few miles inland. The troops of the first flight were landed precisely at 1000. Thereafter, continuous flights were made until all troops, less a small logistical group, were landed. Following the landing of the troops, a number of flights were made simulating the movement of cargo loads requested by the regiment ashore. During the day's operations, a total of 66 Marines and a considerable amount of communications equipment were transported to the beach by helicopter. A total of 35 flights was made between the *Palau* and the landing zone.[36]

The squadron concluded from its participation in PACKARD II that "transport helicopters capable of carrying at least eight troops were urgently needed if combat troops were to be landed expeditiously and in battle formation." Also, that "in order to use the space available in a CVE to full advantage, it would be necessary that embarked helicopters be capable of movement up or down on the ship's flight deck elevators," and in order to do this expeditiously, it was stressed "that automatic blade folding devices must be developed." Two of the five recommendations made at the termination of the exercise stressed "that the helicopter objectives be extended in a similar operation in 1949" and "that every effort be made to equip HMX–1 with at least five HRP–1 helicopters prior to December 1948." [37]

Again, from the standpoint of HMX–1, this was the first test to determine the value of the helicopter in the movement of assault troops in an amphibious operation. Although there was no attempt made to exploit the capabilities of rotary-wing aircraft, the operation was entirely successful in achieving its limited objectives. Neither theoretical nor actual insurmountable obstacles which could prevent future operations of massed landings of troops by helicopter were experienced. The success of PACKARD II proved that the helicopter could achieve the desired troop build-up ashore. As a result, Marine Corps planners became more firmly committed to the new technique of vertical assault in amphibious warfare. This was truly the beginning.

Publication of the New Concept—PHIB–31

In response to the Commandant's directive of December 1946, officers of the MCS were busily engaged in developing a concept covering the tactics and techniques of the employment of helicopters in an amphibious operation and by November 1948 the school had published the world's first printed textbook on the subject entitled *Amphibious Operations—Employment of Helicopters (Tentative)*. It was originally printed in mimeograph form in 1947 as an instructional guide for use within the school and later was used for the planning of Operation PACKARD II. The booklet was numbered 31 in a series of publications on amphibious operations and was written jointly with representatives from HMX–1, but under the

* General Krulak states that "although unwritten, the greatest and by far the most important objective of the Packard II helicopter element was *to create a state of mind* among students, instructors, the Navy and observers, as to the dramatic tactical horizons of the helicopter."

overall supervision of the Senior School's Director and senior member of the Helicopter and Transport Seaplane Board,* Colonel Robert E. Hogaboom.

Phib-31 provided the basis of doctrine governing helicopter landing operations. The preface defined its purpose:

> The advent of troop carrying helicopters and its establishment as standard equipment within the Marine Corps gives rise to a variety of questions related to the employment of such conveyances in the conduct of amphibious operations. It is the purpose of this pamphlet to explore the various aspects of helicopter employment, discerning the manner in which the characteristics of the vehicle can best be exploited to enhance the effectiveness of the amphibious attack.[38]

The publication spelled out the many advantages of the helicopter to the new amphibious concept:

> As a military conveyance, [it] possesses certain distinctive characteristics which, if exploited, can enhance greatly the speed and flexibility of the amphibious assault, while at the same time permitting a desirable increase in the dispersion of the attacking Naval forces. The ability of the helicopter to rise and descend vertically, to hover, and to move rapidly at varying altitudes all qualify it admirably as a supplement or substitute for the slower, more inflexible craft now employed in the ship-to-shore movement. Furthermore its ability to circumvent powerful beach defenses, and to land assault forces accurately and at any desired altitude, on tactical localities farther inland endow helicopter operations with many of the desirable characteristics of the conventional airborne attack while avoiding the undesirable dispersal of forces which often accompany such operations. The helicopter, furthermore, when transported to the scene of operations in aircraft carriers, makes operations possible at ranges which have not yet been achieved by the existing conventional troop carrier types.[39]

These words which appeared in the introduction to *Phib-31* were written by Lieutenant Colonel Krulak. In later years General Krulak had this to say about the book, "I wrote the words [to the introduction but] Dyer was unhappy with them, and properly so, because no helicopters of that era could do these things, or even approach them." As for preface, and the rest of the book, it "was written jointly by Dyer and me [with the help of eight board members]. We had so little to go on; no data: just conviction." [40, 41 **]

A final statement in the introduction expressed, in a way, the attitude that prevailed among most officers at the MCS responsible for the new conceptual document. As an indication of their conviction and dedication in keeping the developmental pace of the concept ahead of the advances in helicopter construction, it said:

> . . . the evolution of a set of principles governing the helicopter employment cannot await the perfection of the craft itself, but must proceed concurrently with that development. Certain of these principles are now apparent, and a concept of employment based thereon is presented in the sections to follow.[42]

Throughout its 52 pages, *Phib-31* discussed, in eight separate sections, such features of helicopter employment as: organization and command, tactical considerations, embarkation, and the ship-to-shore movement. Also included within the text were such subjects as fire support, logistics, communications, and detailed lists of characteristics on the HRP–1 and the HO3S–1. *Phib-31* was published by the MCS as a tentative guide for instructional purposes and served as the guidebook for amphibious helicopter employment.

As General Krulak remarked years later, "the best we could do was to rationalize the operational principles, praying they would turn out to be valid, since we had no real experience." [43]

Other Significant Demonstrations and Operations by HMX–1

By early April 1949, HMX–1 was operating nine Piasecki HRP–1s, having received the first HRP–1 on 19 August 1948. The development of the amphibious assault by helicopter had advanced sufficiently by that time to publicly demonstrate the technique. On 9 May, the squadron, in conjunction with Marine air and ground forces, gave a two-part demonstration to members of the 81st Congress and senior Defense Department officials. The first phase of the show started with the guests witnessing the actual assault preparations and takeoff of eight HRPs with 56 fully-equipped combat Marines from a simulated carrier deck painted on the runway at MCAS Quantico. The helicopters took off, rendezvoused, and in formation flew past the visitors. Then later in the day, the officials were taken to a combat area for the landing phase where they saw the helicopters speed inbound toward the landing zone under the cover of fighter aircraft, which were strafing and laying smoke screens. The HRPs landed in the rough terrain, discharged their troops, and took off in

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* This particular board had been formed for the purpose of devising a concept for the employment of both the transport helicopter and the assault seaplane transport (AST). *Phib–31* was the first product of the board.

** *Phib–31* was truly pioneering and it is significant to observe that it was copied in all its essential elements by the U. S. Army in its first helicopter manual.

approximately 25 seconds. Following the landing of the troops, a second wave of HRPs flew into the same zone transporting 75mm pack howitzers dangling from each helicopter's hook. After the guns were placed into position the crews readied them for firing. Other type helicopters gave demonstrations in laying communication wire, spotting for artillery, and evacuating casualties.[44]

Following the Congressional demonstration, the squadron took part in Operation PACKARD III which was the MCS amphibious command post exercise of 1949. The operation was held again at Camp Lejeune, North Carolina, and was basically the same as PACKARD II in which the squadron had participated the previous year.

The squadron had several objectives for PACKARD III. First, the squadron was to make a "definite advance in the employment of rotary-winged aircraft in amphibious warfare by operating, for the first time, transport helicopters in the ship-to-shore movement." In doing so, HMX–1 was to contribute to the "formulation of tactical doctrines and operating procedures by gaining practical experience and stimulating thought in operating large helicopters from aircraft carriers." As a final objective, the squadron was to "evaluate the operations of a small observation helicopter from an LST (Landing Ship, Tank) for artillery and infantry observation and liaison missions." [45]

For PACKARD III, the squadron's aircraft were divided into three separate sections. The main echelon consisted of eight HRP–1s based on board the USS *Palau* and, for problem purposes, represented a full helicopter aircraft group of 184 HRPs operating from six CVEs for the lifting of a complete regimental combat team. The second group was three HO3Ss land-based with the mission of search and rescue. The last group was assigned on board LST-155 with the squadron's HTL–2 for the observation mission and shipboard evaluation.[46]

A rehearsal was held at Naval Amphibious Base, Little Creek, Virginia, after which the ships moved into position off the coast of North Carolina. A two-day invasion was held beginning on 22 May with landing boats storming Onslow Beach while the HMX–1 helicopters transported troops inland to a point approximately six miles up the New River inlet. They landed and discharged their troops at a strategic road position. High winds and rough seas encountered during the entire operation swamped many landing boats as they approached the beach and upon their return they experienced great difficulty in tying up to their respective attack cargo ships (AKAs). The helicopter operations from the *Palau* were routine as their efficiency was not impaired by these elements. Each HRP helicopter carried six fully-equipped combat troops from the carrier for approximately 10 miles under a heavy cover of fighter aircraft which were simulating smoke and strafing runs on the defending forces. A total of 230 passengers were carried in addition to 14,000 pounds of cargo.[47]

During the exercise, the HTL–2 proved to be totally successful during its evaluation. The small helicopter operated for naval gunfire spotting and observation from the LST while the ship was both underway and at anchor. Although at times the LST pitched and rolled in the choppy seas, the HTL proved that small helicopters could work successfully from that type of vessel.[48]

The search and rescue group, which was based at Peterfield Point, North Carolina, later renamed MCAS, New River, was on station over the fleet for the entire daylight operation. The three HO3Ss had no cause to be used in their primary role, but were called upon for message drops and ship-to-shore transportation of personnel.

Operation PACKARD III was the most ambitious attempt to advance this type of helicopter operation. Although the squadron used only eight transport helicopters, it was convinced that a complete regimental combat team could have been hauled successfully in a helicopter amphibious assault.[49] The operation confirmed the previous conclusions derived from Operation PACKARD II and offered an excellent contribution to the Marine Corps' assigned function of developing amphibious tactics and techniques. The existing concept for the employment of helicopters in the amphibious assault, derived by MCS and HMX–1, was tested through the medium of this problem and proved "to be sound and workable in all respects." [50]

With the completion of PACKARD III, the squadron returned to Quantico and for the following 12 months participated in a variety of projects. Emphasis was placed first on pilot training during June in order to qualify more pilots to fly the HRP–1 and to train the newer pilots who had recently rejoined the squadron after their initial helicopter training at HU–2. The training activity was necessary as by 30 June 1949 the personnel strength had risen to 22 officers and 69 enlisted men, as compared with an authorized level of 21 officers and 89 enlisted.[51] The squadron also had an increase in the number of helicopters which now totaled 14; 9 HRPs, 4 HO3Ss, and 1 HTL–2. The CNO's Aircraft Complement and Allowance List,

dated 15 June, had fixed the number of aircraft at 10 HRPs, 3 HO3Ss, and 2 HTLs.[52]

At the end of June, Colonel Dyer turned command of the squadron over to Lieutenant Colonel John F. Carey, who during World War II earned the Navy Cross at Midway, then subsequently served in an air mission in Peru. The change of command ceremony was a sad occasion for Colonel Dyer, but two months later he was to assume yet another challenging assignment as Commanding Officer, Marine Aircraft Group 12 (MAG–12).

Lieutenant Colonel Carey continued the agressive pace of helicopter demonstrations and evaluations carried on by Colonel Dyer and immediately began contributing many of his own ideas to the advancement of the new technique. During September, under Carey's leadership, HMX–1 sent four HRPs to the Cleveland air races to demonstrate publicly the employment of the helicopter as a troop and cargo transport.

Between 25 November 1949 and 5 April 1950, operations with the HRP were halted as all aircraft of that model were grounded for mechanical reasons. Nevertheless, during December, Carey's squadron experimented for the first time in night flying with the HO3S. For the evaluation, each pilot was given two 45-minute periods of local flying during which a portion of the time was spent in making landings in an area marked by flare pots. As a result of the night flying experiment, a request was sent to BuAer for landing lights and instruments adequate for night flying. These items were considered essential by the squadron before any large-scale night helicopter operations could be undertaken.[53]

As HRPs were still not available during February 1950, the squadron sent four HO3S-1s and the one HLT-2 as a detachment to the Naval Air Facility (NAF), Roosevelt Roads, Puerto Rico on the 11th of the month to participate in the Fleet Marine Force, Atlantic (FMFLant) Fleet Exercise, 1950. Later, on the nearby island of Vieques, during the amphibious landing, an HO3S directed the landing boats during their movement toward the beach by means of an externally mounted speaker system.[54] Other than this novel experiment, all aspects of the amphibious operation were routine.

The HRPs returned to operational status in April after the long grounding period due to a problem with the mid-transmission oil pump. During that month, for the Sixth Joint Civilian Orientation Conference at Quantico, and for Operation CROSSOVER, a 2d Marine Division maneuver held at Camp Lejeune, HMX-1 performed similar missions of delivering infantry troops and 75mm pack howitzers into specified landing areas. Also demonstrated by the helicopters were the techniques of wire laying, resupply, and the evacuation of the "wounded."[55]

The high point of May 1950 for HMX-1 was Operation PACKARD IV, which took place during the final week of the month. Six HRP–1s and two HO3S–1 helicopters landed on board the USS *Mindoro* (CVE–120) at Norfolk, Virginia, after which the ship sailed south to a point 15 miles off the coast of Camp Lejeune. The operation lasted only two days during which five HRPs and two HO3Ss carried ashore a total of 120 troops and over 20,000 pounds of cargo. As was the case in Operation CROSSOVER, the exercise afforded good training for the squadron although there were no new techniques of the amphibious assault exhibited.[56]

On 15 June 1950, HMX–1 was given an opportunity to demonstrate to President Harry S Truman and the Joint Chiefs of Staff the many tasks which Marine helicopters were now able to perform. A simulated amphibious assault was staged for the guests as the helicopters were "put through their paces" in presenting a complete amphibious demonstration similar to the Congressional exhibition given the previous year. The next day a parade and review was staged at Quantico in honor of Lieutenant General Lemuel C. Shepherd, Jr., the outgoing Commandant of the MCS, a position he had held since April 1948. At the close of the ceremony, six HRP–1s, six HO3S–1s, and the HTL–2 made a "Fly-by" in formation. This was believed to have been the largest group of helicopters to fly in formation to date.[57]

Reviewing the progress made by HMX–1 since its commissioning date to June 1950, the squadron performed practically all aspects of its assigned missions and tasks. Evidence indicated that the operations of HMX–1 had been completely satisfactory. Although the Commandant's time-table for the helicopter program had slipped, HMX–1 had used every conceivable opportunity to ensure that fulfillment of the program had been met to the best of its capability.

Development of tactics and techniques in connection with the movement of assault troops had been accomplished by participation in the PACKARD operations. The evaluation of a small helicopter for observation purposes had been completed and specifications submitted for its characteristics. Compliance with the last task assigned had also been completed when a proposed table

of organization was submitted for a typical Marine helicopter squadron.

Although the squadron did not possess 18 aircraft as the original planners had envisioned and CNO had approved, by the end of June, HMX–1 was one aircraft in excess of the authorized level. The latest allowance list, dated 15 June 1950, established the maximum number of aircraft at 6 HRP–1s, 7 HO3Ss, and 2 HTL–2s. This compared with an actual on hand accounting of 6 HRP–1s, 9 HO3Ss, and 1 HTL–3.[58] An HTL–3 had replaced the HTL–2 after it had sustained severe damage in a crash during April 1950.

Personnel strength at the end of June was likewise near the authorized level. It had been readjusted in April 1950 to 20 officers and 90 enlisted men with the squadron reporting a total of 23 officers and 86 enlisted.[59]