

A History of Lockheed Aircraft Corporation

July 1957

OF MEN AND STARS



Chapter V * * *

PEACE, PROSPERITY, PERIL

The Evening News and Evening Mail

Editorial Offices: Carmelite House, London,
E.C.4. Telephone: Central 6000

FRIDAY, JUNE 10, 1938

THIS LOOKS LIKE BUSINESS

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'PLANE'S RANGE OF 2,000 MILES

LOCKHEEDS TO COST
£17,000 EACH

FROM OUR OWN CORRESPONDENT
NEW YORK, Thursday.

Estimates are given here of the
cost of the aircraft bought by the
British Government.

The Lockheed machines will, it is

Much of the world was an uneasy powder keg in the mid-1930s. Japan's warlords took over Manchuria in 1931, walked out of the League of Nations, and invaded North China. Mussolini disbanded his Chamber of Deputies, bombed and occupied Ethiopia, and also defied the League. Hitler rose to rule Germany and began his march to dominate Europe. Spain's civil war broke out in 1936 and drew armed support from half the major nations of the continent. The Rome-Berlin axis awakened Europe and stirred a frenzied armament race.

In a detached way America disapproved. Behind a shield of neutrality and isolationism, it was working its way out of the depression that had halted economic progress for half a decade. Protected, it



Keystone bombers, Curtiss and Boeing pursuit ships were typical of Army Air Corps in mid-'30s. Below, XR20, Navy's Electra, was delivered early in 1936.

thought, by thousands of miles of ocean from the troubles besetting Europe, Asia, and Africa, it remained complacent.

In the six years from 1931 through 1936 the government expended only \$165 million for military aircraft of all types—five-tenths of one per cent of total federal budgets. The Air Corps, Navy, and Coast Guard combined could put no more than 3000 planes into the air in 1936—a large percentage of them obsolete. And by the beginning of 1937 the United States had dropped to sixth place among world powers in combat air strength.

Lockheed Forges Ahead

Lockheed, formed in 1932 out of the debris of a bankrupt predecessor, focused its energy on commercial targets. With the Electra and its smaller sister, the Model 12, it was making steady if not spectacular progress as a builder of speedy, honest, serviceable transports.

By the close of 1936 Lockheed had manufactured 98 airplanes valued at more than \$4 million. Employment grew to almost 1200. Plant area nearly doubled to 108,000 square feet. Net worth crept up to \$2.4 million and total assets to \$3 million.

Indirectly, world tensions benefited the company. Europe's aircraft factories were working day and night to produce weapons of war. Airline operators who had patronized them now came to the United States—and to Lockheed, which had no long traditional connection with the military as had Boeing, Curtiss, Douglas, and Martin. In the five years, 1932 through 1936, only five Lockheed planes had gone

to defense units. All were Model 10 Electras equipped as staff planes, one each for the Navy and Coast Guard, three for the Army Air Corps.

President Robert E. Gross, reporting on results at year-end 1936, reflected the company's preoccupation with its civilian work. He predicted increased foreign and domestic business in the coming year. And he reaffirmed his long-held conviction that Lockheed's future lay in continued manufacture of commercial planes. "The one market that will not fail us," he said, "is the American public."

But the rumblings of war were too loud to be ignored, and the maelstrom inevitably engulfed Lockheed. Within the next five years—from 1937 until the dark day of December 7, 1941, when the Japanese attack on Pearl Harbor drove a shocked nation to war—the company was to experience the most phenomenal growth ever recorded in American industrial history. It was to zoom from the fifth ranking U.S. airframe manufacturer to the largest. Its work force was to multiply more than 40 times to 53,000 and its sales were to skyrocket from \$5 million in 1937 to a staggering \$145 million in 1941. In the one month of December 1941 it was to produce the astonishing total of 325 airplanes—nearly four times more than in the entire year of 1937.

New Transport Introduced

Lockheed's date with that almost incredible destiny was yet to be kept when on a warm July day in 1937 a squat, chunky, twin-tailed airplane skipped into the sky off the flying strip behind the Burbank plant. On its maiden flight its crew included Marshall Headle, chief test pilot, and C. L. (Kelly) Johnson, research engineer. The two were airborne in a flying demonstrator of everything new in the airplane business that year.

The plane was the Model 14 Super Electra, a 14-place midwing monoplane. Its two Wright Cyclone 840 hp engines gave it a top speed of 257 mph—30 mph faster than any contemporary U.S. transport. The 65-foot single-spar wing pioneered use of integral fuel tanks. And beneath the wing trailed the newly-developed Lockheed-Fowler flaps that offered several advantages. They increased the effective lifting surface, acted as a brake to provide slower, safer landings, and when retracted reduced the wing area to permit high performance in the air.

The Model 14 was Lockheed's third bid for attention. As it headed west on that first flight and landed uneventfully at Union Air Terminal a mile away, members of the work force from management to apprentice shared a sense of achievement and pride in a job well done. But they did not know that the airplane they had teamed to build was destined to

help change the course of history. In their most extravagant dreams they could not anticipate that during the next eight years their company would produce more than 3000 Model 14s in a variety of commercial and military versions that would bring \$263 million in sales.

The British Seek Air Cover

First hint of the boundless fame that lay before the Model 14 came in the spring of 1938.

Earlier that year Britain's Prime Minister Neville Chamberlain flew to Munich—coincidentally in a Lockheed Model 10 airliner—signed a piece of paper with Hitler, and spoke wishfully of "peace in our time." But by then most of the military in Britain knew there was precious little peace time left. Germany already had taken over Austria, and the Munich agreement rendered Czechoslovakia helpless. The "tight little isle" desperately needed air cover to ward off the inevitable. In April—the month after the Nazis marched into Prague—the British sent a purchasing commission to the U.S. with \$25 million to spend.

"Lockheed knew nothing of the pending visit," Chappellet recalled later, "until five days prior to their arrival. We were notified by telegram from the British air attache in Washington that the commission would be out to visit California aircraft plants within a week."

The company had nothing but commercial airplanes in production at that time to show the prospective British customers. And it had to act fast. Combining long hours and frantic work, the engineering department and shop designed and constructed a full-scale wooden mockup of a Model 14 converted to a medium reconnaissance bomber. Five days later when the commission arrived it was ready to exhibit.

Kenneth Smith, then a member of Lockheed's sales force, was on hand at the Glendale airport when the British flew in. He had studied newspaper photo-

graphs of every member of the commission and memorized their names and titles perfectly.

"When their plane wheeled over to the ramp," said Chappellet, "Smith stepped up and greeted them as though he had known them all his life."

Smith invited the group to visit Lockheed that very day. The British did so and indicated approval of the mockup, but suggested a number of major and minor changes.

"We promised them the modifications would be designed and installed by the next afternoon," said Chappellet. "Much to their amazement such was the case. They were deeply impressed with our aggressiveness and enthusiasm."

During the visit of the British commission, Gross, in a letter to a business associate, summed up his feelings.

"There has probably been no single thing in American aviation which has stirred up so much enthusiasm," he wrote, "and the aircraft companies are fairly languishing in breathless expectancy of the outcome. For a small company we put on quite an effort, and I gather we have made a proposal which is in line with their ideas."

Visit Well Timed

Gross and his associates freely admit that luck played an important role in the chain of events. For example, Chappellet recalled the only business on the books at the time was an order from a Japanese air transport firm for some Model 14s. There was "nothing else in sight but the end of the line" in final assembly.

"If we hadn't had this business," Chappellet pointed out, "our factory would have been empty and the British would hardly have dared to place contracts with a concern that was not in production. So perhaps we owe the Japanese a vote of thanks for having placed us in a position to plunge into large-scale production and an expansion program that has never stopped since."



Historic Flights

H. T. Merrill and John Lambie flew Electra at left from New York to London in 1937, brought back King George VI coronation pictures.

Right, British Premier Neville Chamberlain returned in Model 10 from Munich conference with Hitler, promising "peace in our time."

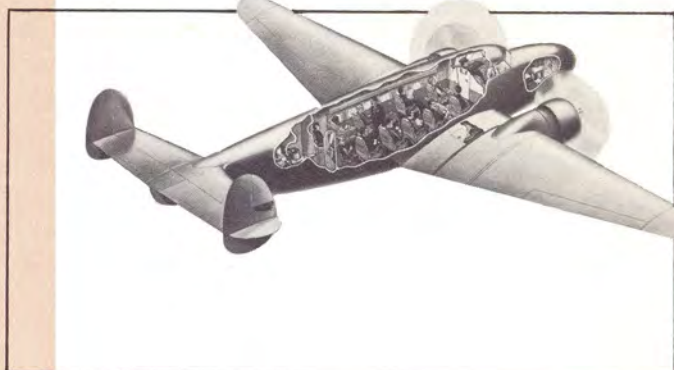
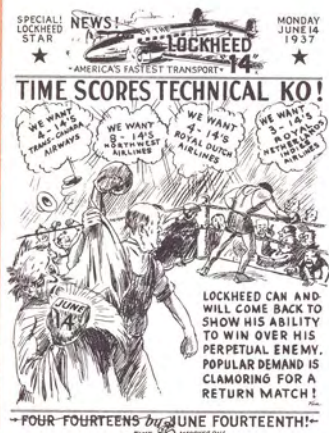
DESTINY'S DARLING

The Model 14



Lockheed-Fowler flap slid backward out of wing to increase wing surface during takeoff and landing.

Pep sheet for workers urged completion of four Model 14s in June 1937. It was fastest U.S. transport of its period with 237 mph cruise speed.



Cutaway shows passenger version of Super Electra. It had small, high speed wing with integral tanks.



Design Engineer P. A. Colman checked model in wind tunnel. Customers ordered 30 before first flight.



Crew readied Model 14 for maiden hop on July 29, 1937. Two Wright Cyclones each provided 820 hp.



Lowered flaps shortened takeoff run. Development won 1937 Sperry award for Engineer C. L. Johnson.

432 W. 42257-2392 500 lbs. 4/38 T.B. 790

AIR MINISTRY.

A.M. Form 465.
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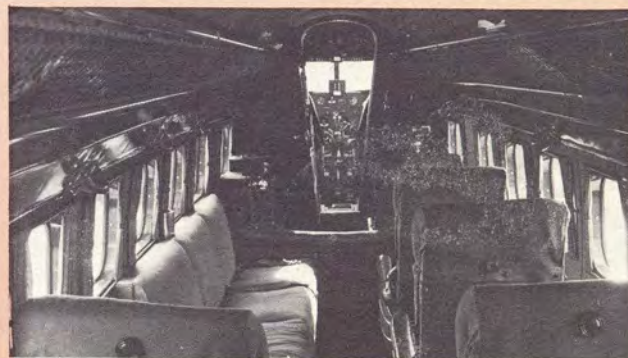
General Enquiry Form and Temporary Pass.

NOTE FOR THE INFORMATION OF VISITORS. It is a strict rule of the Department that visitors must fill up one of these forms, and that they must not proceed without an escort. They must also be escorted on leaving the room of the official they have been visiting, and this form must be handed to the doorkeeper on leaving the building.

Date 9 - JUN 1938

- (1) Name of Visitor *C. F. Johnson*
- (2) Address *Mayfair Court*
- (3) Representing *Appointment*
- (4) Person with whom interview is desired *Mr. Horniman*
- (5) Nature of enquiry
- (6) Escorted by Messenger *(Name to be inserted by messenger)*

British Air Ministry pass Johnson used in summer of 1938 while transforming Model 14 into bomber.



Navy found high speed of Model 14 ideal for fast transport work. Picture shows R40 cabin interior.

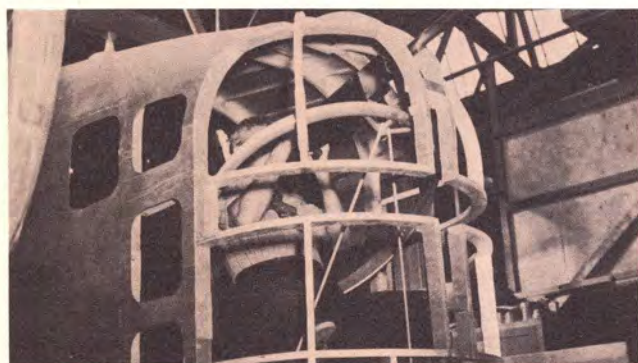
Lockheed Goes Big League...



Drawing shows Model 14 as bomber. Turrets had four .30 caliber machine guns. Bay carried 3300 lb. bomb load.



London newspapers headlined orders for 200 Hudsons, 200 North American trainers, largest ever placed in America.



Wooden turret assembled in five days showed British how Model 14 would make patrol bomber, led to huge purchase.



Japanese air transport officials inspected Model 14 and placed order that kept factory lines going in mid-1938.



Hudson assembly, shown in early stage in February 1939, enabled Lockheed to pioneer mass production techniques.



First Hudson flew in December 1938, six months after go-ahead. Company delivered 287 to British during 1939.



Employees donated time and company gave material for free Hudson to England.



Hudsons camouflaged with green paint lined up on field in December 1939 awaiting delivery to Royal Air Force.

Lockheed, the Model 14, and personnel favorably influenced the British visitors. But the airplane still had to be sold to that nation's Air Ministry. So a sales team headed by Courtlandt Gross, Johnson, Carl Squier, R. A. Von Hake, factory superintendent, and Robert Proctor, a contract attorney, went to London.

History-Making Order

The conferences lasted two months. To work out changes in specifications Johnson frantically redrew blueprints at night in his hotel room. On June 23, 1938 the Air Ministry signed the contract for 200 airplanes plus as many more as could be delivered by December 1939 up to a maximum of 250 at a total cost of \$25 million. It was the largest single order ever received by any American aircraft manufacturer. Chappellet later rated it as the turning point in the company's history. It was the order that for the first time put Lockheed into the big leagues.

For some time earlier Lockheed's management had been increasingly aware that its plant and equipment were inadequate. But the company operated the property on lease and was reluctant to make substantial improvements to facilities it did not own. Late in 1936 it purchased the land and buildings now making up most of the B-1 factory in Burbank—43 acres and about 108,000 square feet of plant.

That decision, plus the need to carry on such new model developments as the Model 14, prompted efforts to raise new capital. Two stock issues brought

in \$1.6 million. A substantial portion went into construction of new buildings and installation of modern machinery and equipment. Completed by June 1937, the expansion program doubled production facilities and included a new administration building and engineering headquarters.

Other airplane makers thought Lockheed was crazy to take on the huge British bomber order. Even with the modernization program, floor space totaled only 250,000 square feet. Net working capital was about \$650,000. The company had just \$334,000 in the bank. But Gross was "serenely confident."

"It makes me laugh," he told the 2500 employees in December 1938, "because so many people in the airplane world think we can't do it."

Barker Joins Company

Lockheed did it. Gross tackled the financing job with his usual aplomb. Until this time the company had not been able to call upon banks to any great degree. But it had made some small loans with a local institution, the California Bank, whose vice president was Charles A. Barker, Jr.

Barker for some years had been taking an increasing interest in Lockheed and its growth. Shortly after the British placed their order for Hudsons, he joined the company as vice president in charge of finance. Together he and Gross invaded the credit market, raised \$1.25 million in short-term funds, and supplemented that amount early in 1939 by a \$3 million stock issue.

At about the same time Chappellet, in addition to his duties as corporate secretary, took on the post of assistant to the president. Von Hake became works manager.

Training Program Begins

With the larger volume of work came the first move toward what became one of the industry's most productive apprentice and general training programs.

"I first became interested in the subject of training men for the airplane business about two years ago," Gross declared in a letter written in April 1938 to the Federal Trade Commission, "at which time it was apparent to me that the growing needs of the manufacturing end of the air business were exhausting the available supply of competent aircraft workers." Experienced men then available "could form little more than a nucleus," he asserted.

The training program that resulted had two objectives. One was to help employees increase their knowledge of aircraft manufacturing techniques and advance themselves in specific trades or crafts. The other was to enable Lockheed, through increased efficiency, to obtain benefits from the training its employees received.

C. A. Barker, Jr., now senior vice president, came to Lockheed in 1938 to help finance job. Below, Lockheed factory as it looked from air in 1937 with Empire Avenue at left.



March 8, 1937

ALL LOCKHEED EMPLOYEES:

Your company has today recognized the Aeronautical Machinists Union of Burbank, which is affiliated with the American Federation of Labor through the International Association of Machinists, as the sole agency for the purpose of bargaining collectively for all the employees. A copy of the agreement is posted on the bulletin boards. This action was taken because a substantial number of employees furnished us with definite evidence that they desired this step, and because it is the opinion of your company that this is the safest course to insure the right to work to the large number of employees who we know want to stay on the job.

LOCKHEED AIRCRAFT CORPORATION
Robert E. Gross
Robert E. Gross
President - Treasurer



March 1937 bulletin announced company recognition of Machinists Union as bargaining agent. IAM had audit help of D. E. Browne, now Lockheed officer.

Management-labor relations took another significant step in 1937. After spurning organizational efforts of one union, Lockheed hourly factory and office employees selected the International Association of Machinists as bargaining representative. And in March the IAM's Aeronautical Mechanics Lodge 727 signed its first formal contract with the company. Dudley E. Browne, then Lockheed's chief accountant, now vice president finance and controller, functioned as union auditor and assisted the union negotiating committee.

The agreement spelled peaceful accord during a period when labor unrest was spreading throughout the country. And it typified what the management praised as "clear, sensible thinking" by the work force plus the company's own "sincere desire to do what is right by our men and women."

Increased manufacturing facilities meant speedier deliveries and led to a swelling volume of orders. One came from Canada, which was developing a new transcontinental air system as an important link uniting the British commonwealth in a network of air-mail service. Trans-Canada Airlines standardized on Lockheed equipment and placed an initial order for three Model 10s and four Model 14s. Other orders came from Australia, Argentina, Brazil, and Mexico, as well as from domestic customers.

Hudson Order Completed

The rise in commercial business was gratifying. But it and the history-making Hudson bomber order created problems. From June through the balance of 1938 redesign and tooling for Hudsons progressed simultaneously. In January 1939 three bombers came off the line. By June Lockheed had completed 48. But by then there was some question—even within the

plant—whether the remaining 202 could be finished by the contractual deadline in December.

However, Gross and his team—including Von Hake and H. E. Ryker, trouble-shooting production efficiency man—stuck steadfastly to their guns. They took the aircraft industry's first step toward major subcontracting by delegating a substantial amount of parts assembly for Hudsons to Rohr Aircraft in San Diego. Production stepped up to one ship a day, then two. After that, as one engineer said, "We never let up."

In a year's period the Lockheed work force climbed to 7000. The company was fortunate in having worked out a selective technique for hiring new personnel. Job applicants took aptitude tests. When Lockheed needed more men, it had a file of candidates on hand, classified as to experience and probable ability.

Hudsons began to come off the line at a steady flow, and the 250th plane rolled out seven and a half weeks ahead of schedule. The Australian Air Board placed orders for 100. The British reordered. Altogether Lockheed built nearly 3000 Hudsons.

Gift Plane Delivered

One was "for free." Lockheed contributed the materials and factory employees contributed time to build the *Spirit of Lockheed-Vega Employees*. It was delivered at a ceremony in Burbank to the British ambassador and his wife. Then Jimmy Mattern, engineering research pilot, flew it to Montreal. It reached England a week later. Announcing its safe arrival, Lord Beaverbrook, minister for aircraft, termed the gift plane a "message of immense encouragement" to his people. It promptly went into service with the RAF Coastal Command and did patrol duty in the Iceland area.

Profitable business generated by the Model 10 and 12 enabled the company to plow back earnings into developing the Model 14. And it supplied the funds to try even further diversification and design development to broaden and strengthen Lockheed's competitive position. Added impetus for these moves came from the success of the airline Model 14s and the brand new military market Lockheed had penetrated with its Hudsons.

Organization of Lockheed's first subsidiary in August 1937 was the climax of a series of events that began two years earlier when the company asked engine designer Al Menasco to build for Lockheed a new type of power plant. The plan was to link two six-cylinder in-line engines together side by side to turn a single propeller. The proposal sparked immediate interest, and development work began.

By 1937 it was so advanced that in a letter to his brother Courtlandt in New York, Robert Gross dis-

cussed ways and means of invading the \$10,000 to \$25,000 price field with an airplane so powered. He envisioned a "twin-engine, all-metal six seater, probably around this two-in-the-nose Menasco arrangement." He weighed the advisability of launching such an enterprise "under a different name and probably different personnel" and began exploring means of establishing a new company to undertake the plane's manufacture.

Lockheed engineers worked with Menasco and designed a free-wheeling clutch system so that either or both engines could deliver power to the propeller. Gross dubbed the result "Unitwin" and set about forming a subsidiary company to develop and market a plane to be called the Model 2 Starliner.

Rebirth of Vega Name

Originally called the AiRover Company, the new organization later became the Vega Airplane Company to perpetuate the famous Vega name. Its headquarters were in an old red brick building next door to Lockheed that in earlier days housed the Empire China Company. Mac V. F. Short, an outstanding designer in the light plane field, was president. Some years previously he had been associated with Gross, Hibbard, and Lloyd Stearman in the Stearman Airplane Company in Wichita, Kansas. Short designed the Starliner's airframe. Jack Wassall, now California Division director of engineering, was project engineer.

The Starliner first flew in April 1939. Tests proved both the Unitwin system and the Starliner itself to be reliable units. But the plane lost its race against time. Air travel was soaring, and feeder lines raised their requirements to an 8- to 10-place craft. The 5-to-6-place Starliner couldn't grow fast enough to meet the demand. Forced also to turn its energies to war production, Vega reluctantly wrote it off as a "good one that might have been" and sold the prototype to a movie studio for use as an airplane prop in background shots.

Air Corps Orders Fighter

The year 1937 has another significant date in Lockheed history. In February the Army Air Corps asked the aircraft industry to submit designs for an experimental pursuit plane having "the tactical mission of interception and attack of hostile aircraft at high altitude."

Specifications, while modest by present-day standards, were revolutionary for the time. They called for a 20,000-foot ceiling to be reached in six minutes from sea level and top speed of 360 mph.

Gross lost no time. He winged his way to Wright Field in Dayton, Ohio, with an armful of blueprints

and specifications for submission in the competition. Hibbard and Johnson had evolved the design, and Gross shared their confidence it could easily exceed what the Army estimated was the obtainable maximum in performance.

The Air Corps liked what Gross showed them. In June, Lockheed, declared winner of the competition, received a contract to build a prototype called the XP-38.

From any aspect it was an outstandingly novel concept. Into it—their first crack at a fighter—Hibbard and Johnson poured many innovations, including the twin booms that became so famous, tricycle landing gear, extremely high wing loading that was a Lockheed characteristic, armament concentrated in the nose, and turbo-superchargers hooked to two Allison liquid-cooled engines.

Construction began in July 1938. And on New Year's Eve the XP-38, under wraps, went by truck to March Field near Riverside, California. Cigar-smoking Lieutenant Ben S. Kelsey—later a brigadier



general and deputy director of Air Force research and development—assumed duties of project test pilot. And after elimination of minor bugs the Air Corps, eager to set a transcontinental record, gave Kelsey the nod to try.

Record Flight Ends Disastrously

In February 1939 Kelsey gunned his XP-38 into the sky from March Field. Hurling at speeds as fast as 420 mph, he reached Long Island in exactly seven hours and two minutes' flying time. But on his final approach the engines lost power. Kelsey, making a forced landing at a golf course, climbed out of a rubble of twisted junk.

Despite the crackup the Air Force gave Lockheed a substantial contract for a production version, the YP-38. But losing the prototype was a serious blow that set back the development several months. The company had to start over almost from scratch.

The first YP-38 flew in September 1940 with Test Pilot Headle at the controls. "This is a very fast airplane," he reported. "In all my experience as a pilot, it's the easiest plane I have had to fly."

But ahead lay a problem Headle did not experience on that flight. It was a new phenomenon in high-speed flight called compressibility.

Test Pilot Tony LeVier, now California Division director of flying operations, was one of a number of flyers—including Ralph Virden and Milo Burcham

—who personally encountered compressibility. It resembled, LeVier later explained, “a giant phantom hand that seized the plane and sometimes shook it out of the pilot’s control.”

Compressibility Problem Licked

Johnson and Hibbard had suspected it would happen. As early as 1937 in reports to the Air Corps Johnson warned that “as airplane speeds and operating altitudes increase...consideration must be given to the effect of compressibility.” And Hibbard, in a memorandum to Gross in December 1938, explained it this way:

“In order to have the minimum possible drag, it is essential that air flow smoothly over any part of an aircraft structure. As the speed is increased, the air tends to be ‘splashed’ by the leading edge of the wing more or less like the prow of a boat at high speed in the water. As one approaches the compressibility range, the air is thrown so violently up and down by the leading edge that it does not have a chance to flow over the wing in the proper manner.” Compressibility effects, he noted, were “appreciable” at 425 mph and “very serious” at 500 mph and over.

After nearly two years and many experiments including counterweights on the elevators and raising the tail, Hibbard and Johnson found the solution in transonic tests in the wind tunnel. The answer was a dive brake or flap attached to the main wing spar that immediately restored lift to the underside of the wing. They solved the problem just in time. World War II was almost upon us, and the P-38 was destined to become one of the most widely-known fighters in that conflict.

The British bought it in quantity and called it the Lightning, one of seven names suggested by Gross to Air Commodore Baker of the British Purchasing Commission late in 1940. Among other suggestions were Liberator, Leeds, Liverpool, Lexington, Lincoln, and Libra. Gross, in his letter to Baker, “strongly” favored Lightning and the British agreed.

Globe-Girdling Howard Hughes

Meantime the Model 14 from which came the famous Hudson made notable contributions to commercial aviation’s progress. It ran into difficulties, however, early in its career. Structural failure of the tail surfaces caused one, operated by Northwest Airlines, to crash early in 1938. And a second disaster—this time due to pilot error—occurred in May when a Model 14 ran into a mountain in California.

One customer who eyed the new Model 14 eagerly was a millionaire sportsman pilot named Howard Hughes. He had long admired Wiley Post for his 1933 solo world hop in the famous Vega, *Winnie*

Mae, and determined to make a new record flight over the same course—not to eclipse Post’s shining mark, but to demonstrate and promote flying progress. It was an opportunity to navigate around the globe with use of every available type of flying and navigation equipment.

Hughes’ evaluation of the Model 14 was confirmed in June 1938 when pilots from the Polish airline, LOT, flew a standard production model from Burbank to Warsaw—a distance of 16,500 miles—without incident. Hughes bought a Model 14, hung more powerful engines on it, increased fuel capacity to 1800 gallons, and packed it with navigation and radio communication instruments. Then he spent a day and a half in the pilot’s compartment, without leaving the airplane, to familiarize himself with the controls. His passion for detail paid off.

Model 14 Makes Record Flight

On July 10, 1938, Hughes, casually dressed in wrinkled gray trousers and sport jacket, stepped aboard the plane, christened *New York World’s Fair 1939*. Accompanying him was a crew of four, including Lieutenant Thomas F. Thurlow of the Army Air



Hudson, P-38 production volume brought a need for many new programs to develop higher skill levels. President R. E. Gross signed training certificates.

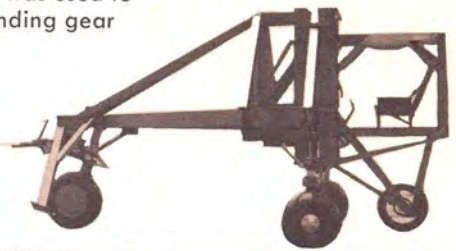


“Wiggly block” test was designed to measure manual dexterity and suitability for job.

Vega Shines Again



Novel drag system was used to test knee action landing gear for Vega Starliner.



Applicants lined up at Vega Airplane Company, first located in brick building adjoining Lockheed plant.



Starliner, shown taking off at Union Air Terminal, featured tricycle landing gear, "Unitwin" engine.



NA-35 in flight. Vega built four of the trainers, halted project when design changes exceeded value.



Volunteers demonstrated how Starliner cabin mockup easily held five. Plane first flew in April 1939.



Mac Short, left, first president of Vega Airplane firm, was succeeded by Courtlandt Gross in 1940.



Third Vega airplane was the Model 40 target drone, controlled from the ground. Only five were built.

Corps, co-pilot and navigator. Flying via Paris, Moscow, Yakutsk, Fairbanks, and Minneapolis, the Model 14 and its passengers covered 14,709 miles in the record time of three days, 17 hours, 14 minutes, and 10 seconds—an average speed including stops of 165 mph—and landed again at Floyd Bennett Field on July 14.

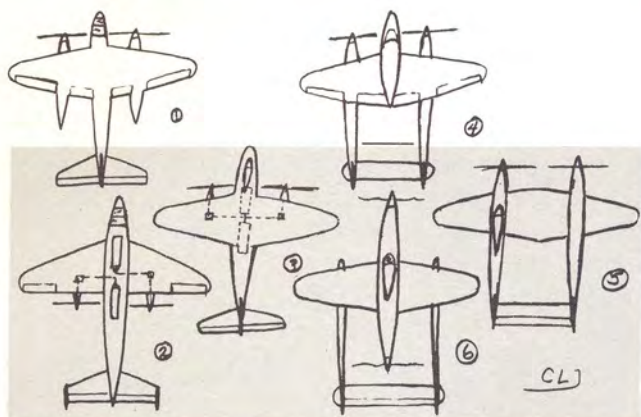
At takeoff from Yakutsk, Russia, Hughes lifted a full load of fuel, 226 per cent of the plane's empty weight—a record in itself. During the flight the Model 14—traveling in the same direction as the earth turned on its axis—saw the sun set and rise five times in four days. The journey was a triumph of precision navigation. Hughes and his crew were never more than a few miles off their course and

never off their planned schedule for landings by more than a few minutes.

"It was in no way a stunt," Hughes emphasized on his return. "We are in no way supermen. Any one of the airline pilots of this nation with any of the trained Army or Navy navigators and competent radio engineers in any one of our modern passenger transports could have done the same thing."

The Hughes flight and other accomplishments, although less spectacular, all contributed to a growing volume of commercial and military business. In 1939's first six months Lockheed delivered 133 airplanes. As Hitler opened World War II with his march into Poland in September 1939 Lockheed and Vega found themselves with nearly 7300

Lightning Strikes...



Sketches illustrate six designs roughed out for 1937 Air Force fighter competition. Number 4 became XP-38.



XP-38, only prototype built, crashed on Long Island in February 1939 after setting 7-hour cross-country mark.



Dubbed "Lightning" by British, Model 322 P-38 lacked usual turbo-superchargers. British later added them.



Test Pilot Milo Burcham discussed new dive flaps on P-38 with C. L. Johnson.

Below: War production chief W. S. Knudsen, left, detailed P-38 buildup with General H. H. Arnold and Robert Gross.



From left, engineers J. J. Johnson, Hall Hibbard, C. L. Johnson, and James Gerschler looked over P-38 design.



Control surfaces were located ahead of wing in canard version of P-38, abandoned after wind tunnel testing.



Lieutenant Ben Kelsey, later brigadier general, held model of P-38 he piloted to transcontinental record.



YP-38, nicknamed "Yippee," succeeded lighter XP-38, was armed with 37 mm. cannon, four .50 caliber guns.



High tail P-38, above, failed to solve compressibility problem. Below, Lightning production rate hit 15 daily.



employees. Plant area had risen to 550,000 square feet. The government had placed a substantial order for P-38s. The Electra, Model 12, and Model 14 were selling well, and Hudsons were rolling off the lines bound for Britain.

There was no room in the principal Burbank factory to turn out P-38s in quantity, but up San Fernando Road was a distillery. In June 1939 Gross went to lunch with the three owners, and over the coffee cups he bought the property. For a considerable time thereafter subassemblies for the early P-38s went together in the revamped distillery amid the lingering odor of bourbon mash.

To afford European operators a handy service and maintenance base, Lockheed set up a parts depot in Amsterdam in 1938. Simultaneously the sales organization expanded to virtually a world-wide network. Late the same year came formation of a British reassembly division, and a crew headed by Henry H.

Ogden, now vice president of Lockheed Aircraft Service, established headquarters in Liverpool. There they received and assembled the first Hudson bombers after they came off Burbank lines.

Lockheed established a similar reassembly unit in Australia in 1939. And the following year, when Hitler's Luftwaffe began strafing Liverpool, the company formed satellite bases in Scotland and Northern Ireland. They were so successful that the British asked Lockheed to take over reassembly of warplanes from other American factories.

250 mph Transport Flies

Germany had completed its month-long conquest of Poland and World War II had quieted into a sitzkrieg when late in 1939 the company introduced another commercial transport. Sales specialists under Squier had surveyed the western hemisphere's airline requirements and concluded that a rich market awaited a 17-passenger twin-engine job. This was the Model 18 Lodestar—so named in the tradition of calling Lockheed planes after celestial bodies. Engineers developed it by "stretching out" the Model 14 fuselage by about five feet.

No known contemporary could touch the Lodestar's 251 mph top speed and 231 mph cruising speed. But Test Pilot Headle tossed some cold water on the management's enthusiasm when, landing after his first flight, he reported:

"Good airplane—but it's got mice in the tail!"

By "mice" he meant a zone of turbulence that caused elevator flutter and gave engineers many a headache before they found the "fix"—a trailing edge extension on the wing that deflected the flow of air downward.

Lodestar Sells Well

Within a year after their introduction Lockheed moved Lodestars into the hands of such varied customers as Mid-Continent Airlines, Regie Air Afrique, and the Netherlands East Indies government. Model 18s set several civilian speed records including a coast-to-coast mark of 9 hours, 29½ minutes.

By this time Lockheed's design and sales brains believed air traffic had broadened to the point where no one size or type of aircraft could henceforth be expected to do all the work. Engineers crowded their drawing boards with a bewildering array of design proposals, all aimed toward expanding existing markets and invading new ones.

"Our big problem of the moment" was the question of new models, Chappellet wrote in 1938. "We are now casting about for a model which will be sure fire, if such a thing is possible."

Seriously considered were an 18-passenger, three-

Around the World in Four Days...



Polish airline flew Model 14 from Burbank to Warsaw and crossed South Atlantic in record time of 11 hrs. 27 min.

Howard Hughes, at left with Carl B. Squier, bought Model 14, increased fuel capacity and radio equipment for world hop.



Hughes plane was serviced before 14,709-mile trip to prove value of latest airline equipment.



Bourbon mash odors lingered months after Lockheed converted G.G.G. distillery for work on P-38s. Below, early pilot house.

engine job, a 14-passenger configuration with two engines, and an 18-passenger four-engine airliner, all with a 650-mile range. Another was a 30-passenger design employing two liquid-cooled engines submerged within the wing. For one reason or another these never got much beyond the conversation stage.

But others did. One was the Model 16. Designed in 1939—with customers like Catalina Airways in mind—it combined passenger capacity of the Model 14 with the wings and engines of the Electra. End result was to be an efficient short-range feeder line transport. But after the company built a mockup, further study indicated the Model 16 had only lim-

ited capabilities and would not be practical in any operation other than the short flight from Los Angeles to Catalina Island. Consequently, since the airline could not afford to have only two built for its own use, Lockheed discarded the project.

Most radical of all was the Model 27. A twin-engine, all-metal monoplane, it differed from the conventional in one important aspect—horizontal control surfaces were located ahead of the wing. It aroused “considerable interest” among airline operators, Chappellet wrote at the time, but they didn’t “rush forward to place their orders.” As a matter of fact, he admitted, “it appears to us that they are backing away a bit.”

Perhaps it was just as well. As development work progressed and wind tunnel tests began engineers ran into difficulties so serious they outweighed advantages of the tail-first configuration.

“One of the foremost problems,” Kelly Johnson explained later, “concerned the stalling of the forward tail at angles of attack substantially below that at which the wing developed its maximum lift. Along with the problem of longitudinal control and stability, the problem of directional stability was also difficult.”

Lockheed Explores Four-Engine Field

So the Model 27 was consigned to limbo. But Lockheed’s people continued to probe and grope, argue and discuss. And out of those exploratory sessions came the Model 44.

Conceived to fit in between Lockheed’s Lodestar and the Douglas DC-4, the Model 44 Excalibur was a four-engine low-wing monoplane designed to carry 21 day passengers and a crew of three at a maximum speed of 241 mph. Advising a selling price of about \$150,000, Hibbard declared early in 1939 it would be “an excellent airplane—the world’s best flying and best performing craft”—without incorporating all of the expensive refinements of the DC-4.

13

Lockheed Goes Overseas

Executives of British reassembly division: W. Hinnau, J. E. Boyce, G. L. Hitz, B. B. Randolph, Base Manager H. H. Ogden, J. K. Hull, B. W. Messer, G. V. Russell, and Marc Worst. Lower left, British fighters defended Lockheed base at Liverpool. Train transported workmen to big overhaul center Lockheed operated near Belfast.



Workhorses to the World



Northwest Airlines flew 14s, named Sky Zephyrs, for St. Paul-Seattle service.



Snow covered Model 14 of Trans Canada, which started with 7 Lockheeds in 1937.



KLM Super Electra flying over Rotterdam showed guide rails trailing behind wing for Lockheed-Fowler flaps.



Primitive and modern transportation contrasted when Bolivian airline operated Lodestars in South America.

During its development the Model 44 expanded to a 30-passenger job with 270 mph top speed, and Lockheed predicted it could "be the backbone of the air transport business." But Pan American Airways, with which Lockheed began negotiations late in 1938, decided it wanted the plane even bigger and faster. Work started on a full-scale mockup of a 34-passenger 300 mph version.

Then in June 1939—less than a year after he flew his Model 14 to its round-the-world record—Hughes came to Burbank with his business associate, Jack Frye, seeking for Transcontinental & Western Air a large four-engine plane with pressurized cabin, capable of nonstop transcontinental flights.

Gross, Hibbard, and Johnson met with Hughes and Frye, made notes of what they wanted, and took another look at the Model 44. Out of it they developed the Excalibur A or Model 49.

Constellation Design Begins

Within weeks Hughes and Frye viewed rough outlines of an airplane that in many respects exceeded their original requirements. Gross discarded the name Excalibur in favor of Constellation and gave the signal for an intricate and costly period of design development.

With the Model 49 Lockheed entered a new market—the luxury class four-engine transport field. Originally the Constellation was a 40- to 50-place plane weighing 68,000 pounds gross and to cruise at nearly 300 mph. Its designers aimed for maximum aerodynamic efficiency—one reason for the three vertical tails that became one of aviation's most distinctive trademarks. Oversized engines went into it to give better performance and outstanding safety.

Lockheed and TWA were confident the Model 49

would score an overwhelming airline victory. But they reckoned without the fast-moving international developments that would so soon plunge America into World War II. No commercial production was allowed after Pearl Harbor. And although Lockheed delivered 15 of them, known as C-69s, to the Air Force during the war, it was not until hostilities ended that the Constellation penetrated the world's commercial air routes and became the most famous name in Lockheed history.

Vega Builds New Factory

Meantime Lockheed's new subsidiary Vega, after sidetracking its Model 2 Starliner, built five small experimental pilotless drones for the U.S. Army. With them the military learned that much more development work lay ahead to perfect operation of radio-controlled aircraft. In midyear 1940 Courtlandt Gross succeeded Mac Short as Vega's president and Short became vice president in charge of engineering, a change made to permit Short to devote full time to the company's complex and varied engineering problems.

Vega was suffering growing pains. Lockheed handed it a \$59 million subcontract to build bombers for the British. And at about the same time Vega bought from North American the design and manufacturing rights to its NA-35 primary trainer. Clearly the company had outgrown its 172,000 square feet.

To remedy the situation it bought 30 acres adjacent to the Union Air Terminal, a mile from the parent Lockheed plant, and began construction of a new factory with about 750,000 square feet. Total cost of land and buildings was close to \$4 million—but the move enabled Vega to engage in high production output.

Chronologically the NA-35 was the first plane off the new factory line. But the trainer was not an unqualified success. So, with rising wartime pressure for combat planes, Vega abandoned the project after manufacturing only four.

These years before Pearl Harbor were, for Lockheed as well as for other aircraft firms, years of getting ready. Lockheed production in 1939—spurred by completion of the initial 250 British Hudsons—brought the highest sales and profit for the company to date. Deliveries totaled 356 units, 329 of them military. Sales reached \$35 million and net profit \$3 million. And in December patient stockholders received their first dividend since 1932, \$1 a share.

But, although Europe's skies were dark with war-

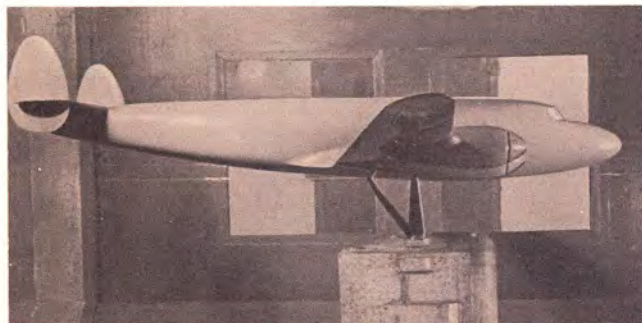
planes in 1939, American aircraft factories still produced in comparatively modest quantities. The great surge forward came that year when President Roosevelt asked Congress to vote a \$300 million Air Corps appropriation to build 5500 planes a year and train 20,000 pilots to fly them. A year later he asked Congress for another \$896 million toward the manufacture of 50,000 planes a year, and the industry wired him: "We can do it." Roosevelt had committed the U.S. to its role as the "Arsenal of Democracy."

By May 1940—less than a month before the British retreat from Dunkirk—the U.S. had sent almost 2000 planes to France and England. And Allied governments placed orders with American builders for 45,000 more during the next two years.

Here Comes Connie



Canard transport designed in late 1930s had horizontal control in nose, aroused great interest but no orders.



Early twin-tailed Excalibur tested in wind tunnel would have had 241 mph speed, carried 24 passengers plus crew.



Excalibur A became first Constellation design. Several different windshield and cockpit layouts were evaluated.



Excalibur design built as mockup in 1938-39 was a four engine airliner larger than Lodestar, smaller than DC-4.



Pan American Airways wanted Excalibur larger and faster to carry 34 passengers plus crew at 300 mph top speed.



As originally conceived in 1939, Constellation showed faired nose, reverse flow cowling for its Wright 3350s.

In September 1940 the War Department alerted the industry to tool up for mass production orders soon to be placed. The Defense Commission notified plane builders they could not accept orders for commercial transports without government approval. By year's end the industry had spent more than \$83 million on plant expansion for national defense, let contracts for another \$232 million worth of facilities to be in operation within six months, and manufactured nearly 13,000 airplanes, 6000 of them military. The backlog stood at a record \$2 billion. Employment jumped from 63,000 in 1939 to 149,000 at the close of 1940, and net sales of the 12 major airframe companies climbed from \$141 million to \$247 million in the same time span.

Factory Jobs Simplified

To employ thousands of lesser skilled workers, housewives, and the handicapped, Lockheed concentrated on work simplification and improved manufacturing techniques. It constructed expensive research facilities, including one of the largest and most modern privately-owned wind tunnels in the U.S. And it streamlined Lockheed and Vega management under a joint committee to provide maximum cooperation. Von Hake, assisted by Ryker, supervised all production, with J. H. Sreenan as Lockheed works manager and George H. Prudden as his counterpart at Vega.

The company also took steps to solve another problem that was sure to come—a shortage of skilled aircraft engineers. In conjunction with California Institute of Technology, it inaugurated a high-speed engineering training program, first of its kind. It brought to California topnotch men from all parts of the country—aqueduct and highway engineers, machinery experts, and other specialists. A 16-week course taught aviation fundamentals so they could

envision, draft, and build the airplanes so urgently needed.

Lockheed leadership in employee training attained national recognition when Secretary of Labor Frances Perkins visited the plant in 1940 and inaugurated the first federally approved apprenticeship program in aircraft manufacturing.

In 1940 the company took another major step in physical expansion by purchasing for \$1.5 million Union Air Terminal, adjacent to the Vega plant under construction. The terminal, then owned by United Air Lines, was Southern California terminus of the major airlines.

By acquiring the property Lockheed expedited testing, flying, and delivery of airplanes that poured out in ever-increasing quantity from its assembly lines. It formed Lockheed Air Terminal as a subsidiary and named Chappellet president.

The Hudson Gains Immortality

By now the Hudson—so named by the British for Henry Hudson, early-day explorer—had earned another nickname. An Australian pilot with the RAF dubbed it "Old Boomerang" because when the plane went out on a mission it came back.

Hudsons sank schools of Hitler's submarines. They tracked the German battleship Bismarck and played a major role in that vessel's destruction. They pioneered transatlantic delivery flights. They provided air cover for beleaguered troops on the beach at Dunkirk. They emerged from that holocaust with wings and tail surfaces riddled with bullets and cannon shells and wrinkled from the stress of dive-bombing—a tactic for which they were not designed. But they came back.

In such ways the Hudson earned its reputation. And when Congress passed the Neutrality Act in September 1939, forbidding U.S. citizens to deliver

Vega Gets a New Home



Vega bought 30 acres next to Union Air Terminal in 1938, began building \$4 million plant for British bomber job.



New Vega factory, looking west toward airport, produced Ventura bombers and later Boeing B-17 Flying Fortresses.



Vega merged with Lockheed in 1943. Its offices now are occupied by corporate and California Division personnel.

arms to European belligerents, the British became concerned that their supply would be cut off.

Gross waved away their fears and began looking for an airport. He found what he was after near Pembina, North Dakota—an airstrip lying jointly in the U.S. and Canada—and bought it. Until the U.S. eased Neutrality Act provisions, Lockheed pilots flew Hudsons to North Dakota. Mule teams pulled the planes up to the international boundary, where they crossed the border into Canada. The process did not violate neutrality laws since at Pembina title was passed and customs officers verified the transactions in compliance with procedures agreed upon with the State Department.

Model 12 Helps Dutch

Another famous Lockheed, the Model 12, contributed its measure to the Allied cause. In July 1938 engineering was completed on a conversion of the Electra Jr. into a military trainer called the Model 212, and the first one flew in February 1939. The Dutch government liked the configuration, ordered 16, and dispatched them to the Netherlands East Indies.

The Japanese war machine came grinding down into Java two years later and bombed the planes into uselessness. Out of two crippled survivors, with urgency and skill born of desperation, a crew of one Dutchman, two Australians, a Canadian, and a New Zealander fashioned one airplane that would fly. It carried them on a hair-raising journey up the coast of Sumatra, eluded nine Japanese bombers, and landed safely at Ceylon—with 15 minutes' fuel supply left.

The Lodestar Goes to War

Also caught in the vortex of World War II was the Model 18 Lodestar. The Army and Navy used cargo and personnel transport versions. It was the first American plane adapted for training paratroopers. A group of Lodestars bought for use in the Netherlands East Indies evacuated the bulk of the civilian population flown out when Japanese invaders struck.

The Lodestar shared with the Model 14 a valuable characteristic. Designed as a high performance airliner, it was easily converted into a lethal warplane. No one knew this better than the British. Pleased with the Hudson, they listened willingly late in 1939 when Lockheed proposed an even more formidable aerial weapon, the Model 37, developed from the Lodestar.

In February 1940 the British placed an initial order for 25. Lockheed promptly subcontracted the business to its subsidiary, Vega, to be manufactured



By mid-1940, when France collapsed, Lockheed had expanded Burbank factory to build Hudsons.



One of largest private wind tunnels in U.S., costing \$175,000, opened at Lockheed in 1940.



Nine-foot powered Constellation scale model was tested in throat of 300-mph wind tunnel.

in its new factory. It was Vega's first big order.

In keeping with the pattern set with the Lockheed Lightning, the British wanted an alliterative name for its Vega bomber. Courtlandt Gross suggested among others Volcano, Velociter, Vauxhall, Vindictive, Vermont, Ventura, Ventnor, Viceroy, and even Vulpecula—a constellation meaning in English "The Little Fox." To his brother Robert he also suggested Vopocatepetl, Venividivici, Veribest, and—brace yourself—Vurbank.

"How's that for a list of beauts?" Courtlandt inquired.

The name selected was Vega Ventura, which could be translated roughly to mean "lucky star." The first Ventura flew in July 1940. Pleased with flight test data, the British added 650 more to their order. U.S. Air Corps officials liked the plane too, and pitched in a contract for 200 called the B-34. Altogether Vega built 3010 including 2135 U.S. Navy PV-1s and PV-2s.

Early in 1941 management of the two companies took a fleeting look at the preceding year's accom-



In 1940 Lockheed bought Union Air Terminal. Picture shows how airport appeared in 1930.



Original layout of airport proposed park on site at right later occupied by Vega factory.

plishments and noted huge gains. Floor space doubled in 12 months to more than 1.6 million square feet. The backlog multiplied six times to \$280 million. Number of employees tripled to 20,000. And 396 airplanes rolled off assembly lines.

In March 1941 Congress passed the Lend-Lease bill. It had far-reaching scope because it permitted the government to lend "defense articles" directly to Britain and other nations whose defense was vital to the safety of the U.S. and the western hemisphere.

Recognizing its significance, Gross immediately put Lockheed on a "war footing" and warned that "perhaps our very lives are at stake." And the nation redoubled its efforts to build up its own air power by providing orders that enabled the aviation industry to expand facilities, tool up for mass production, and train thousands of inexperienced workers in new skills.

Vega Joins B-17 Bomber Pool

One such order came in April.

Robert and Courtlandt Gross were discussing an expansion already necessary in the just-occupied Vega factory.

The telephone rang.

It was Major General Oliver P. Echols, chief of materiel for the Army Air Corps, calling from Washington.

"I've just been talking to General Arnold," said Echols. "He outlined a three-company mass produc-

tion program for Boeing's B-17. We want Vega to join Boeing and Douglas in the pool. How about it?"

"Hold the phone," said Gross. He turned to Courtlandt and relayed Echols' message.

It takes a certain amount of time for a company president to shift plans for the future of his organization and submerge its identity to further a cooperative enterprise. In the case of Courtlandt Gross it took about two seconds.

"Sure," he said. "Let's get going."

The B-17 got going. Vega's own project, the Ventura, instantly became secondary, and Vega joined Boeing and Douglas to manufacture in quantity the aircraft that Gross called "the backbone of democracy's bombardment force...a noble and wonderful airplane." The program soon got the "B-V-D" nickname from initials of the three firms.



Lockheed offered Model 12 as three planes in one: for attack with bombs, nose guns, defensive gun turret; photography and observation; and speedy transport. Camouflaged plane above served Dutch in East Indies, aided evacuation during Japanese invasion. Left below, bombs on belly of Model 12. Right, window holes were for firing small arms.



Lodestar was loaded at Cape York, Australia, with supplies for Allied outposts in Dutch New Guinea.

Bombers for Britain



Aboard ship in Long Beach harbor, first Hudsons began ferry trip to England. Deliveries started early in 1939.



Hudson bombers were shipped from both coasts. This one was loaded on lighter in New York, then on boat.



Ability to come back earned name of "Old Boomerang" for Hudsons. This one returned despite gaping hole.



George VI of England climbed out after ride in Hudson. Versatile airplane performed variety of wartime jobs.



Front to rear, Hudson, Douglas Havoc, Vega Ventura started journey overseas by Long Beach Ferry Command.



Over Dunkirk, waves of Hudsons bombed German boats, strafed Nazi soldiers, helped bring off evacuation.



By sea and air they came. In 1941 Hudsons crossed the Atlantic on their own power to speed deliveries.



Wartime cartoon captured crew's appreciation of "Old Boomerang's" ability to take it and come back again.



Hudsons at Lockheed Air Terminal awaited delivery to the British. Lockheed built a total of 2941 of them.



Pleased with the Hudson, the British placed orders for the newer Ventura, a conversion of the Lodestar.

We Were Ready!



Month before Pearl Harbor, Vega employees held rally to hear March Field pilots tell great U.S. need for B-17s.



Production began on first Flying Fortress before U.S. entered war. Vega joined Boeing, Douglas for B-17 job.



Factory grew rapidly in weeks before Japanese attack on Hawaii. Parking problem became acute for 50,000 workers.



By December 1941 Vega was engaged in full-scale output of Ventura bombers to fill big British and U.S. orders.

In October Lockheed employment rose to 50,000, an all-time record in the airframe business. Its backlog stood at \$565 million. By the end of 1941 it had built 1733 Hudsons, 25 Venturas, and 267 P-38s for national defense and overseas combat. Lockheed and Vega occupied total floor area of nearly 3.5 million square feet. Production and executive staffs were progressive, and the work force was alert and efficient. In

less than a decade they had built the organization into one of the most modern and productive in the American industrial family. They had met and overcome many a challenge.

But their greatest challenge was still to come.

It arrived on December 7, 1941, when the Japanese attack on Pearl Harbor stirred America's armed might into full-scale action.

Coming Next Month / LOCKHEED AT WAR

Not until President Roosevelt proclaimed his 50,000 airplane-a-year goal in May 1940 was the U.S. jolted from its business-as-usual smugness. In that year America's aircraft factories produced 2885 combat planes—but only a fifth of them went to the U.S. Army and Navy. Our victory in the single Battle of Midway in June 1942 lost for our Navy the equivalent of six months of its production at the 1940 rate.

Not until after Pearl Harbor on December 7, 1941, however, did U.S. schedules call for production of as many as 50,000 planes in a single year. Aircraft output then picked up momentum. The record of U.S. industry in turning out

more than a quarter of a million warplanes in the four years up to V-J Day was a real production miracle.

One out of every 11 planes that went into this miracle came from the Lockheed-Vega plants in Burbank. For the story of Lockheed at war—from the exploits of its planes at the battlefronts to the work of thousands of housewives who became Rosie the Riveters on the home front—read Chapter VI of *Of Men and Stars* to be distributed at your gate boxes next month.

If you have missed earlier chapters in this history of the Lockheed organization, call your division's public relations office.