AIR TRAILS

A STREET & SMITH PUBLICATION

15c

MARCH, 1939

WANT A JOB IN AVIATION?

Y THEY STAY UP
RANK TINSLEY

★

BOMBERS ABOVE
BY LT. W. M. WOOD

★

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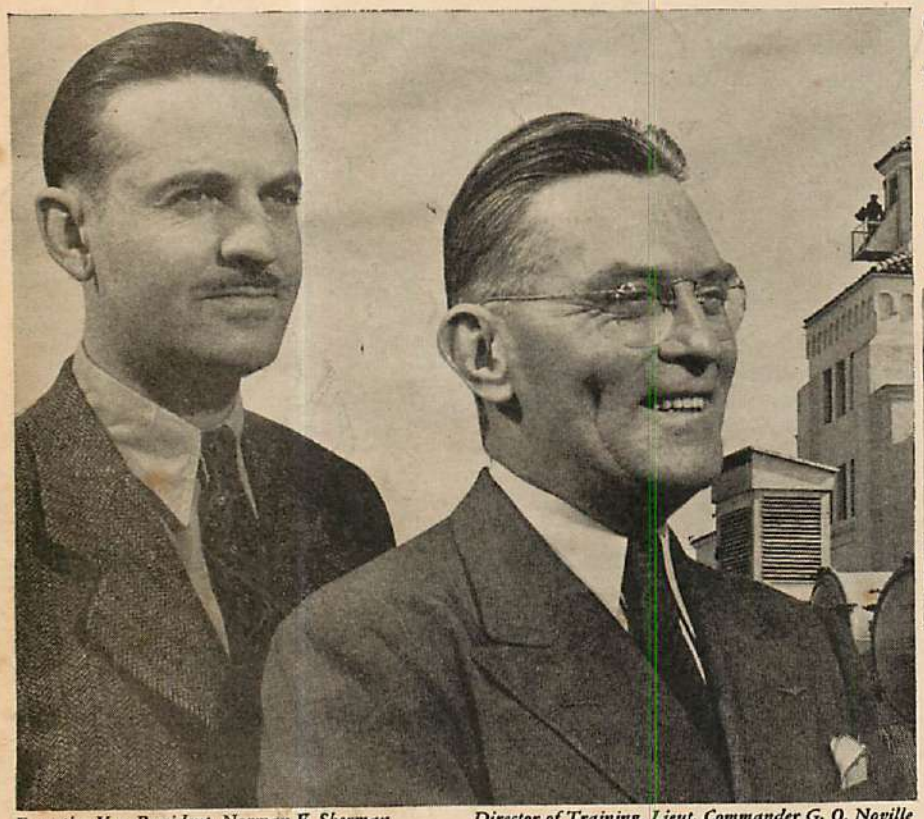

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It is not the man who knows only the answers to proven engineering formulas and established flying principles, but the man who can answer the unanswered problems who earns the greatest rewards. Such a man is Lieut. Commander G. O. Noville. Training under this man with his broad experience in the pioneering of flying, engineering and mechanics will be a vital factor in producing tomorrow's leaders. This is another reason why California Flyers offers the greatest training opportunities of this generation, to the young man who, as an engineer, mechanic or pilot has the ambition to look beyond present horizons to conquer aviation's new problems.

In addition to the high caliber of its instruction and instructors, California Flyers offers the opportunity of learning aviation and all its branches here in Los Angeles where the miracles of aviation have been and are being conceived. Here the greatest advancement of aviation engineering and construction have been made, as proved in the Los Angeles-built Douglas DC4's, the Lockheed 14's of today, and the famous round-the-world Douglas' and Lockheeds of yesterday. Los Angeles has led the world in flying, engineering and manufacturing both in advancement and volume.

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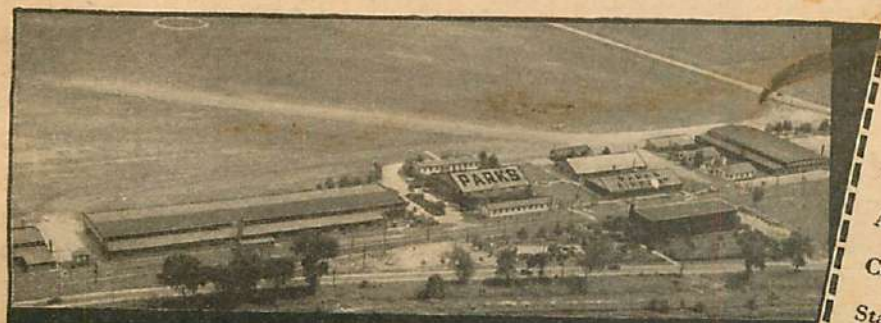

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MARCH, 1939 **VOLUME XI, NO. 6**

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AIR TRAILS

ARTICLES

STORY

MODEL ITEMS

Model Contents on Page 43

FEATURES

DEPARTMENTS

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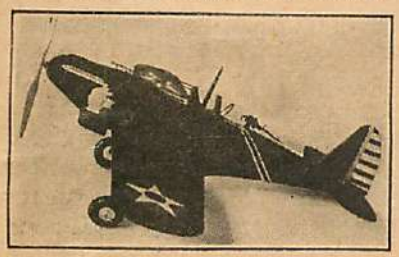

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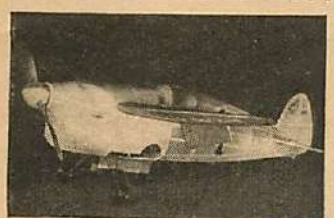

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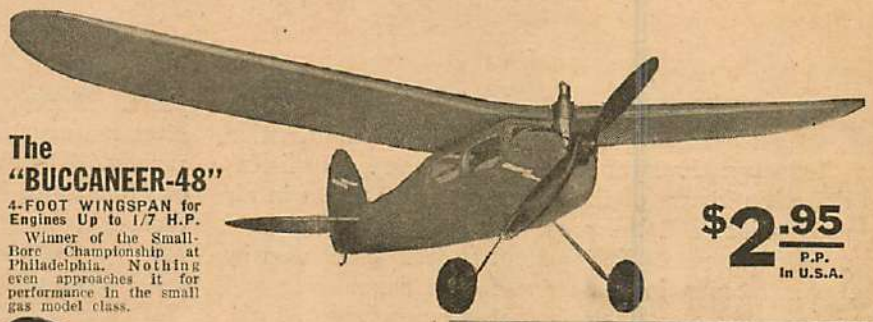

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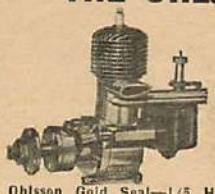
⅝" Bore x ¾" Stroke



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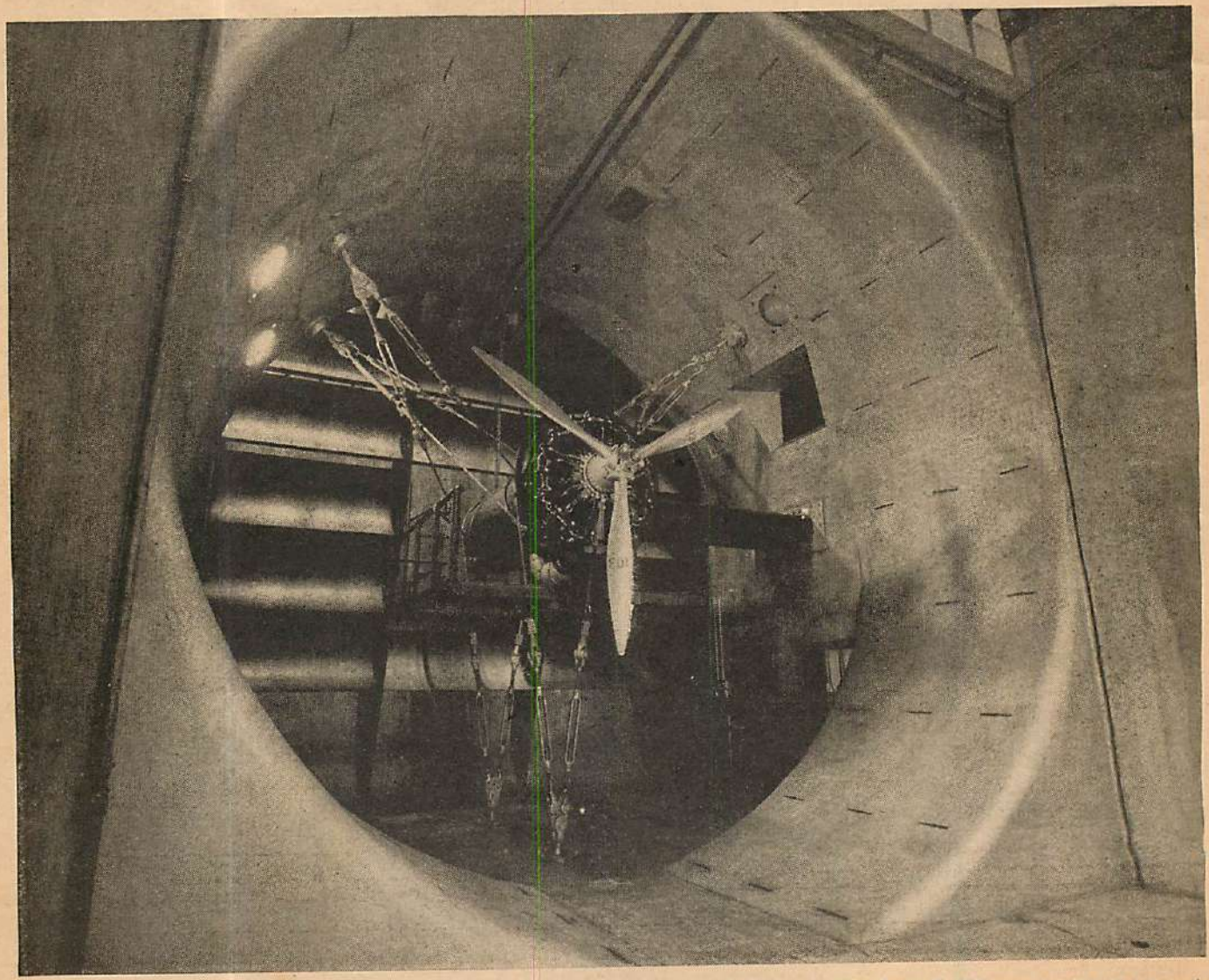
FORGERS OF AIRCRAFT

PROBABLY no other industry in the world has been so much in the public eye recently as the aviation industry. Everyone who reads the papers or listens to the radio knows of the amazing developments in air transportation, and the growing importance of aircraft to national defense. Perhaps not so well understood by the average man in the street is the engineering and manufacturing effort that has been necessary to make this growth possible. Aviation is still a young industry and it is changing so rapidly that the creative side of the business is still in a constant state of flux, with little prospect that it will stabilize to any marked degree in the immediate future. On the contrary, it appears probable that technical development will continue at the accelerated pace that has been evident for the past few years. Moreover, as the art advances, the cost of technical improvement and development is mounting very rapidly. The manufacturer who would retain a position of prominence in the aircraft industry must maintain a thoroughly competent and progressive creative staff, and must gamble an increasing proportion of his manufacturing income on development and experimental work.

This is a fundamental policy of the management of United Aircraft Corporation, and we believe it is a most important reason why the four manufacturing divisions of the corporation have continued to maintain their leadership in this highly competitive field.

When Pratt & Whitney Aircraft was organized in 1925, its first engine was one of four hundred horsepower, the most powerful ever developed in the United



Exemplary of one of the many phases of aviation serviced by United Aircraft Corp. is this Pratt & Whitney engine test mount.

an editorial by DONALD L. BROWN, guest editor

States up to that time. From that auspicious beginning Pratt & Whitney has pioneered in the development of single-row and double-row types of engines, and within the last year has announced the production of the Twin Hornet engine, rated at one thousand four hundred horsepower! It is an open secret that other and still larger types are under development, although our policy is not to discuss these until they have passed the experimental stage. It should be noted here too that the development has not been only along the lines of increased power, but that remarkable progress has been made in improved fuel economy, lower weight per horsepower, increased reliability, and all of the other factors which affect the efficiency of an airplane engine. Incidentally, as an indication both of the progress in engine design to be expected in the very near future and of the rapidly mounting costs of such development, Pratt & Whitney has just completed an engine testing laboratory, costing a quarter of a million dollars and capable of testing engines developing up to three thousand horsepower each.

Donald L. Brown, president of the United Aircraft Corporation.

The Hamilton Standard Propellers division occupies a unique position in the aeronautical world, and has been responsible for more important contributions to the art than any other propeller manufacturing organization. Hamilton Standard produced the first successful controllable-pitch propeller, and followed this with the improved constant-speed type. Both of these developments made such important contributions to the improvement of airplane design that today Hamilton Standard propellers are unquestionably the most widely used items of aviation equipment in the entire world. Recently Hamilton Standard announced another important achievement—the perfection of the Hydromatic quick-feathering propeller, which, it might be added, has been under engineering development for the past three years. This new propeller offers still further improvements in both performance and operating safety, and is already finding wide favor among major air lines and important military forces.

The achievements of the airplane divisions of United Aircraft have been equally noteworthy. Sikorsky Aircraft at Bridgeport has been a pioneer in the design and manufacture of large flying boats and amphibians. It was only four short years ago that Sikorsky developed the twenty-ton Clipper which revolutionized previous conceptions of limiting sizes of aircraft, and which has become world-famous as the trail blazer of the ocean routes across the Pacific and the Atlantic. Recently, Sikorsky Aircraft was called in by Pan American Airways to discuss proposals for future transoceanic aircraft, and has submitted tentative designs for a one-hundred-passenger flying boat. In addition Sikorsky has made an important contribution to national defense by designing and building for the United States navy the largest patrol-bomber flying boat ever constructed.

The achievements of Chance Vought Aircraft have been more or less screened from the public eye because of the military secrecy that necessarily surrounds the performance of naval aircraft. While detailed description of Vought designs cannot be disclosed, it is significant that their technical development has kept pace for the past twenty years with the rapid increase in performance and efficiency of the naval aviation service. The newest Vought scout-bombers now being delivered to the fleet are vastly superior in speed, in load-carrying ability, in maneuverability and in every other respect except reliability to those that were the pride of the naval air service only a few years ago. Tomorrow's designs, which are on the Vought drafting boards today, will continue to show this technical improvement in order that the navy's program of national defense will be adequate for its task.

MEET DONALD L. BROWN

As Introduced by Tracy Richardson

Donald Lamont Brown, president of the United Aircraft Corporation, is one of the fortunate persons who has combined his avocation with his vocation. He goes fishing and plays golf but his unswerving devotion is to things aviation. He is one of the pioneers of the industry, having been engaged in it since 1915 when the flying business was a very small cub.

Today President Brown heads one of the largest and most important aviation manufacturing groups in the world. Combined under his direction are Pratt & Whitney Aircraft, Hamilton Standard Propellers, Sikorsky Aircraft and Chance Vought Aircraft. Each division of this corporation is a monument to the industry in itself, and their products cover most of the aviation world.

Donald Lamont Brown was born in Berlin, Wisconsin, November 17, 1890. After grade and high school he attended Northwestern University School of Commerce. In addition to his studies at the university, Mr. Brown was employed by the Illinois Steel Com- *(Turn to page 82)*

A new contender for the Bermudian trade looms over the Sperry horizon, in the form of the New York and Bermudian Air Line, with offices in Hoboken, N. J. This new aspirant to traffic leadership to the little island proposes to use new Sikorsky S-43-B twenty-four-passenger-type amphibians on four round trips weekly, operating between Newark, N. J., and Plaice's Point, Bermuda. Good luck and C. A. V. U.!

★ ★ ★

Did somebody in the back row ask what C. A. V. U. means? Simply Ceiling And Visibility Unlimited, a term now actually used. It's to be the new heading of this department, and those of you who enjoyed Air Progress will continue to find under C. A. V. U. "meaty" information outside of the regular news flashes concerning things aviation, from all over the world and from all kinds of sources, both high and wide.

★ ★ ★

The *British Burnelli*, built by Cunliffe-Owen Aircraft at Southampton, England, was being readied for tests when this was written. It will be remembered that it was for the testing of this ship that our old friend Clyde Pangborn went to Europe. The structure of the ship has been completely redesigned. Engines are two nine-hundred-horsepower sleeve-valve Bristol Perseus.

★ ★ ★

New orders to Douglas brings T. W. A.'s list of equipment up to thirty-six ships, all of which are either Douglas Sky-Clubs, Sky-Sleepers, or Sky-Liners. Incidentally, the rumor that Lindbergh's name has been removed from T. W. A. ships is a sensation-seeking falsehood.

★ ★ ★

Sensation of the recent Paris Air Show was the Fokker D-23, twin-engined fighter. The basic design is suggestive of the Reaper bomber-fighter with which Fokker scooped this same show two years ago. The D-23 has armor-sheathed cockpit and a tricycle chassis. Armament includes four Browning machine guns—two .30 caliber and two .50 caliber, firing explosive ammunition. For general disposition of the ship see plans on Pages 62 and 63.

★ ★ ★

The Paris Air Show is not the kind of show Americans are familiar with. Mars was the chief exhibition there. Whether for mere purposes of sales or as part of the current European game of blindman's buff is hard to say. Military planes of a sensational nature ruled the roost, for it's a matter of pride with nations abroad to throw down on the exhibition floor the gauntlet of their rearmament.

★ ★ ★

As we are about to rush upstairs with this copy we are informed by a reliable source that the Seversky organization has been taken under the wing of the Kellett operation system.

★ ★ ★

A new Hispano engine, developed for transatlantic flying, delivers two thousand horsepower. There are twenty-four cylinders arranged in H shape, two crankshafts, and twelve carburetors. Horsepower per weight ratio is excellent, the engine weighing two thousand two hundred pounds.

★ ★ ★

According to reports, August 9th of last summer was a secret red-letter day for Bellanca, for at that time a tentative contract was entered into between Bellanca and Generalissimo Chiang Kai-shek for two hundred bombing planes totaling nearly eight and a half million dollars. The individual planes, known as Bellanca Model 28-90B multipurpose fighter-bomber land plane, will cost approximately thirty-nine thousand five hundred dollars each, exclusive of additional expenses for machine guns, ammunition and bombs.

This is one of the largest orders placed by the Chinese government to date, and shows once more the confidence the foreign powers have in the ability of American planes and equipment, as well as our ability to fill orders on time. These planes are expected to be ready for shipment within eight months, with a delivery rate of no less than twenty-five or more than fifty a month. Bellanca was businessman enough to insist upon fifty percent of the total price upon signing of the contract, and the rest ready when final delivery has been made. A nice little order and payment arrangement in any language, including the Chinese.

★ ★ ★

The first De Havilland Albatross delivered to Imperial Airways and christened Frobisher proved its worth by flying with seventeen passengers and mail from London to Paris in fifty-three minutes! Remember Bleriot?

★ ★ ★

Major Al Williams, in a recent article, emphasized the fact that the German Heinkel fighter, having set the record three hundred and ninety-four miles per hour on an oval course, did four hundred and thirty-five miles per hour straight-away. It is the major's contention that America is handicapped by the lack of adequate liquid-cooled engines. He cited the Heinkel as an example of the possibilities of the combination of horsepower and proper plane "contours."

★ ★ ★

The Liore 45 proves that the French are coming back with a surge. The 45 is a bomber, of course, and typical of recent French bomber designs, is a beautiful ship. It is doubtful if any similar ships in the world can match its performance. If powered with the Gnome-Rhone P-14s of twelve hundred horsepower, top speed will be three hundred and twenty miles per hour! Most unusual is its rear gun, a flexible shell gun.

★ ★ ★

A new French fighter which holds great promise is the C. A. O. 200, said to do three hundred and forty miles per hour with a nine hundred horsepower Hispano 12-Y. Climb to nineteen thousand six hundred feet takes only seven and a half minutes. See "The Paris Air Show Presents."

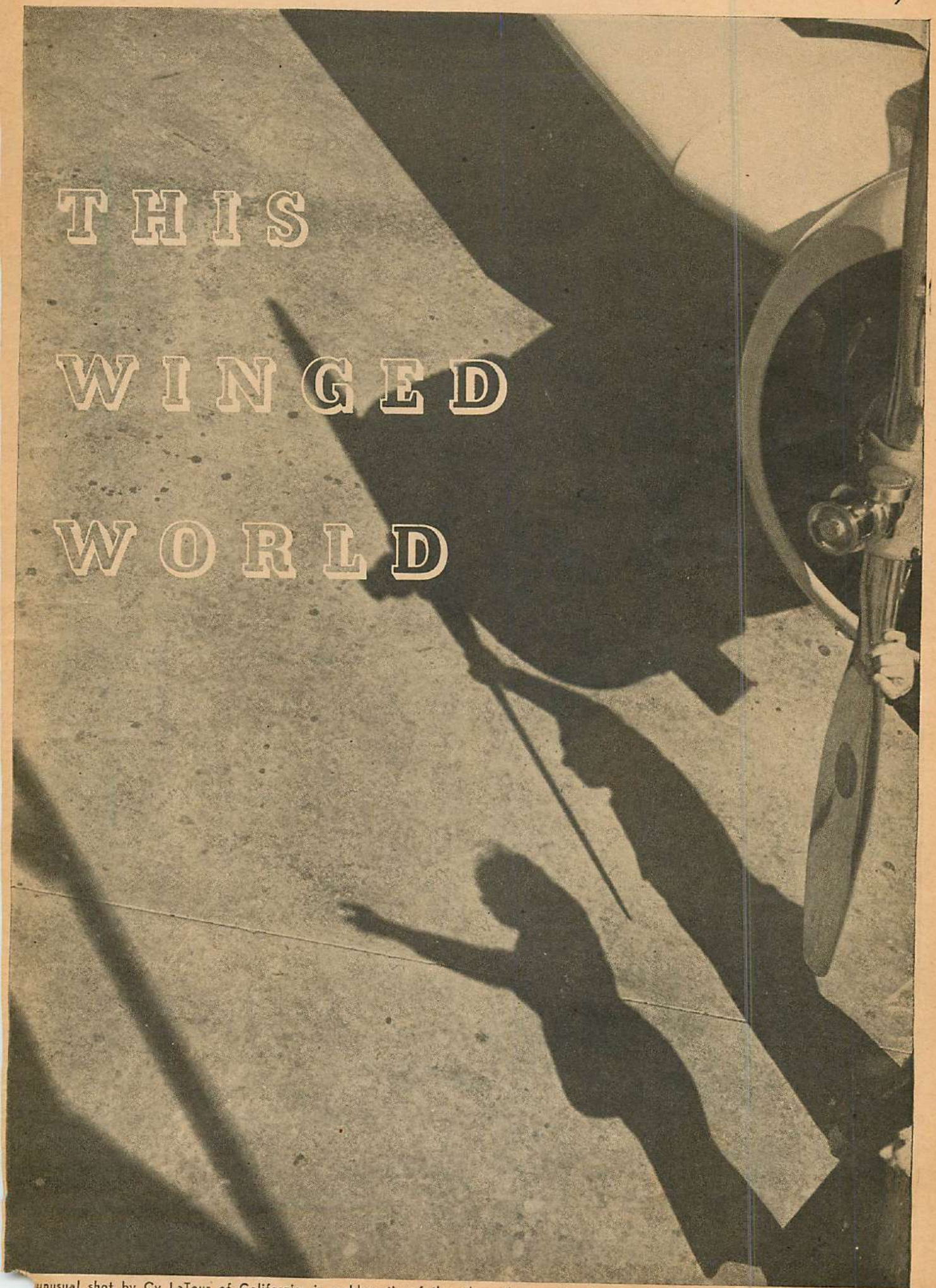
★ ★ ★

Germany's dread Dornier D-17 "Flying Pencil" is said to perform as follows when powered by the Daimler-Benz inverted, liquid-cooled engines: top speed, three hundred and ten miles per hour; range, one thousand five hundred and fifty miles; ceiling, twenty-nine thousand five hundred feet; maximum load, six thousand six hundred pounds.

★ ★ ★

Air Trails recently received a telegram signed by representatives of various recognized and approved aviation schools requesting our support to the end that established and approved aviation schools be utilized by the powers that be as part of the National Defense Training Program.

Needless to say, Air *(Turn to page 96)*



unusual shot by Cy LaTour of California, is emblematic of the adage that coming (aeronautical) events cast their shadows before.

NEWS OF THE AERONAUTICAL

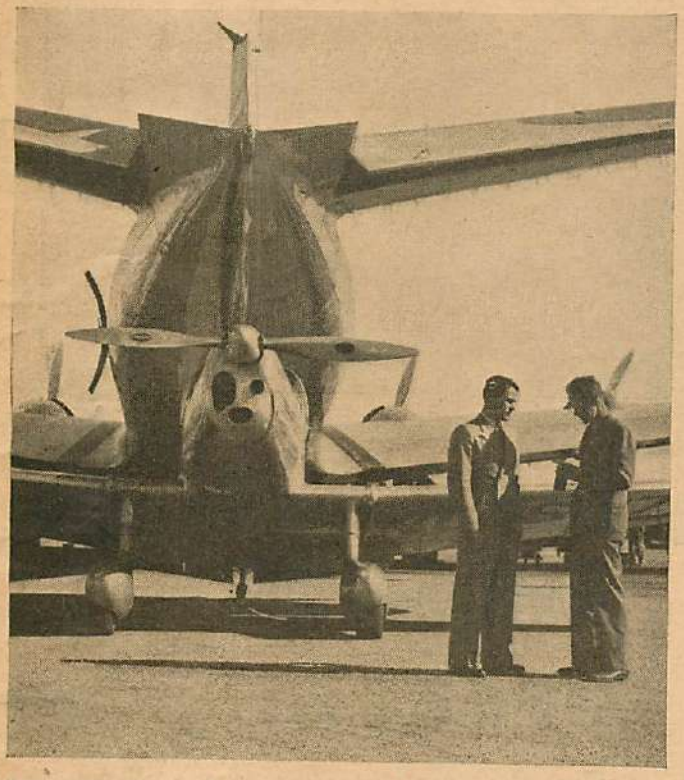
"Navy-TWA Squadron," third-time winner of Noel Davis Efficiency Award.

T. W. A.

Model of world's fastest and largest airliner, the British Fairey transport.

International

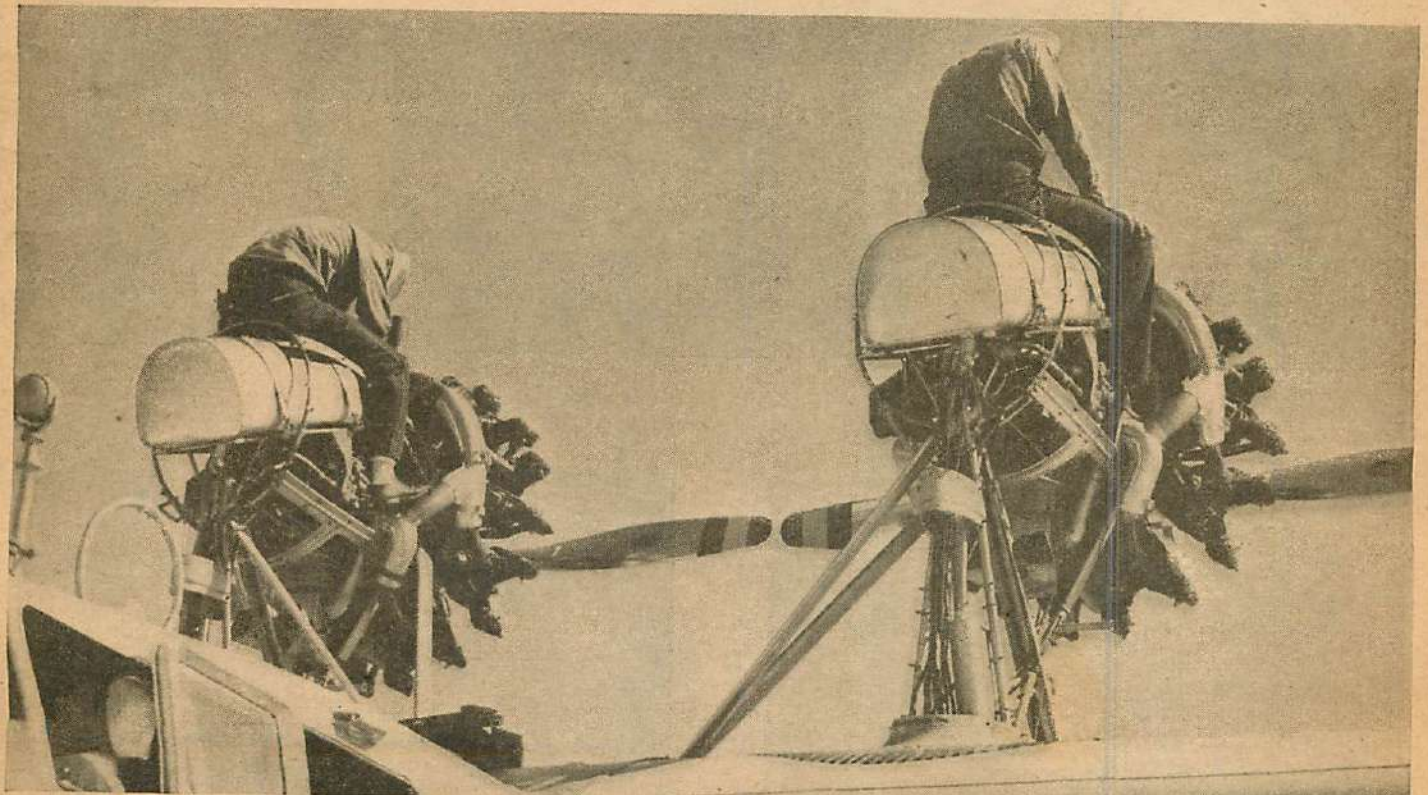
WORLD PRESENTED IN PICTURES



This weird mix-up of planes, wings, and props is translated into the Phillips "Aeroneer" parked under the tail of the giant DC4.

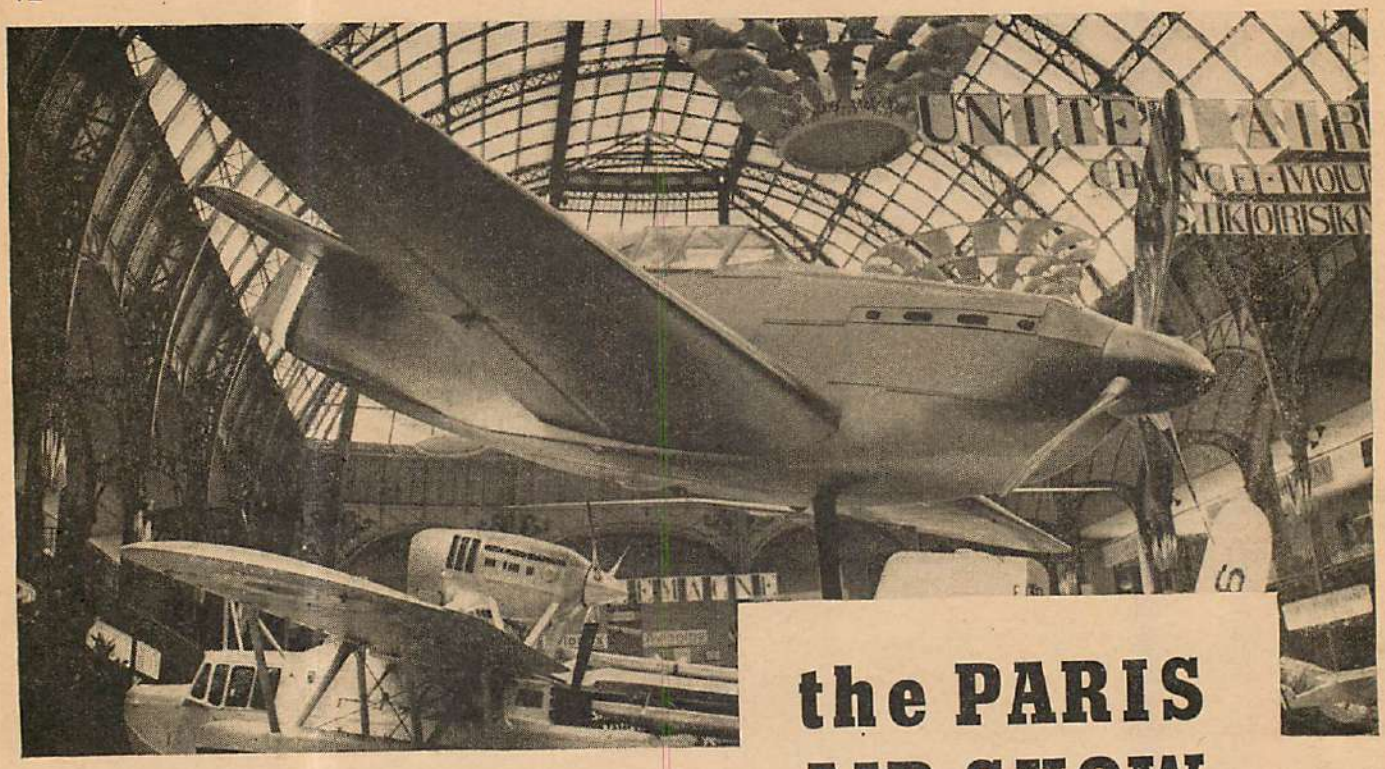
International

This is not the "Shadow" out for a drive, but a mobile "Shell burst" designed by the 108th Field Artillery for aerial spotting.



Rudy Arnold

Ride 'em, cowboy! These apparent cowhands are checking Pratt & Whitney engines on the coast guard's Fokker F. L. B. flying boat at Floyd Bennett Field. The streamlined motor nacelles are removed, as are also the N. A. C. A. rings about the air-cooled engines themselves.

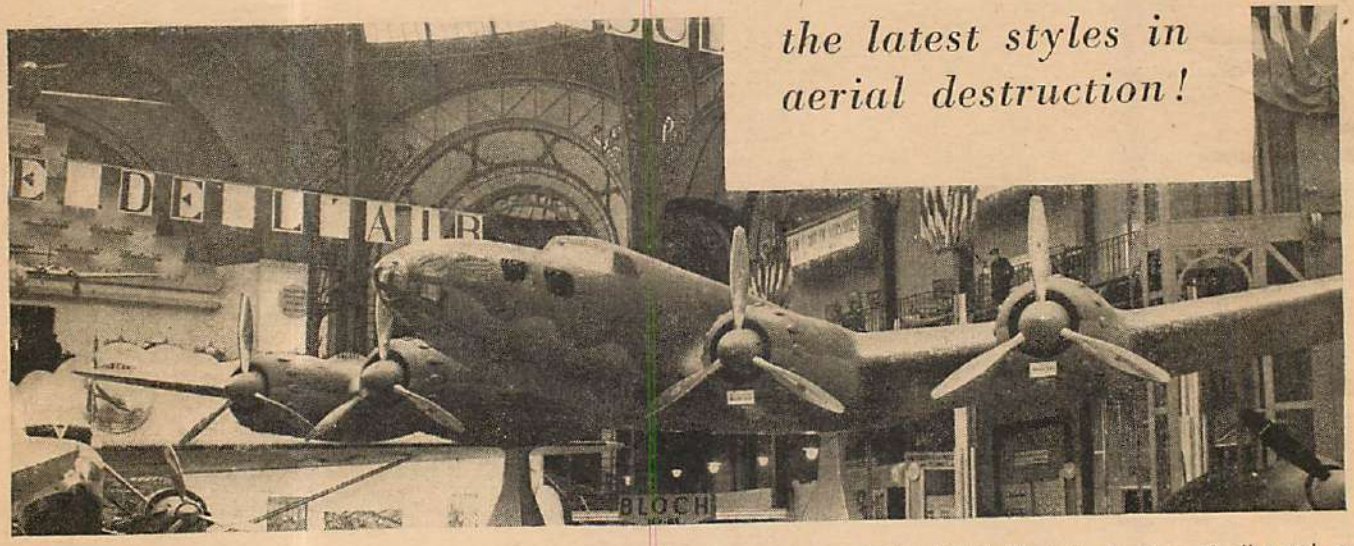


An apparent mock-up of the C. A. O. 200 of France planned for a speed of 340 m.p.h. and ability to climb to 19,600 ft. in 7.5 min.

the PARIS AIR SHOW presents

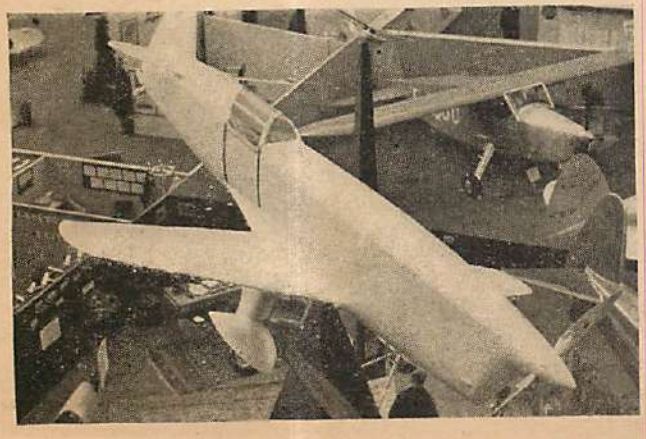
the latest styles in aerial destruction!

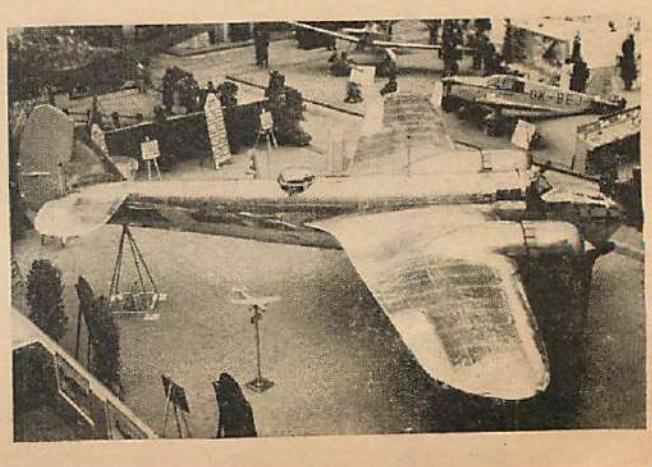
Extremely realistic is the mock-up of the French Bloch 162 B.5 four-engined bomber; speed 300 m.p.h., maximum ceiling 29,500.

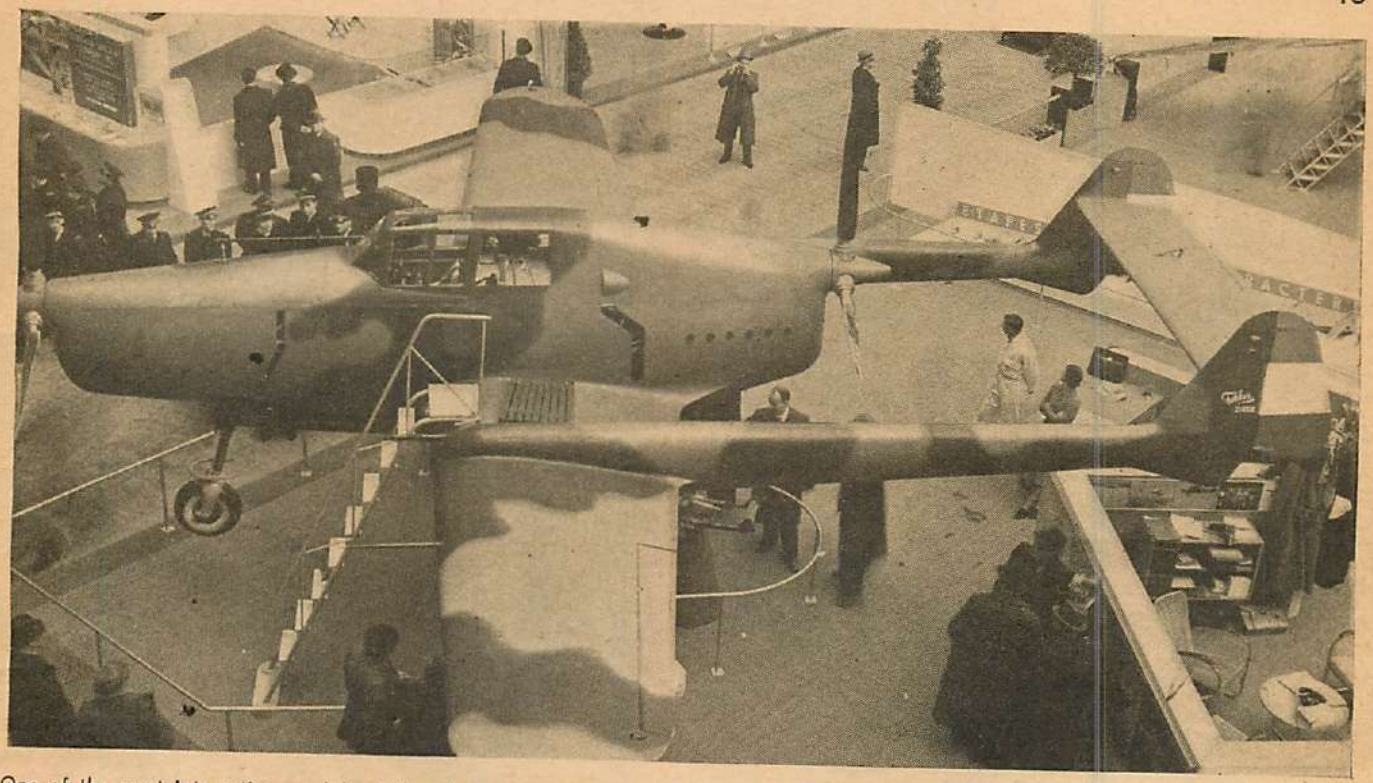


Nonmilitary but interesting was the future entrant in the Deutsch de la Meurthe Cup race for 1939. Resembles our Greve ships.

The familiar British Bristol Blenheim bomber of all-metal construction. The top speed is 295 m.p.h. and ceiling 30,000 ft.



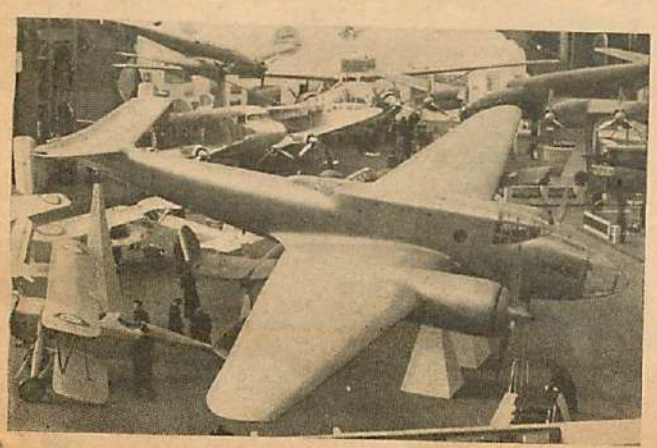




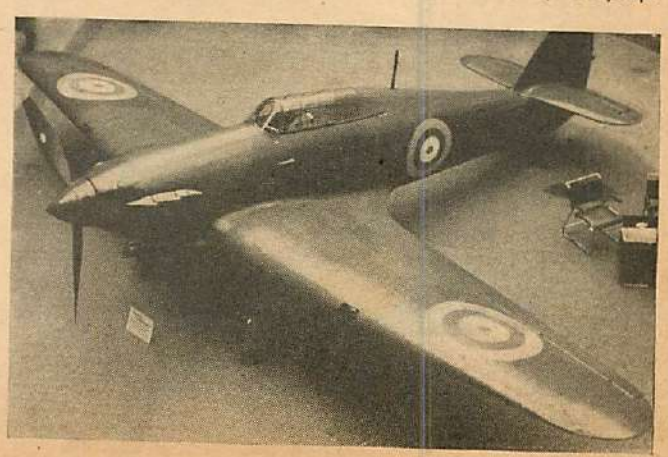
One of the most interesting models at the show was of course the Fokker D.23 tandem-engined, single-seater fighter with four guns. To add to the confusion, this unusual ship has a tricycle landing gear. The engines are Walter Sagitta inverted Vees. Speed is 330 m.p.h.

Another unusual type was the Polish P. Z. L. Wolf two-seater fighter armed with nose cannon and twin machine guns. The cannon is a 20 mm. shell gun and the twin machine guns are apparently .50 caliber. There are also two machine guns in the rear cockpit.

An interesting night bomber by Liore et Olivier of France. This model features an inverted tail group to aid firing over tail.

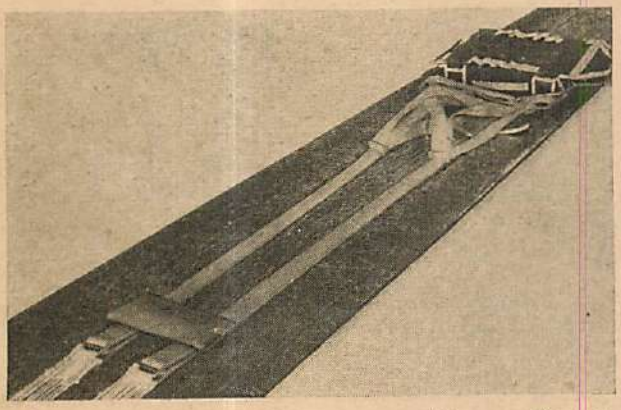


Britain presents a new model of the famous Hawker Hurricane eight-gun fighter with a new three-bladed variable-pitch prop.

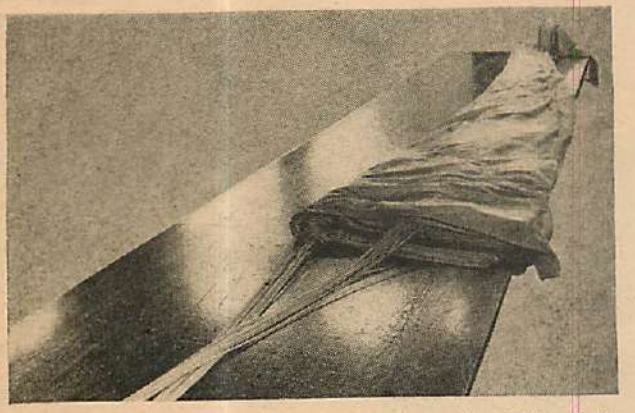


"WRAP IT UP"

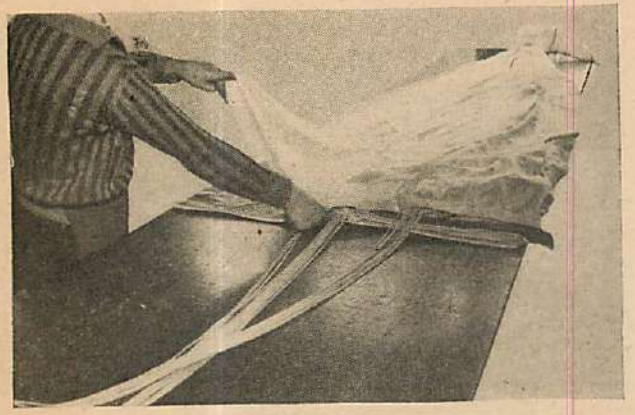
How they get them back together after a jump!



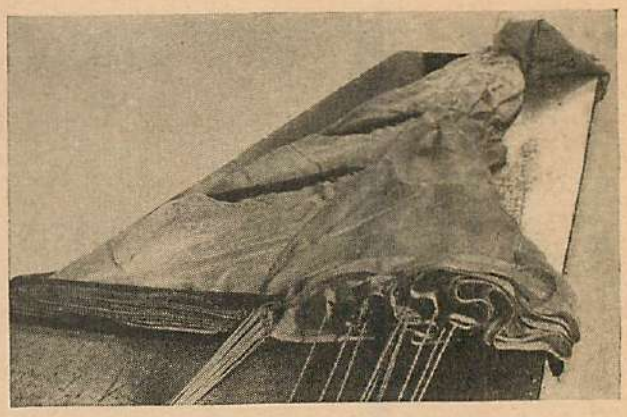
1 First arrange the pack, harness, and harness lift webs along the packing table. Note weight on the lift webs.



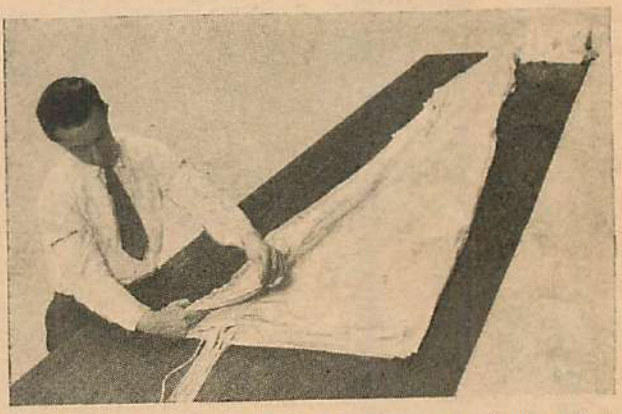
2 At other end of table straighten out the folds of the 'chute with the pilot 'chute at extreme end of table top.



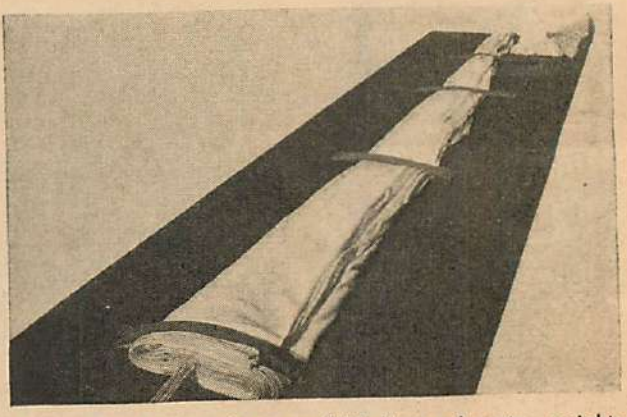
3 Arrange the panels of the 'chute evenly, smoothing out wrinkles and folds. Keep the shroud lines straightened.



4 Half of the 'chute is now arranged smoothly and evenly. Note shroud lines in center and bag weights on panels.



5 After other side of 'chute has been smoothed as first, both are folded in toward the middle, reducing pack.

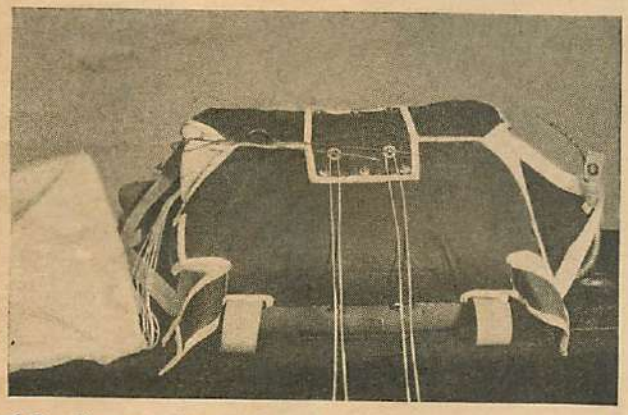


6 With both sides of canopy folded toward center, weights are used to hold down. Note the pilot 'chute at peak.

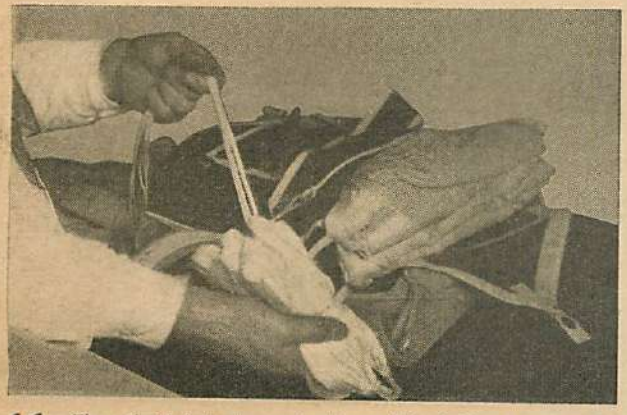
7 Now the entire group of shroud lines is hooked into loops in the bottom of the pack to prevent fouling.

8 As the shroud lines are hooked into loops the 'chute is moved nearer. Now it is folded on top of hooked lines.

9 The main 'chute is now folded down upon top of shroud lines in the bottom of pack. Note pilot 'chute to left.

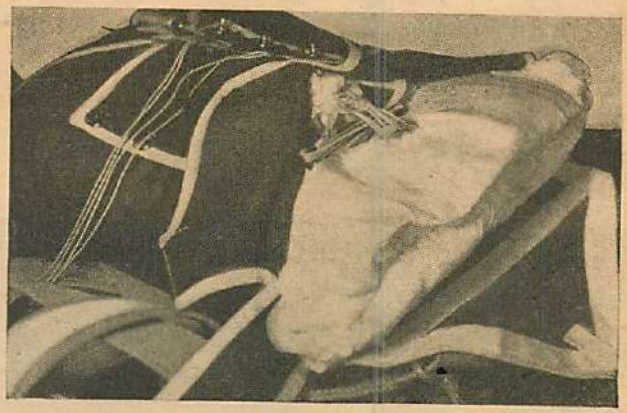


10 The two sides of the pack are now brought up over the folded 'chute and held by temporary pins through pegs.

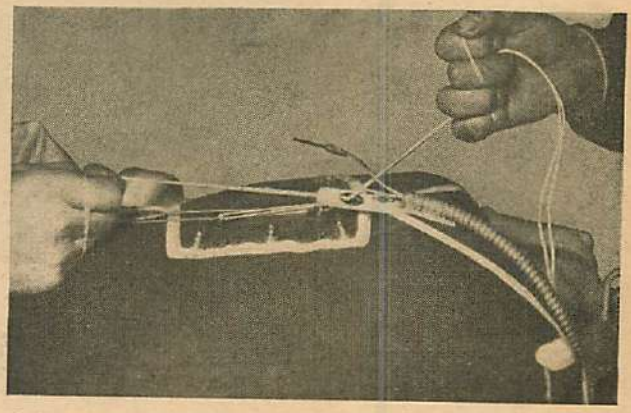


11 The pilot 'chute is now collapsed by folding spring ribs together and pulling pilot 'chute shroud lines with hand.

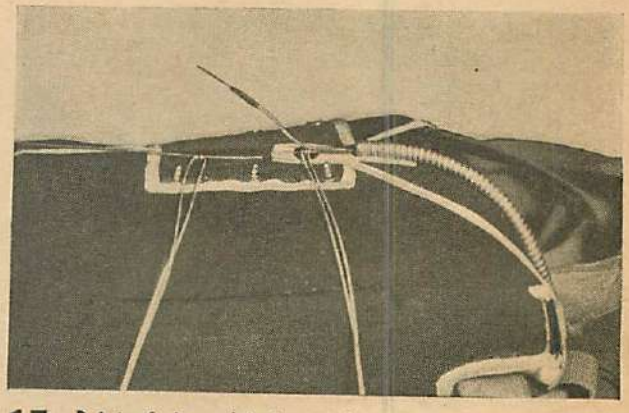
12 The collapsed pilot 'chute is inserted between the main pack and the temporarily fastened sides of the 'chute.



13 With main 'chute, pilot 'chute, and sides of the pack in place, we are now ready to close the ends of the case.



14 The end of the pack bearing the ripcord carrying tube is brought up and ringed flap placed over nearest peg.



15 Point of ripcord is inserted in peg. The other end is held by second ripcord tip. Snap protecting flap. Done!

Most potent threat in the international chess game is the bomber. Can bombers be stopped? If so, how? What is the latest in aerial strategy?

BOMBERS ABOVE

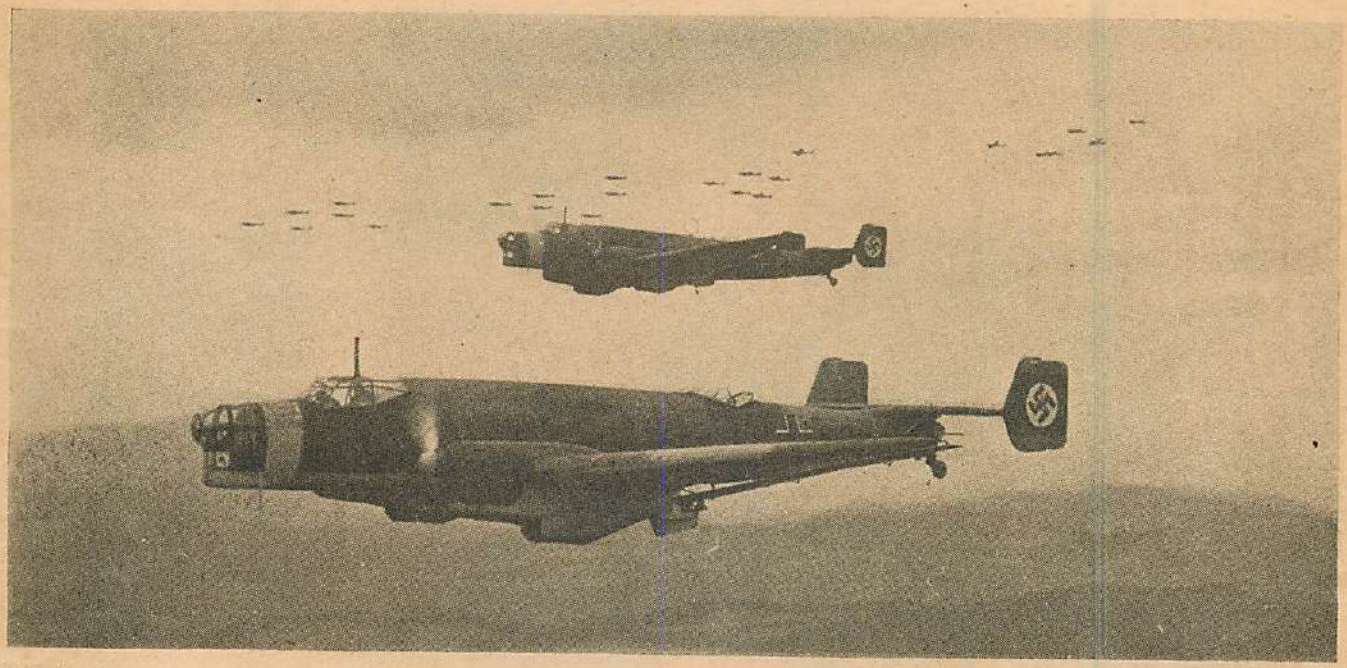
by Lieut. W. M. WOOD, Ret.

THE torn and bleeding cities of China and Spain stand today as shocking evidence of what modern aerial bombardment on a small scale can do to great centers of population. What will bombing on a large scale do?

The nations of Europe wonder, and grow jittery with dread of this twentieth-century flying dragon, the bombing plane, which comes in the night with a roar, breathing fire and spreading death and destruction. With all the speed they can muster they dig holes in the ground where they may hide themselves, and teach kindergarten children to wear gas masks. At the same time they build elaborate balloon barrages, rush work on antiaircraft guns, and seek faster fighting planes.

But it is more, bigger, and farther-flying bombers which they seek most feverishly. Apparently they agree with Stanley Baldwin, who warned the man in the street

Night firing of machine-directed 3 in. AA guns in simulated raid. Current plans call for immediate building up of ground defense.



Today bombers fly at immense height, throttle their motors, and glide over their objective undetected. These are Junkers Ju. 86Ks.

in these words: "Whatever people may tell him, the bomber will always get through. . . . The only defense is offense, which means that you have to kill more women and children more quickly than the enemy if you want to save yourself."

Here in America we ourselves have been rudely awakened by the recent expansion of air power abroad, but particularly by the amazing development of enormous long-range planes and the announcement that they are merely "little ships," in fact the "last of the little ships." The Russians have already carried more than two thousand three hundred pounds of pay load (i. e. bomb load) for more than three thousand one hundred miles at an average speed of two hundred and twelve miles per hour to set a land plane world record. No telling what they are doing in secret. We could probably beat that with our XB-1 super flying fortress, or our Douglas DC-4, and of course there are several flying boats which could probably carry that much that far, but not so fast.

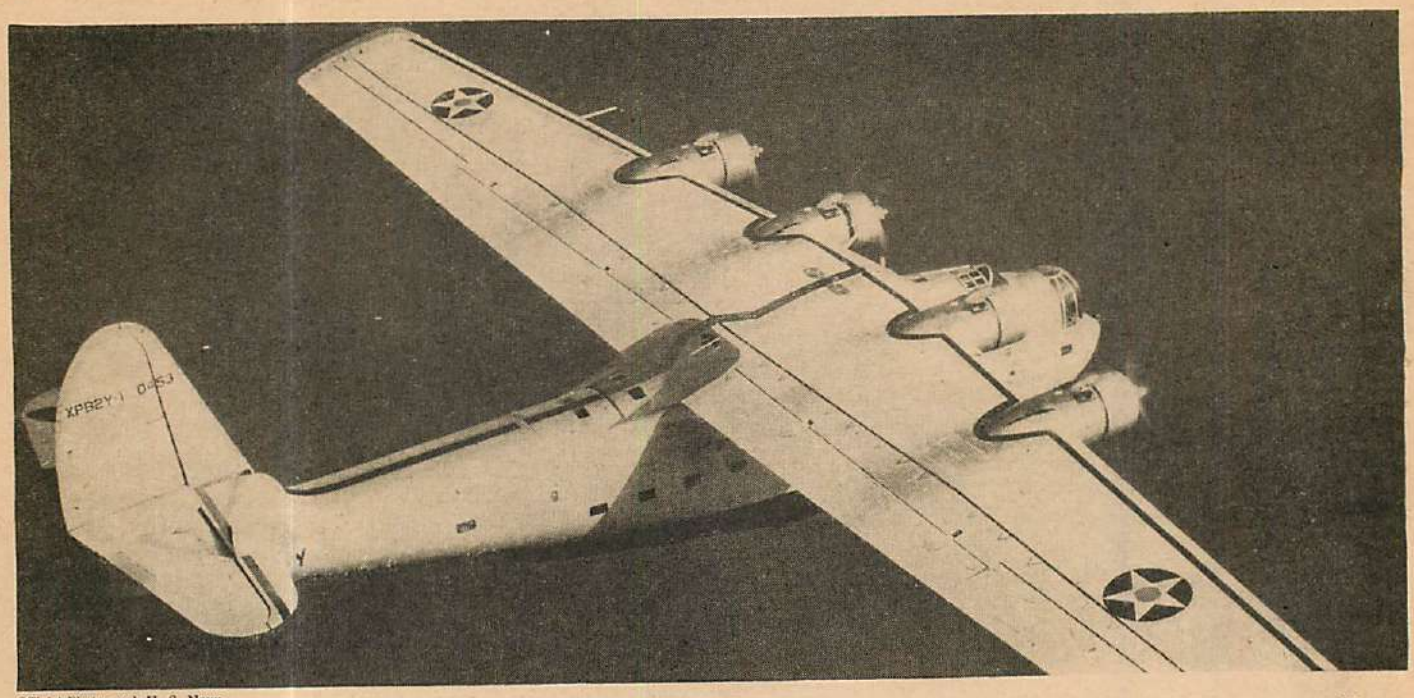
The Germans have caused the world to sit up and take notice with their great development of catapult launching of heavy Diesel-powered long-range seaplanes. They hold the seaplane distance record of five thousand two hundred miles, made early in 1938 with an old Dornier Do-18, powered with two six-hundred-horsepower Junkers Diesels, launched by catapult from a ship. The catapulting of the seventeen-ton seaplanes *Nordmeer, Nordwind,* and now the new *Nordstern,* which makes two hundred miles per hour with four six-hundred-horsepower Diesels, has become routine in the North Atlantic mail service of the Deutsche Lufthansa. The acceleration in launching is too great for passenger comfort, and the mother ships cost too much for commercial profit. The whole business seems to be for military experimental purposes.

The possibilities for increased range and loads by using catapults and Diesel power are something to make this country look into both. And that is being done. The newest Junkers Diesel on which information is available is the 205-E Jumo, which is said to develop eight hundred horsepower for take-off, six hundred and fifty-five for cruising, and to consume only 0.35 pound of fuel per horsepower hour. Our high-powered gasoline engines burn about 0.50 pound of fuel per horsepower hour at cruising speed. The new Diesel is said to be quite light, 1.42 pounds per horsepower. But our radial gasoline engines are down to about 1.30 now. Allowing for this difference, a Diesel-powered plane should fly close to thirty percent farther than a similar gasoline-powered plane, or else carry a heavier load the same distance.

Most amazing have been the developments and predictions as to giant airplanes the plans for which do not contemplate use of catapults or Diesels—though it is obvious that if large enough catapults and larger Diesels are developed, and it seems they will be, the range and bomb load of any big plane could be increased.

Glenn L. Martin says he can build at any time a seaplane that could carry two tons of bombs eleven thousand miles nonstop at three hundred and eighty miles per hour —and nobody contradicts him. Half a dozen big plane builders have well-advanced plans for air leviathans. For example, Consolidated has plans for a two-hundred-ton flying boat, really a flying wing with retractable floats, that would carry three hundred passengers, a crew of thirty, plus baggage, mail and express, for five thousand miles at three hundred miles per hour. As a bomber it obviously could carry more fuel instead of part of that great load, and fly the eight-thousand-mile trip to the center of Europe and back. Or from Europe to New York, and back to Europe. It would be powered with six two-thousand-horsepower engines, probably the new engines being developed by Allison for the army's new eighty-ton high-altitude bomber which Douglas is building.

That is doubtless the biggest airplane actually under construction in the world. Air corps officers will say nothing about it—dismiss it as a mere rumor when asked. But fairly reliable rumors persist that this giant plane—I suppose it will be the XB-19—will be able to fly to Europe and back nonstop, not carrying much of a load, perhaps, but even at that it will be something of a wonder.



Official Photograph U. S. Navy.

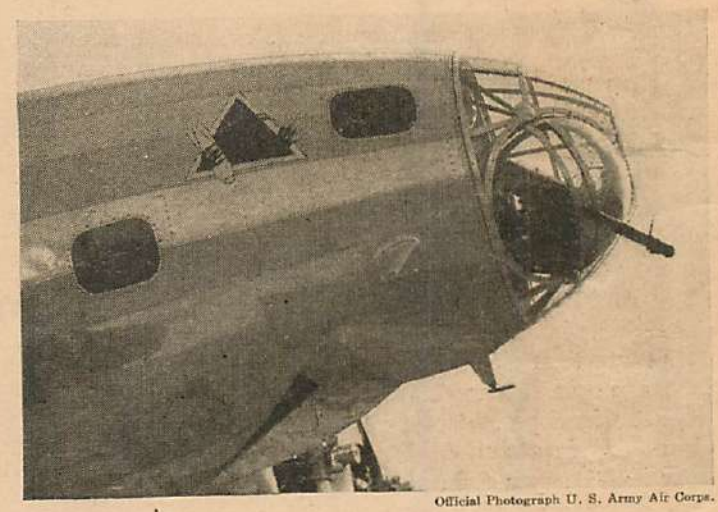
The immense Consolidated XPB2Y-1 patrol bomber, built for the navy. Reports are that Consolidated is building one even bigger.

The Boeing Atlantic Clipper could swap all of her eight thousand pounds or so of pay load for gasoline, and not be able to make the round trip. Flying light, without passengers, she might make a little more than her usual average of about one mile per gallon. But after all, eight thousand pounds of gasoline is only about one thousand three hundred gallons. And it would be four thousand miles back from the middle of Europe.

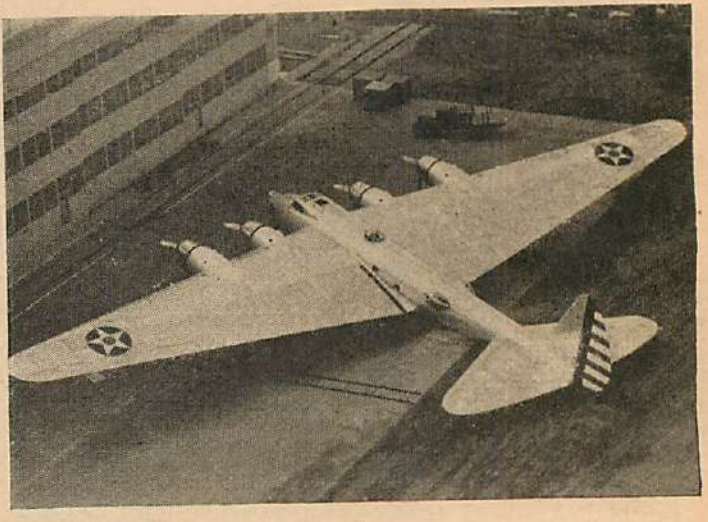
This new Douglas bomber is rumored to have a wing spread of about two hundred and fifty feet and to be about one hundred and twenty feet long. Its eighty-ton bulk will dwarf the thirty-two-ton XB-15, which has a span of one hundred and fifty feet and a length of ninety feet. The little old Flying Fortress B-17, with its puny wing span of one hundred and five feet and its twenty-five tons or so of gross weight, will be in the midget class. We will have three squadrons of B-17s in the Second Bombardment Group at Langley Field when present orders are filled. And it's a mighty good little ship, of three thousand mile extreme peace-time range and a fighting radius of seven hundred and fifty miles. But it will soon take its place as a sort of practice plane for bigger things.

The navy, of course, has already confirmed plans for a fifty-ton flying boat, ten tons heavier than the present "biggest" title holder, the Boeing Atlantic Clipper. This patrol bomber, according to Admiral Cook, will have a range considerably in excess of the five thousand miles necessary to fly to Hawaii and back. At present the navy's standard patrol bomber is the now familiar "routine hopper" of the Pacific, the Consolidated PBY-1 and its later models. More than two hundred are in service, and more on order. It can fly four thousand miles, weighs about thirteen and one-half tons, and carries two tons of bombs.

Now undergoing secret tests is the thirty-ton Consolidated XPB2Y-1, powered with four one-



Official Photograph U. S. Army Air Corps.



Top—A closeup of the nose turret of a Boeing B-17, showing detail of gun installation. Rumors already make the B-17 a "baby."

Above—The famous YB-15, super Flying Fortress. Truck visible in photograph affords interesting comparison of their relative sizes.

thousand-and-fifty-horsepower Wasps, and capable of carrying a "large" bomb load about five thousand miles at close to two hundred miles per hour, so the rumors say. High speed is guessed at around two hundred and forty miles per hour, though it is probably not that fast. The Sikorsky XPBS-1, similar to the Consolidated boat, is also being tested.

These thirty-ton navy boats, like the army's thirty-two-ton XB-15 bomber, are such little ships that it is possible they will not be put into production. They are practically obsolete already.

As a high-ranking air corps officer remarked to the writer in Washington recently, the United States has always favored big, long-range battleships because of our lack of many naval bases such as England has. The same reasoning, he said, applies to airplanes. We need long-range craft because our national defense may require that we go a long way from home, strike with a lot of power, and then fly all the way back without stopping. The chief conclusion reached in the GHQ air force maneuvers of last spring was that more long-range planes are needed. Longer range planes mean bigger planes capable of carrying bigger fuel and pay loads. Engineers see no limit to the greater efficiencies, that is, load and speed per horsepower, which seem to be possible by building planes bigger. We are going to see some air giants.

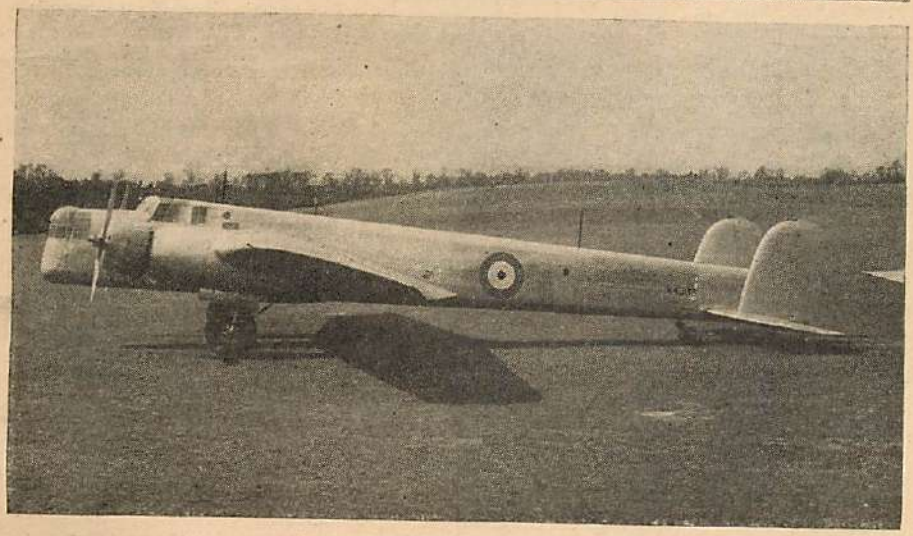
But others can build planes just as big as we can. And every extension of range makes America more vulnerable to air attack.

Perhaps the bombing plane, by putting statesmen and armament makers and profiteers and their families in the danger zone, will bring peace, as we all hope. Without the "bombs" of Damocles over London and Paris and Berlin, we would probably have had another big war in Europe already. If, however, the bomber does not paradoxically bring peace, it can bring constant danger to the cities of America within a very few more years. Great air powers of the world will before long be able to launch round-trip nonstop raids from the relative safety of their own land bases.

The United States, aroused really for the first time to the air menace, has started to build our four regular antiaircraft artillery regiments up to twenty-four regiments. About twenty-three million dollars has been appropriated. Our air corps expansion to two thousand three hundred and twenty first-line planes is being pushed. Navy aviation is being approximately doubled to give us "not less than three thousand" navy planes, while surface-ship tonnage is to go up twenty percent. (After this article was written newspapers carried information of intended increases in our national air defense. As we go to press the figures here quoted remain accurate, but before this issue reaches our readers official announcements may boost these figures considerably.—The Editor.) Airplane manufacturers watch the back logs of orders pile up to new highs, while young engineers speed up their slide rules, and gigantic land planes and flying boats take shape in their brains, on drawing boards, and eventually take the air to everyone's increasing amazement.

In all this rush of activity, the long-range bombing plane holds the spotlight. We are going to have a lot of them, for on them our future safety depends.

Around bombardment aviation at present rages a heated controversy. That controversy has been going on almost from the time the first bomb from an airplane was dropped on certain amazed citizens of Tripoli in 1911. An Italian flier did it, and Italians have been dropping some of the latest bombs dropepd— in *(Turn to page 66)*



Top—Italian Savoia-Marchetti S-79B bomber. Italian construction is a composite of wood, sheet metal, and fabric. Purpose, no doubt, is the utilization of limited materials.

Above—British Armstrong Whitley heavy bomber. Tail gun turret is obscured by vertical tail. A number of types are in heavy production. This type specializes in night work.

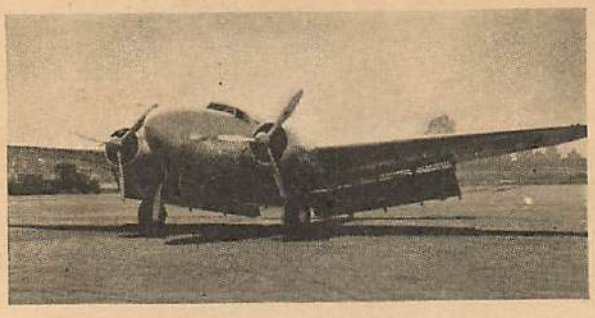
WHY THEY STAY UP

The ingenuity of man has been able to build and maneuver in the skies twenty-five tons of such engineering perfection as the YB-17.

by FRANK TINSLEY

Realizing there are many new converts to aviation, we present an expert's "WHY."

How often have you seen the casual visitor at an airport survey the glistening wings of a big transport plane with a puzzled look in his eye? He knows that the darn thing can fly all right—it has just circled the field and landed—but how? How can that thick, heavy wing, which neither flaps like the wing of a bird nor swirls like a fish's tail, lift eight or ten tons of fuselage into the air and keep it there? When Sonny Boy, alongside him, pipes up with a perfectly natural but rather embarrassing question, John Citizen is very apt to mutter something about "sky hooks" and cover his confusion with a booming ha-ha.



A Lockheed with its Fowler flaps in full extended position, the purposes of which are explained at length in the text.

It is astounding how many intelligent people accept the fact of human flight without troubling to learn its relatively simple explanation. The basic theory of aerodynamics seems to be a complete mystery to the average man. Indeed, there are plenty of aviation fans who are more than a little fuzzy as to just what makes an airplane fly. This is inexcusable in our winged world of today. So let's devote a few minutes to really finding out why they stay up. Let's even get down to elements, start from scratch.

We'll begin with the air itself.

The atmosphere is composed mainly of oxygen and nitrogen combined with small quantities of other gases. Though extremely light, it has nevertheless a definite, measurable weight. In common with all other substances having weight, atmosphere is subject to the force of gravity. This force constantly draws it down toward the center of the earth, just as gravity pulls a pencil to the ground when it rolls off a table top. An envelope of this atmosphere almost seven miles in depth completely surrounds the earth like the skin of an orange. It is invisible and varies progressively in density from a very thin gas at the upper levels to a relatively thick atmosphere below. At sea level, with the piled-up weight of seven miles of air pressing down upon it, the atmosphere is compressed to a density of 14.7 pounds per square foot.

This thicker air provides greater support for a low-flying airplane. It explains why a plane can land much more slowly at sea level than on a high mountain airport where the air is thinner. The lower resistance of this thin air also explains why the same plane can fly faster at ten thousand feet than at one thousand. In climbing, however, the progressively thinning air acts adversely on the efficiency of the propeller, which has a less solid substance into which to bite. (This does not apply to the controllable-pitch propeller which changes its blade angle in order to take a larger bite of thin air.) If we continue to climb, our plane at last reaches an altitude at which the atmosphere has become so thin that it no longer furnishes support to the wings. The controls cease to function, our plane washes around sloppily and we can ascend no higher. This altitude is said to be the plane's ceiling.

Air is a light, fluid mass, just as water is a heavier and denser liquid mass. As we move about, the air is compressed ahead of us, flows around our bodies and closes in behind us just as water flows around the hull of a boat. We are unconscious of this surrounding atmosphere because of its lightness and invisibility and because our bodies are accustomed to its weight and density.

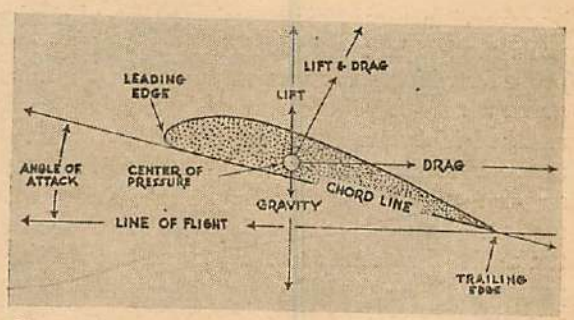


Fig. 1. The variety and direction of the forces acting upon an airfoil in flight. Note center of pressure point.

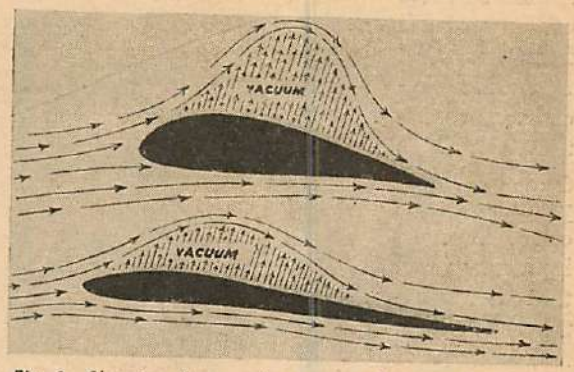
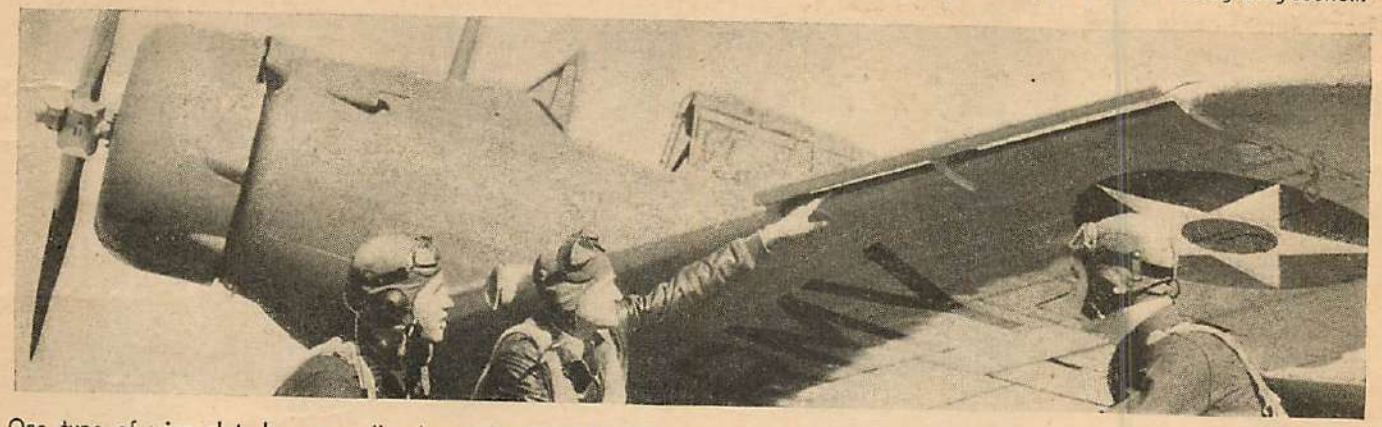


Fig. 2. Showing the greater suction developed by high-lift thick wing as compared to thin racing-wing section.



One type of wing slot, known as "eyebrow slots," is fixed to the leading edge of the wing, which causes a smooth flow of air to pass over the ailerons at slow speed making them effective.

This fluid mass of air commences a similar flow around an airplane's wing as soon as the ship starts to move forward. The curvatures of the wing are designed to force the atmosphere to flow in such a way that it exerts an upward pressure and suction which results in the supporting force we call lift.

The principle of lift can be demonstrated by whirling a sheet of stiff cardboard at arm's length. If the surface of the cardboard is held exactly parallel with its path of motion, it will encounter almost no resistance from the atmosphere and will produce no lift. If, however, the cardboard is tilted upward at a slight angle as it moves forward, the air which it encounters is forced downward. The resistance of this diverted air exerts a pressure against the bottom of the cardboard and causes a distinct lift. At the same time, the air rushing over the upper edge of the sheet creates a partial vacuum behind the cardboard. This vacuum results in an upward suction which further increases the lifting action.

Experimentation will demonstrate that the amount of lift generated by an airfoil or lifting surface is governed

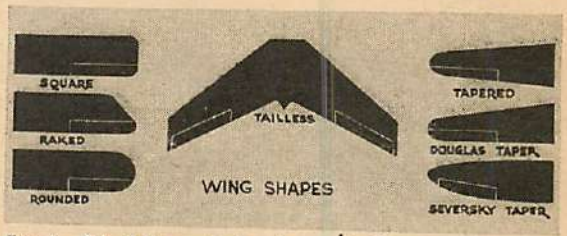


Fig. 3. Of all the varied and practical wing forms these seven are accepted as standard for their various uses.

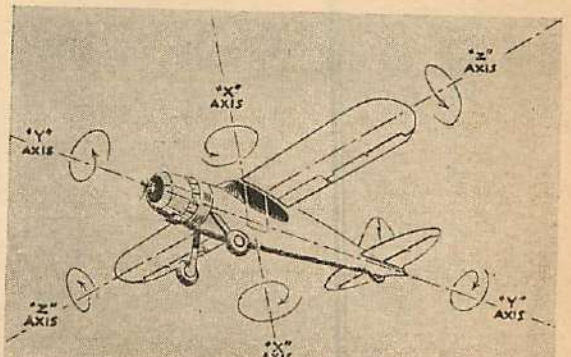


Fig. 4. The three axes about which an airplane rotates. Turning about axis X-X is called yawing, about axis Y-Y is called rolling, and about Z-Z is called pitching.

by several factors. First we have that of motion. Forward motion in an airplane is produced by means of a propeller which screws its way into the fluid mass of the atmosphere. The airplane to which the propeller is attached is drawn after it. The force produced by this action is known as thrust. Another factor is the angle at which the airfoil is held in relation to its path of motion. This angle is called the angle of attack. As the angle of attack increases, the atmospheric resistance pressures acting against the upper and lower surfaces of the airfoil increase and the lift increases proportionately. This gain in lift is partially canceled, however, by a new force that here enters the picture. As the angle of attack is increased, a larger area of the bottom of our airfoil is exposed to the resistance of the atmosphere. This resistance causes a backward pressure called drag. In addition to thrust, lift and drag, a fourth force must be reckoned with. This is the downward pull of gravity acting on the weight of our airfoil. Figure 1 shows the variety and direction of the forces to which an airfoil is subjected.

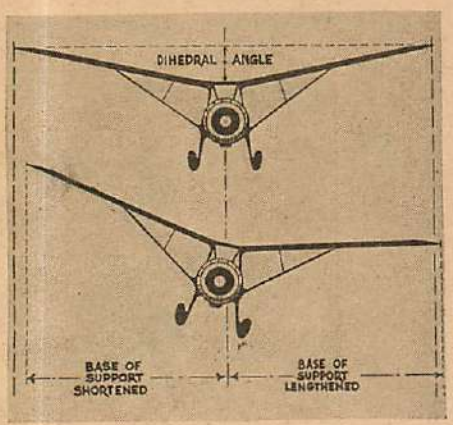


Fig. 5. The stabilizing action of dihedral. When the plane is tilted as at bottom, the down wing increases in lift and rights plane.

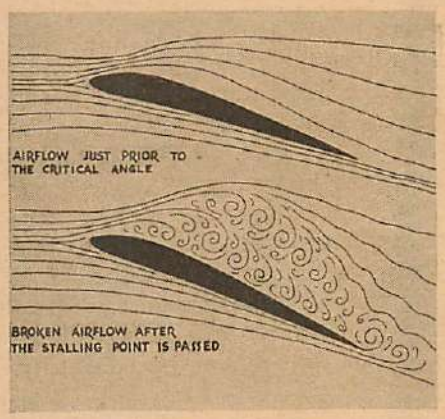


Fig. 6. The stalling point of a wing is reached at about fifteen degrees angle of the attack, when air turbulence kills lift.

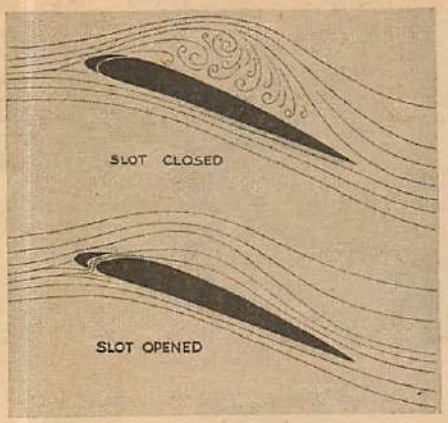


Fig. 7. The action of the wing slot is shown by the lower sketch. The opened slot allows smooth air to flow over wing and restore lift.

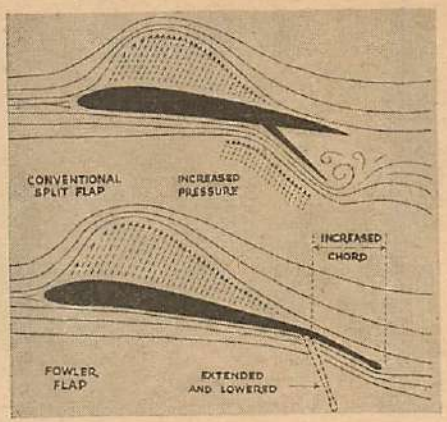


Fig. 8. The effect of the flap. Upper, the split flap increases the pressure. The Fowler flap at bottom increases the chord.

In the early days of flight, airplane wings were flat in section due to an erroneous belief that the lifting effect of the wing was derived entirely from air pressure operating against its bottom surface. Even today many people have a vague idea that an airplane stays up by skittering along on top of an imaginary pillow of air. It was this misconception that led to the widespread use of the term air pocket. Well-informed people now know that the idea of holes in the air is just as silly as that of holes in water, and that the so-called air pockets are merely rising or falling currents in the atmosphere that lift or drop planes passing through them.

The modern wing section varies from the fairly flat airfoil used on racing planes to a high-lift wing with a thickness of up to twenty percent of its width. A glance at Figure 2 will show why the shape and thickness of a wing governs the amount of lift produced. As its thickness increases, the front or leading edge of the wing deflects the flow of air at a higher angle over its upper surface. This increases the depth of the vacuum above the wing and the greater suction developed results in increased lift. In a well-designed wing of medium thickness, an average of sixty to seventy percent of the lift is derived from the upper surface.

The shape of the wing is of great importance due to a tendency of the air stream flowing beneath the wing to curl upward around its edges and disturb the vacuum on the upper surface. This is particularly noticeable at the outer ends of the wing where the lift is impaired over a considerable area. In order to minimize this difficulty, rounded wing tips and a tapered plan form are frequently used. The latter has the further advantage of providing a more uniform pressure distribution. We usually find, therefore, that where cheapness of manufacture is not subordinated to aerodynamic efficiency, modern design practice calls for a wing which tapers both in plan and thickness to a small, well-rounded tip. The proportion of the length or span of a wing in relation to its width or chord is called its aspect ratio. The average wing has an aspect ratio of from five to eight. By this we mean that it is five to eight times as long as it is wide. Generally speaking, a high aspect ratio makes a wing more efficient and stable than a low one. However, it presents a more difficult problem in structural design. (See Figure 3.)

When we say that an airplane is inherently stable, we mean that it will fly itself "hands-off." It has been designed to return automatically to a straight course and an even keel after being thrown out of its normal attitude by wind currents. Inherent stability makes a plane easy and safe to fly and is a characteristic of most modern, nonmilitary ships. Each gain in stability, however, is balanced by an equal loss of maneuvera- *(Turn to page 81)*

WEATHER GUIDE for the AIR PASSENGER

T. W. A. Photo

by ALLAN FINN

Let's take a look at this stuff we fly through called Weather.

A WOMAN passenger on a westbound transcontinental airliner remarked to the hostess that the trip seemed less fast than the one she made east.

"Tailwinds!" replied the beauteous young attendant, without any annoyance.

"Tailwinds?" the inquirer said, puzzled. "Well, why doesn't the pilot use them on this route?"

The hostess smiled and explained: "It isn't that—you see, we have them only from the west. It's the drift of atmosphere in these latitudes. The upper winds prevail from the west and increase in velocity with altitude."

"Oh!"

Airline hostesses meet with questions like this every day. Schooled in rudimentary meteorology themselves, then don't laugh. They mark them down to the public's notorious general ignorance of weather lore.

But flying is doing more than anything else to alter this state of mind. Former illusions are going by the board. Today, fewer and fewer air travelers "fly from the front-office window," as they say. They realize now that dark clouds overhanging the sky there are no index to weather at the airport or along their route.

They have learned, too, that you really have to go aloft to appreciate the wonders of cloudland, to see the rose-tinted horizons to advantage, to smell and feel the spidery fogs, or to experience the thrill of clear, frosty sunlight.

Sailing close to the heart of these phenomena, it is only natural that they should become curious about their meteorological nature. How much more fascinating it is, for instance, to perceive "heat lightning" playing impishly along the horizon, say at Lake Michigan, and know that it is merely the reflection of thunderstorms too distant to be audible; or, to know that the lurid red sky over industrial Pennsylvania may be due to an excess of fine dust in the air.

The fact is, a basic knowledge of weather signs and meanings is becoming increasingly important today to appreciate weather reports, maps and flight log notes which the companies have taken to thrusting upon the flying public. Some of the big transport lines now pass around log reports every five hundred miles. At ticket offices and airports the air traveler has access to almost as much route weather intelligence as a pilot had a decade ago.

It's exciting, as you roar at two hundred and fifty miles an hour through the heavens, to peruse these reports and idly check them with flying "scud," ice formations, cloud arabesques, line squalls and the varying ceiling.

Weather fundamentals are simple once you train your eyes to observe sharply. You don't have to concern yourself with barographs, statoscopes, actinimeters, hygrometers and other instrumental gadgets of the forecaster.

It is essential first to understand the background of weather manufacture. This consists of the troposphere and the stratosphere, the atmosphere's two *(Turn to page 74)*

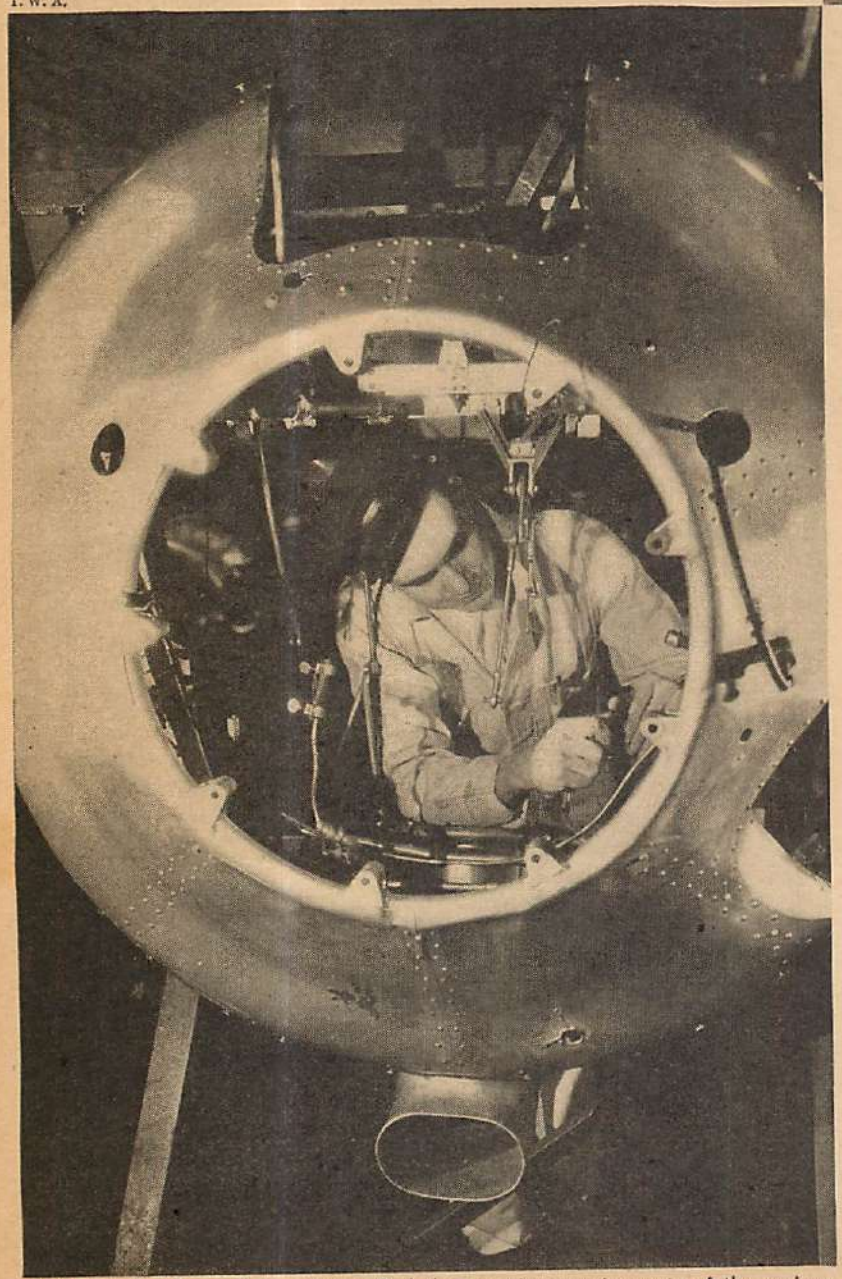
want a job in aviation?

by Dr. CARL NORCROSS

The world's fastest growing industry opens new fields to qualified workers

Consolidated

Careful supervision of every step in aircraft construction guarantees sure performance.



T. W. A.

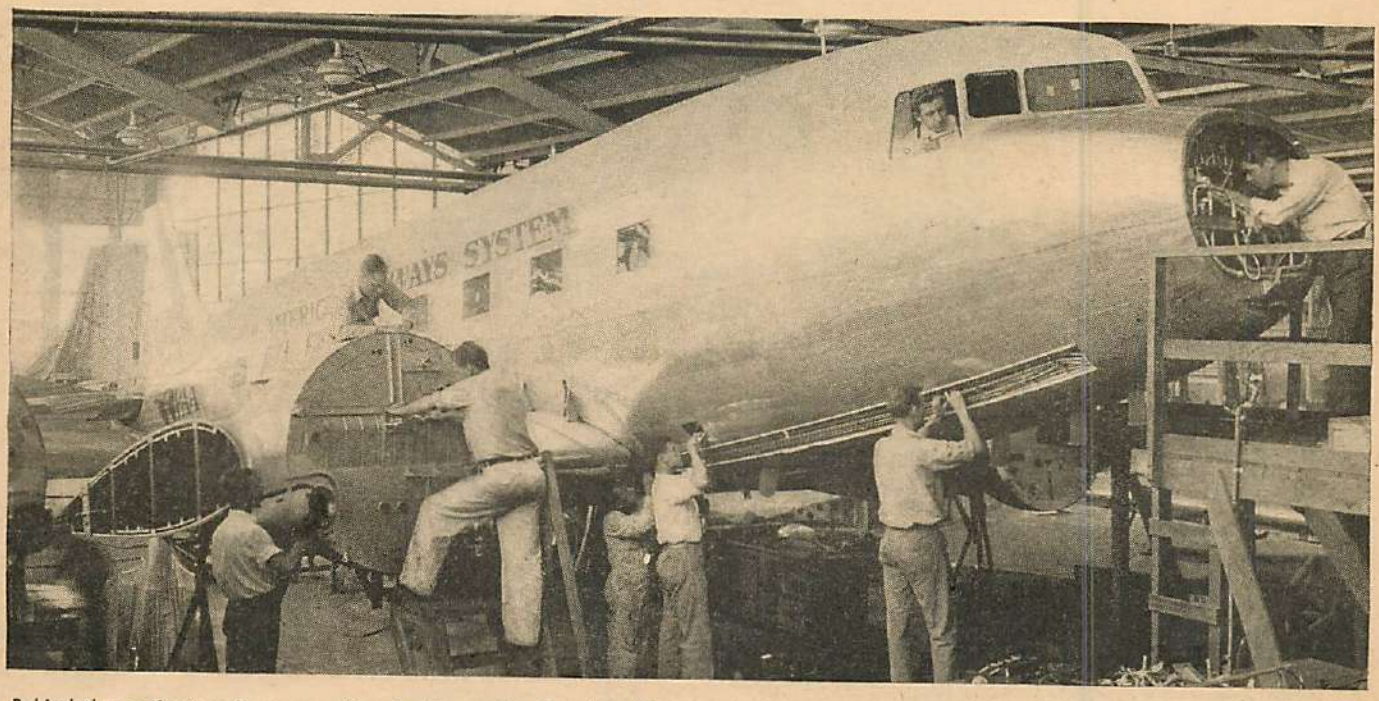
Skilled technicians of many types find the exacting requirements of the various phases of aviation an exciting, well-paying challenge to their skill and training.

YOU say your greatest hope and ambition is to get a job some day in aviation. You have hitched your wagon to a star—the kind with aluminum wings that zip from New York to Los Angeles in ten or twelve hours. Today aviation is your hobby but you want it to lead you to a job.

Aviation is a fascinating industry. It is a business that is growing and one that offers opportunities. There are many more jobs today than there were five years ago. There will be still more jobs in another five years. There is no reason, you insist, why one of them cannot belong to you.

But there is another side to the picture. Competition is exceptionally keen. A great many young men today want aeronautical jobs. Because there are many applicants for each job, employment managers choose the best from among those who apply. If you are determined to get a job, you must prepare yourself for it. You must make yourself outstanding, so that the personnel manager of the air line, airport or aircraft factory will say, "There's the kind of man I want!"

One of the first steps in your preparation for a job is to find out all you can about the job. Square your shoulders and look the facts right in the eye. You don't want to spend four or five years getting ready for a job and then learn that the job or requirements were not what you thought they were. Many boys who want to be physicians find out too late that they cannot get into medical



Behind the perfect performance of such ships as the Douglas DC-3 stands the experience of many skilled workers. Such varied technicians as metal workers, electricians, metallurgists, chemists, draftsmen, and design engineers work toward a common goal, perfection.

school because they haven't enough foreign languages or sciences. A similar situation exists in many jobs in aviation. You must know how much training is necessary and what the employment managers are looking for.

The air-line pilot is at the top of the heap. He has a job which is the biggest attraction in aviation. Above all men, the air-line pilot is admired. But he has a great responsibility—the lives of his passengers, the good will of his company, and a ship costing over one hundred thousand dollars are in his hands. Men for these jobs are chosen with great care.

Air lines do not employ pilots, or captains as they are usually called. They hire copilots and train them for three or four years before promoting them to jobs as captains. On all the large lines and most of the smaller lines, copilots must have about one thousand flying hours before they can get a job. They must have done night flying, cross-country flying, instrument flying and have had some experience with big ships. They must be in excellent physical, mental and emotional condition. In most instances today they must have a college degree. If it is an engineering degree, so much the better. If they have less than a full college course they must have special flying ability or experience to count in their favor.

In the past few years the majority of new copilots have been trained at the government's Randolph and Kelly Fields or at Pensacola. These army and navy fields are the finest flying schools in the world and when a pilot finishes his training and then goes with the army air corps or with the fleet, he is a capable flier when he gets out. These are the men the air lines like to get for copilots.

Recently, however, both the army and navy have been keeping their reserve pilots on active duty for a longer period than formerly. This means there are fewer military pilots available and the lines are beginning to look elsewhere for some of their men. They are taking the best graduates of the best private aviation schools. A graduate of an air-line pilot's course in one of the outstanding schools has about three hundred hours of flying time, which, with all the rest of his two-year course in related subjects, has cost him about five thousand dollars. After that it is up to him to get some kind of flying job so that he can acquire experience and build up his time. He may get a job in South America, help operate a summer air route, fly a charter service, or do some teaching. But somehow or other he must get his flying time up to the neighborhood of one thousand hours before he can get a copilot's job.

There are nearly eight hundred pilots and about six hundred copilots today. Pilots earn an average of about six hundred and seventy-five dollars a month, while copilots earn about two hundred and thirty dollars. If a pilot's wages appear high, remember that he may not have been promoted from copilot to pilot until he was about thirty or more years of age, and that when he is forty-five or forty-eight he may begin to develop eye trouble or some other physical condition that classifies him as "too old," and his commercial flying days with the air line will be over. Many an engineer or other skilled worker on the ground may earn more in his lifetime than a pilot does.

There are many other flying jobs outside the air lines. Miscellaneous operators fly approximately one hundred million miles a year in this country and carry one and one half million passengers. Pilots are also flying ships for business firms, oil companies, newspapers, ranch owners, mining firms, geologists, moving-picture concerns and dozens of other kinds of businesses. Aerial advertising and photography give employment to many fliers. There are summer air lines and charter services. Teachers are needed for flying schools. The government employs mapping experts, and pilots to watch for forest fires. These are only some of the uses for airplanes.

Requirements for these jobs are high. Anyone who owns a plane will not put it in the hands of a pilot who may crash it. The young man who goes to a flying school and pays for twenty-five or even fifty *(Turn to page 70)*

Howard Batt William Cline Al Lary Paul Mantz Tex Rankin

Gene Austin, old-time stunt flier, breaks down and confesses to the

HOW WE

YOU can fool the people. I have. But you cannot fool the elements. Whether phony or real, these stunts can always kill you if you relax. You see a form come hurtling down out of the sky (maybe it's me) like a little meteor—so fast you think his body must be screaming through space like a siren!

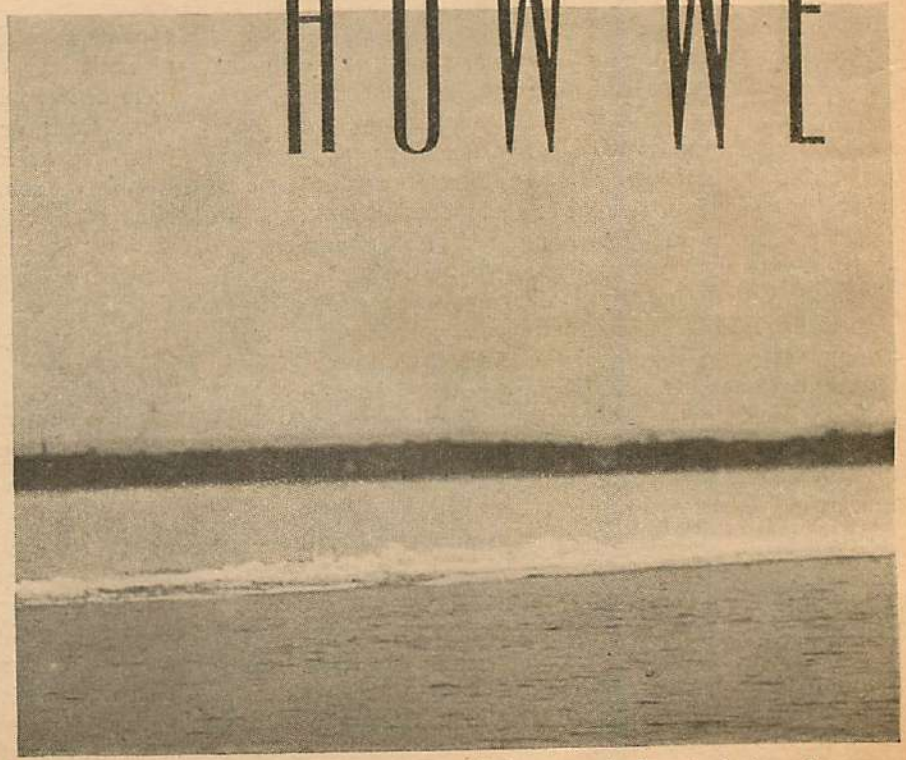
He is thousands of feet up in the sky, and you say to yourself, "Gee, he is sure dropping fast. I'd think the wind rushing past him so fast would set him on fire." Sure enough, you look again and you see a wisp of smoke curl up from his body and roll over his head. The smoke gets as thick as mud, a huge billow of it reaching straight up in the sky for possibly four thousand feet, and perhaps if you're a lady you shut your eyes and feel kind of sick. A ball of fire he is, that baby, a human torch—and he falls maybe a mile while you stand there thinking that you are watching a man die.

Then the smoke stops pouring from his body and a parachute blooms out above him and holds tight. The smoke scatters and fades. To see this fellow drifting down so softly, so gently under his parachute, you have trouble keeping in mind your previous thought—that by this time he must resemble a bachelor's homemade toast.

But he isn't the least bit singed. You saw a body plunging down and thought you saw smoke. You thought you saw fire. There wasn't a fire; not even any smoke. That was just plain flour, poked out of a ten-pound paper bag and sucked out in a long white line by the force of the fall and the rush of air.

I originated this stunt years ago, and I started to get real ashamed of it when crowds would rush up, and then, seeing my untoasted appearance, decide I must have worn an asbestos suit. To give the people the real lowdown, tell them that you phonied them into a terrible fright, takes quite a lot of nerve, and I never did get around to it before now. But even if it is a fake, it's a good one, and there's no fake about what would happen if a little something went wrong. One thing is true

There's no trick to this—just no nerves, lots of confidence and some strong toes. A popular stunt of Bill West of Daytona, Florida. Top—Ten famous stunt pilots of modern times.



Another trickless trick that either worked or somebody got plenty wet.


Dick Rinaldi


Jerry Phillips


Garland Lincoln


Herb White


Frank Clark

Paramount Photos

host of tricks employed in this dangerous and fascinating profession.

always—whether you are killed phonying up a thrill or doing the McCoy, it makes no difference to the undertaker.

The cautious part of this stunt is the handling of the flour. You've got to poke a hole in the bottom of the bag, another in the top. You then have to make sure that the flour doesn't start going places before you are far enough down. You have to keep your body between the air and the flour for a few hundred feet, else the flour will get caught in the slipstream of the plane above and blow all over the pilot, with the possibility of blinding him. Then you have to keep the flour away from your own face, because it can blind you, too, and this would make it difficult to find the ripcord to release your parachute. Hold the bag at arm's length, which is not hard until you start to somersault! Then it becomes something to do. I call this stunt the "Human Meteor."

It's the honest little difficulties involved that make me feel more comfortable doing the "Human Meteor" stuff than something à la Houdini. The aerial version of the Houdini hocus-pocus is to drop a fellow tied up in a mailbag off a wing of the airplane thousands of feet up in the air, have him get out of the bag and float down tooting a horn or playing a mandolin, or what have you. Now there's an out-and-out phony. The mailbag is sealed tight with any kind of a knot suggested, and everyone is so busy tying the bag around the poor fellow's neck that they don't find time to notice the zipper arrangement whereby the whole top of the bag comes off with a flick—ropes, knot locks and all.

You've got only two chances of getting killed doing this stunt, which makes it practically a day off for any professional stunt artist. The first comes on the way up. Safely tucked in your mailbag, you are held on the wing of the plane by an assistant in the forward cockpit. If he weakens and lets go before you are high enough, where you have time to work the zipper *(Turn to page 78)*

FOOL 'EM

Mabel Cody, famous aviatrix and stunt pilot, is in the motorboat.

Up the ladder to fame as demonstrated by Diavalo, another veteran of stunt flying. Any of you old-timers recognize the "Hisso-Standard," grand old battle wagon of the past?

light plane flying

conducted by ARCH WHITEHOUSE

WE live and learn—if we read enough.

For years the aviation world has been living in a fool's paradise in the belief that some day airplanes will be turned out in mass production, just as we now turn out automobiles. You know, shove a large sheet of metal under a monster press, step on a gadget and *plonk,* out comes a car body all ready to be picked up and dipped in another machine that puts in the upholstery, wires for the lights and paints the outside, while the guy in charge screams at the bird across the belt because he has turned out only five hundred and forty-six eight-cylindered motors in the last hour or so.

Somehow they seem to do this sort of thing very well in the automobile industry, in spite of the many changes that occur in design and fittings every year. Somehow they turn out about five million passenger cars and trucks every year, and sell them—whereas no factory in the United States appears to be capable of turning out anything like one thousand planes a year.

We of the light plane fraternity, who really want to fly, know what flying costs. We know we can't buy a good light plane, new and suitably guaranteed, for much less than one thousand five hundred dollars, and when we ask why, the dealers carefully explain that the motors cost so much, the instruments cost so much, and the skilled labor demanded by the government runs quite high, and besides they can expect to sell only so many every year, so that there is not much to be made out of a one-thousand-five-hundred-dollar airplane.

For years, now, I for one of the many in this business have been telling my readers that some day, not so far off, they'll be selling Cubs, Taylorcraft, Aeroncas and all the rest at prices that will make the automobile dealer twist in agony. I really believed all this myself, and once started a one-man war on the aero-motor manufacturers because they were demanding eight thousand dollars for a modern nine-cylindered radial engine.

I was all alone in the wilderness, bellowing up a very dud tree.

It seems now that nothing the manufacturers can do will ever put the airplane in the same production category as the motor car. It just can't be done, and the quicker we get that down our gullets the sooner we can all start off on a new tack and probably get somewhere.

I have been reading with much interest the details of a lecture given recently by T. P. Wright, director of engineering, Curtiss-Wright Corporation, given before the Royal Aeronautical Society in London. Mr. Wright had a lot of interesting dope to reveal on his topic, "American Methods of Aircraft Production."

Mr. Wright pointed out that while it is generally believed that American aircraft production is carried out in much the same way that the automobile manufacturers work, such is not the case. In the first place most production orders for planes average at best about thirty planes at a time, and to set up an expensive set of jigs, dies and presses to put out that many on the production-line system would be far too costly an experiment.

This of course refers to orders such as Curtiss-Wright would be likely to get, although some firms have received orders for military types numbering from two hundred to three hundred planes. Still, this number would hardly justify the outlay of a vast amount of money for special machine tools for specific jobs. Instead they have to adopt general tools for specific use.

Mr. Wright also explained that production of aircraft was a delicate thing, in that once the design is passed and plans are set up for production, it is often necessary to make many changes in the design. After the original "mock-up" some engineer discovers that a pound in weight can be saved here or one mile per hour added to the cruising speed by a certain adjustment there. He pointed out that every pound in weight saved was worth about seventy-five dollars in production cost price. At that rate, then, a nine-hundred-and-seventy-pound Cub should be worth seventy-two thousand seven hundred and fifty dollars.

It seems to be this one point that holds up the business of mass production. It is all very well to punch out automobile bodies which glib salesmen present as streamline jobs, because of their curves and lack of square corners, but it is quite another to build an aerodynamically correct streamline unit with parts punched out at high speed on a giant hydraulic press.

How much this means can be explained by the fact that the streamlined Rafwires now used on all stressed portions of an airplane add just over five miles per hour to a plane, if they replace ordinary round wire cables. Another item along this line will be found in the fact that six miles per hour have been added to the speed of the Hawker Hurricane by the use of a new designed exhaust outlet. Wing fillets, strut-base fillets and the hundred and one other items adding to the clean lines of a plane cannot be punched out and assembled by any automatic means. It must be done by what the old book calls loving hands.

Of course prices can be lowered *(Turn to page 73)*

Is mass production the solution to the light plane problem? . . . Private flying is going collegiate in a big way . . . Grove Webster of the C.A.A.

Photos by Rudy Arnold

Johnny Jones' coast to coast Aeronca drones through the sky on its way to records and fame.

The man who did the trick. Johnny Jones and his slide rule. Note the front of auxiliary tank in the cockpit.

Below—Johnny's stock Aeronca fitted with auxiliary tanks, wind-driven generator, and 50 h.p. plant.

Miles, 2,785; time, 30 hrs. 47 min.; miles per gallon, 22.3; cost per mile, $0.009; cruising speed, 90.6 m.p.h.; result, a record plug for light planes!

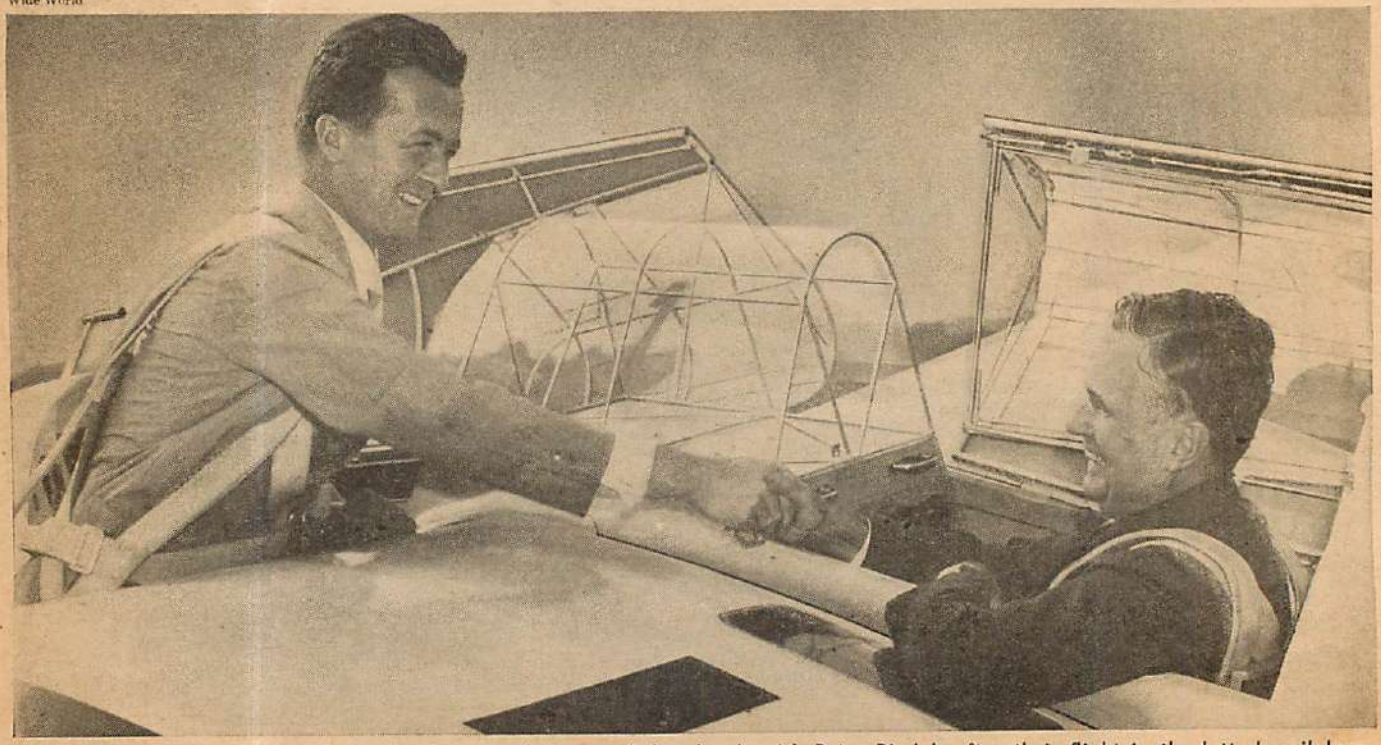
N. A. A. OBSERVERS NEEDED

THIRTY-FIVE States in our country have a total of one hundred and fifty gliding and soaring clubs, which means that well over a thousand people are engaged in active glider flying, yet according to the statistics less than seven hundred have "A," "B," or "C" licenses. In great part this is due to the lack of official N. A. A. observers, whose task is to witness the pilot's flight and forward his application, duly signed by him and two witnesses, to N. A. A. headquarters at Washington, D. C. (As described before, qualification flight for an "A" license consists of two gliding flights of at least one-minute duration each, an S turn and a normal landing; for a "B" license, two gliding flights with 360° turns, one to the right and one to the left, and landing so as to come to a stop within a hundred feet of a designated mark without use of brake; for a "C" license, one soaring flight in which an altitude greater than at the starting or releasing point is maintained for at least five minutes.)

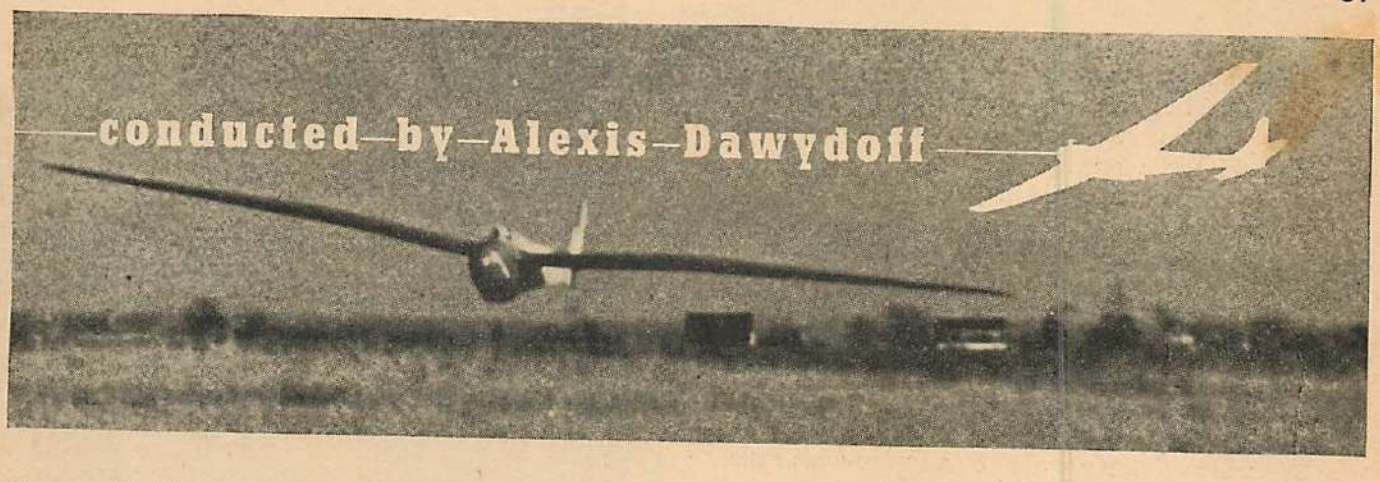
We seriously urge those active in gliding and soaring to select at least one person in their group as a candidate for the title of a National Aeronautical Association observer. Anyone with good character and understanding of glider flying is eligible; you don't have to be a Silver "C" pilot for that. Write to William Enyart, secretary, National Aeronautical Association, Dupont Circle, Washington, D. C., for an application blank for an N. A. A. observer. Although the "A," "B," and "C" licenses are not government certificates, the possession of any of them is proof of your flying ability, and with a "C" button you are eligible to enter any of the national or international contests sponsored by either the N. A. A. or the International Federation of Aeronautics. With any of these certificates you also get an N. A. A. sporting

Why not GET that license you are qualified to hold? The Laister sailplane, club news, and a review of the long-awaited S. A. A. Manual.

Wide World



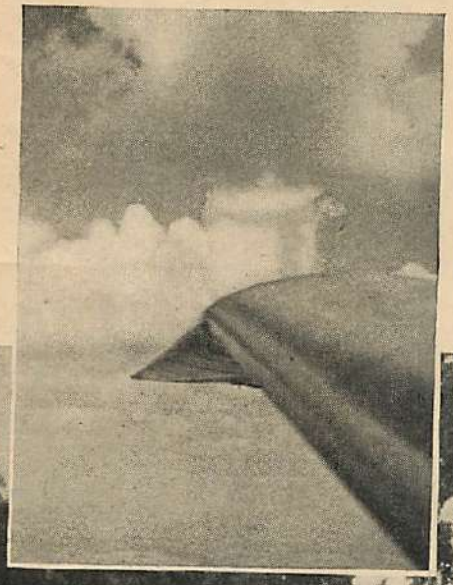
Thanks for the ride. Edward J. Noble, C. A. A. chairman, shakes hands with Peter Riedel, after their flight in the latter's sailplane.



license. Besides, you will be proud to wear the single, two or three-gull lapel buttons that you receive with your license. These buttons usually arouse people's curiosity and give you a good chance to talk on your favorite topic, and therefore help promote the soaring movement. The charge for obtaining any of these licenses is one dollar, or free to all members of the S. S. A.

THE LAISTER SAILPLANE

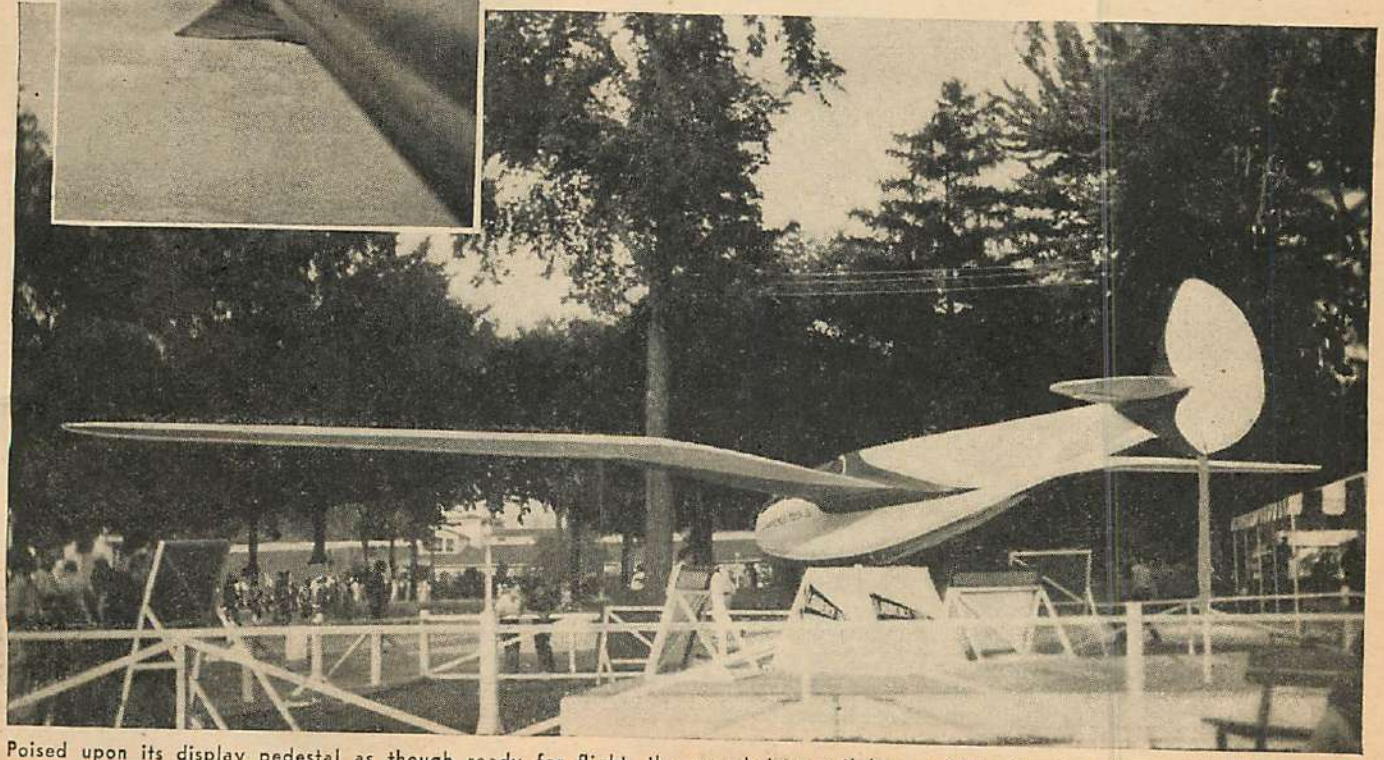
A new high-performance sailplane has been designed and built by Jack W. Laister of Universal Gliders located at Warren, Ohio. The first model was constructed for the Lawrence Institute of Technology of Detroit, Michigan. The ship is a midwing, gull-wing sailplane of rather small span, which gives it a fairly high cruising speed and good maneuverability. The fuselage is of chrome-molybdenum tubing covered with fabric; the cockpit inclosure is of plexiglass and follows the line of the fuselage, giving it an extremely clean appearance. The cockpit itself is very comfortable and roomy, has an adjustable seat and rudder pedals. The wing is constructed of wood, having a single box spar and spruce ribs. The leading edge is covered with plywood up to the spar to take up drag loads, and is fabric-covered from spar to trailing edge. The spoilers are hinged at the top of the wing and are connected with the brake on the single landing gear. The airfoil section of the wing is the N. A. C. A. 4400 series. The specifications of the ship are as follows:



Eyes right, from Barringer's "Ibis," and you see this interesting angle of the gull wing, taken at 4,000 ft.

Wing span, 46 ft. 6 in.
Wing area, 135 sq. ft.
Aspect ratio, 16
Wing loading, 3.48 lbs./sq. ft.
Weight empty, 285 lbs.
Gross weight, 470 lbs.
Design top speed, 125 m.p.h.
Sinking speed, 2½ ft./sec. at 55 m.p.h.
Gliding ratio, 1:32.

Future ships will be offered in two standard and two deluxe models. The two models are the *(Turn to page 69)*



Poised upon its display pedestal as though ready for flight, the new Laister sailplane exhibits its clean lines and efficient wing.

OFFICIAL SENIOR N.A.A. NEWS

Prepared by
William R. Enyart, Sec. NAA.

New developments in national aviation activity as viewed by the National Aeronautic Association

GOVERNMENT PILOT TRAINING ACTIVE

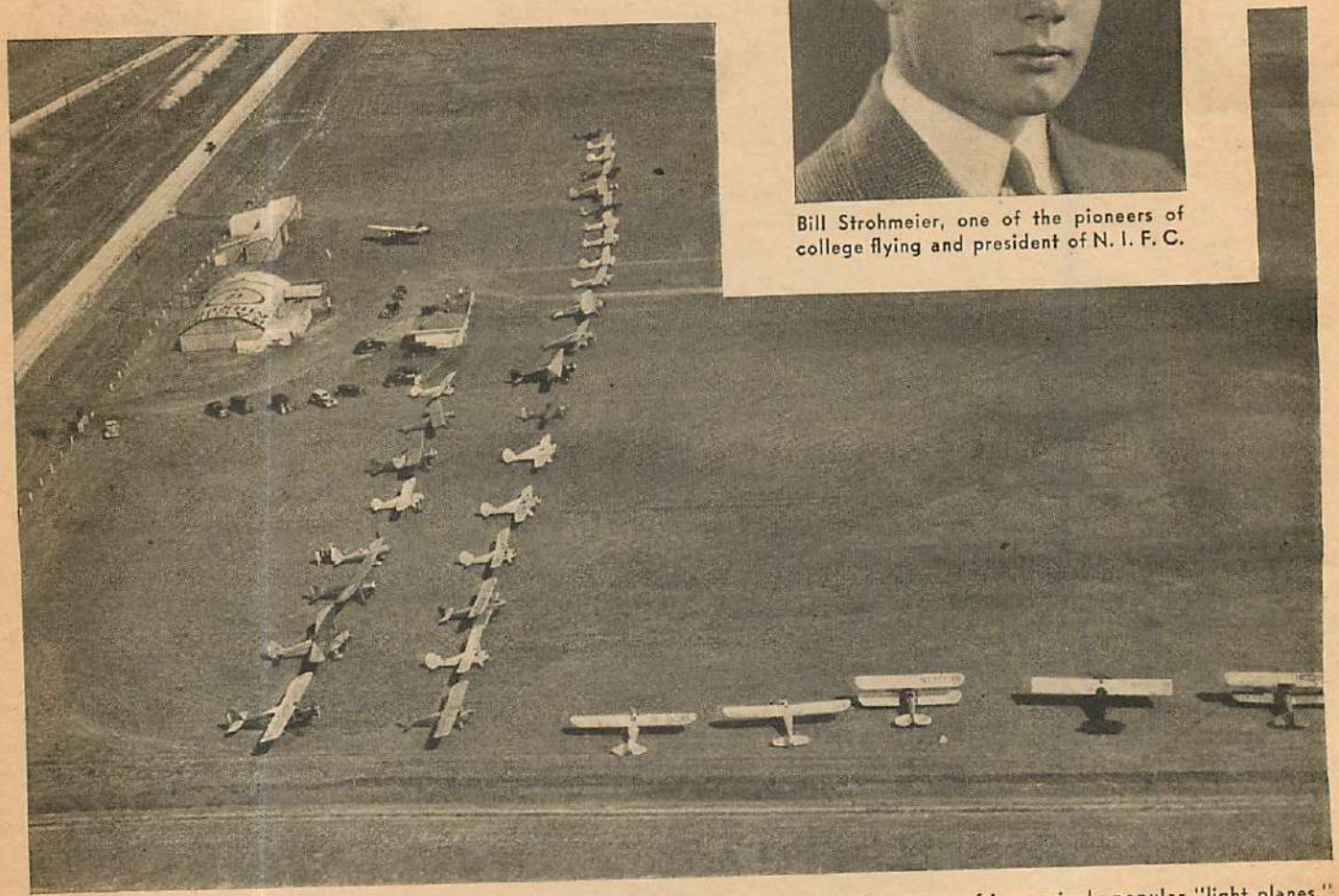
THE program approved by President Roosevelt for the annual training of approximately twenty thousand pilots in the colleges and universities of the country calls for a practical test during the second semester of the present school year.

The plan contemplates an average of fifty hours dual and solo flying for a group of three hundred college students between the ages of eighteen and twenty-five. This amount of flight training is more than enough to qualify candidates for a private pilot's certificate. Adequate ground school courses will be a prerequisite to all flight training.

If the results of the test prove satisfactory, the C. A. A. will apply its program on a nation-wide scale in several hundred colleges and universities during the 1939-1940 school year.

The estimated cost of the first full-scale, one-year training program for twenty thousand pilots is nine million eight hundred thousand dollars. It is believed that there will be no trouble in attaining the goal of twenty thousand pilots from the one million two hun-

Bill Strohmeier, one of the pioneers of college flying and president of N. I. F. C.



Typical light plane meet held at Racine, Wisconsin, airport. Note the various types and vintages of increasingly popular "light planes."

dred thousand young men and women now enrolled in our colleges considering the tremendous interest of modern youth in aviation.

The Civil Aeronautics Authority states that "it is convinced that in addition to building up a valuable aeronautical reserve of young men soundly versed in the fundamentals of flying, the plan will stimulate a healthy development of the aircraft manufacturing industry and that the two things together will create a back-log of inestimable and concrete value to the nation's air defense."

Only by such an approach, the Authority believes, can the United States safeguard itself against the vast aerial militarization programs now being pressed by foreign powers, unless it is to emulate their warlike preparations. "It is more in keeping with the American spirit of preparedness to build up a great pool of men and machines, dedicated to and engaged in the pursuits of peace, but yielding first place to no other nation in flying skill or technical development, and quickly adaptable to military needs in event of war," the Civil Aeronautics Authority declares.

The award is voted by the representatives of the thirty-eight National Aero Clubs which comprise the membership of the F. A. I.

NATIONAL AERO FORUM

Announcement of a broad educational program under joint sponsorship of the principal associations active in aviation was made at a meeting held at Washington, D. C., on last December 19th. Leaders from the American Legion, the United States Chamber of Commerce, the American Federation of Labor, the Veterans of Foreign Wars, the American Municipal Association, the C. I. O., the National Exchange Club, Kiwanis and Zonta International, the International Organization of Chiefs of Police, the United States Conference of Mayors, the National Association of Broadcasters, Disabled American Veterans Association, and the Daughters of the American Revolution in attendance at the meeting indicated that they would lend their assistance in developing the coöperation of the organizations in the joint program. Initial activity will be the holding of a national aeronautic forum at the nation's capital on February 20th—21st.

Grove Webster, chief of the private flying division of the Federal C. A. A.

Gill R. Wilson, who presided at the National Aviation Forum in Washington.

Howard R. Hughes, sportsman pilot, voted U. S. outstanding aviator for 1938.

HUGHES NAMED BEST U. S. FLIER

Howard R. Hughes, sportsman pilot who last July circled the globe in the amazing time of ninety-one hours, fourteen minutes and ten seconds in his Lockheed 14 monoplane, was selected by the National Aeronautic Association, the official sport-governing body for aviation in the United States, as the nation's outstanding aviator for the past year.

On his round-the-world flight which won him this enviable designation, he covered a total distance of fourteen thousand six hundred and seventy-two miles and maintained an average speed in flight of 206.3 miles per hour.

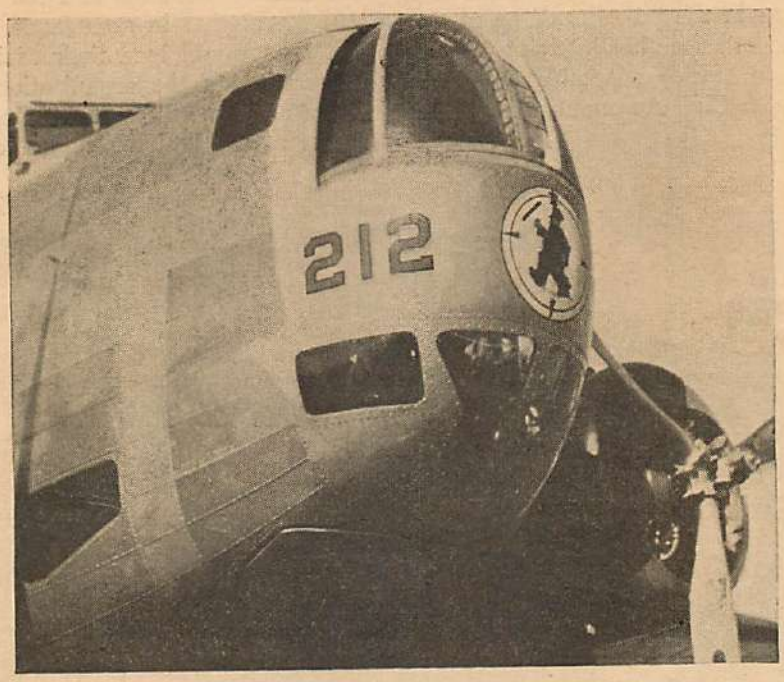
Through his selection as the outstanding United States pilot and since his performance is believed to be the most outstanding aeronautic feat, world-wide, during the year, the National Aeronautic Association has nominated Hughes to the Fédération Aeronautique Internationale as a candidate for the award of the F. A. I. Gold Medal. This medal, most coveted honor which any pilot can receive, goes to the world's outstanding aviator each year.

The meeting was called by the National Aeronautic Council, the permanent aviation coördinating committee comprised of leaders from the National Association of State Aviation Officials, the Air Reserve Association, the Aeronautical Chamber of Commerce, the National Aeronautic Association, the Seaplane Flying Association, the Air Transport Association, and the Private Fliers Association.

The establishment of the National Aeronautic Council has been a project of the N. A. A. The secretary of the N. A. A. serves as secretary of the council and, in addition, the association's executive committee has acted to underwrite initial expenses in connection with the February National Forum.

The nation's aviation needs in every phase, as drafted by the air leaders serving on the aeronautic council, will be presented in detail at the February conference. As a further activity under council sponsorship, on next December 17th, the anniversary date of the first airplane flight, all aviation organizations, private fliers, government air departments, and national, *(Turn to page 76)*

What you get out of it.



This is what the new nose of the Douglas B-18 bomber looks like if you are lucky enough to get close to it. The film of this picture was sent in by an Adventurer and we enlarged it to show the rare detail. Good shot?

YOU need not duck, this isn't going to be a sermon.

In the past, when we were trying to build some tradition, spirit and loyalty into a cause, we used the points of our Creed to put over an idea. For some months now we have refrained from putting on the preacher attitude and have kept away from any reference to it. We have discovered through your letters that there is no necessity for sermons to Air Adventurers. The spade work performed in the early months has brought rare fruit, and we are more than proud of the group our organization has attracted.

In the first place we had very little to offer, as an organization. A card, a badge and a chance to take part in a scheme to learn something about aviation. There was a chance for some of you to express your opinions on various subjects. We of Air Trails got a lot out of these letters and many of the improvements noted in the magazine during the last few months have come as the result of your expressed opinions.

Air Adventurers has grown into a solid organization, and we are proud of it. There are times when we feel that there is a possibility of its getting too big for us to handle. An organization such as this with thousands of members scattered all over the globe often provides a wide range of problems. Canadian problems, Australian problems, American problems and problems that come up as the result of divided opinion caused by differences in geographical areas.

Still, somehow these problems when attacked in the right spirit often result in widespread good, and so far we have discovered this is usually the case. That's what we are getting out of Air Adventurers.

To rephrase the same idea, what are you as Air Adventurers getting out of aviation?

I have had this question put to me in several forms during the past few months, and at times I have been hard pressed to answer the query in a manner that satisfies my questioner and myself. Only recently I was fortunate enough to have sat in on something of a mass question session where a number of people presented their opinions and ideas on aviation as a profession.

It was surprising to me to discover that very few of these young people were interested in flying as a profession. They were interested in aviation as a life work, but not as professional pilots. The general comment was: "Sure, it's fine to be an air-mail pilot—if you can get a job; but what can you get out of it?" They were all willing to take aviation as a profession on the ground, as engineers, publicity writers, traffic dispatchers and maintenance superintendents, but few of them wanted to fly. The general impression was: "What can I get out of it?"

Some may decide that this particular group was very sane. Others may decide that they were an unusual lot. A few may just wag their heads and ask what America is coming to?

Without going into the details of the salary a first-class pilot can make in commercial aviation, or the uphill

climb he has getting there, it might be well to ask: "What do you expect to get out of any profession?"

Doctors, lawyers, professional baseball players, actors, artists and others in the ranking professions get out just what they put into their work. Their pay is high as long as they can produce, or as long as their physical attributes stand up. It costs a lot of money to get their knowledge, or a lot of work. As long as they ply their trade or profession, they usually receive financial returns commensurate with their efforts.

These are straight facts, not the bleating of a sermon. If you are a six-thousand-a-year air-line pilot, you'll get that much today, have no fear. If, in a few years' time, you gain further valuable experience, your salary will go up in proportion, and as long as you maintain the spirit of aviation and continue to study and learn, you needn't fear being discarded to the boneyard when your flying days are over. As a matter of fact, few pilots who are first-class air-line men will have to give up flying, for airliners in the near future will not be flown by the first officers any more than the *Queen Mary* is steered by the captain.

The first officers of tomorrow will be learned skippers who tread the bridge of our super-Clippers, and they will perhaps never touch a control wheel, but they will have all to say as to how the ships shall be flown, which is as it should be.

So, you need have no fear for your future in aviation. You yourself are the future, and it will become what you make it. If aviation is to survive it will be because Air Adventurers all over the world will keep the faith in flight. You who are starting out today, hopefully saving your dimes for flight training in a light plane, can become the super-airliner skipper of tomorrow, and I who have passed that age envy you.

That's what you can get out of aviation, if you want to put in just a little effort.

Your Flight Commander,

ALBERT J. CARLSON.

This is what they do to a Beechcraft in Canada when winter sets in. This Mackenzie Air Service ship was photographed by B. Mussieux.

An Air Adventurer and his model. Bernard Klochn, Milwaukee, Wis., and his Mulvihill Trophy winner, taken from the March, 1938, issue.

CLUB NEWS

But now into the mail bag, which gets bigger and bigger.

We have several fairly good photographs from a tried and true member, John R. Parsons, of North Apollo, Pa. John "covered" the aircraft model display sponsored by the Junior Civic Model Club of Apollo. To be a member one has to build at least one model. John's pictures, which won him a Photographer's award, were taken with a No. 120 box camera, and he certainly came through with the goods.

George F. Meyer, of Ridgewood, N. Y., has come through with a poem he has written entitled "Wings." We would be glad to publish it if we had the space. George also wants us to do something about a special department concentrating on the United States air services.

The idea is good, but there are many problems to consider. In the first place, George, we would have to be certain we could get enough live information to fill it regularly every month. We have learned after years of bitter experience that news does not run that smoothly. It is often hard to get service information, because the most interesting is generally kept a "secret" until it is no longer a secret, and therefore no longer interesting. Still, we do carry a lot of interesting facts in Air

(Turn to page 86)

Actual size of your Air Adventurers pin.

(MEMBERSHIP COUPON)

To the Flight Commander, Air Adventurers,
79-89 Seventh Avenue, New York, N. Y.

I am interested in aviation and its future developments. To the best of my ability I pledge myself to support the principles and ideals of AIR ADVENTURERS and will do all in my power to further the advance of aviation.

Please enroll me as a member of AIR ADVENTURERS and send me my certificate and badge. I enclose ten cents to cover postage.

Name..... Age.....

Address.....

.....

☐ Check here if interested in model building.

(This coupon may not be used after April 15, 1939.)

WHAT'S YOUR QUESTION?

Question: What are the chances in aviation for a fellow who is near-sighted and wants to do actual flying? Is there a chance of his being able to enter a flying school or join the army, navy or marine services? J. F. S., Jacksonville, Fla.

Answer: If a fellow's eyesight is not too weak he can get a private license, otherwise it's out of the question. I suggest that you consult your nearest department of commerce physician. Army, navy and marine forces are definitely out, as one has to have perfect vision to enlist in them.

Question: In the August issue of Air Trails there is a picture of Lee Gehlbach beside a Seversky amphibian with the lines of a convoy fighter. Could you please give me some information regarding this ship? I would also like to have some information on the Aeronca KM, whose picture appeared in the same issue. R. A. G., Burlington, Vt.

Answer: The Seversky amphibian you mention was built especially for the Russian government and is similar to the first amphibian built by the Seversky Aircraft Co. back in 1934. Outside of that I have no further information on that ship. The Aeronca KM is the regular Aeronca K powered with a fifty-horsepower Menasco engine.

Question: Could you tell me who is the man who designed the plane known as the San Diego Flagship and be so kind as to give me his address, the airport he is located at, and where you obtained the photograph appearing in the December issue showing the ship? E. B., Watervliet, N. Y.

Answer: The San Diego Flagship was designed by C. C. Flagg, an aircraft engineer. We do not know his home address, but he can be located at Lindbergh Field, San Diego, Cal. The photograph was obtained from a news agency.

Question: Can you tell me when and where the National or International Air Show, which was held in Chicago last fall, will be held this year? P. L. P., Detroit, Mich.

Answer: There will not be any air show this year. But next year the aviation show will be at the World's Fair in New York City.

Question: Can a young married man get into aviation, preferably mechanics? R. E. B., Battlesville, Okla.

Answer: Yes, he can. There are a number of aviation schools that teach mechanics. In the issue of last September we printed a list of such schools with details on the courses they offer and prices for tuition. If you send fifteen cents to Mr. Clifford, Circulation Department, Air Trails, he will forward you a copy of the magazine.

Question: I am seventeen years old and want to learn to fly, but don't know whether I can afford regular lessons. Can you tell me where I can get instructions very cheaply? W. W., Los Angeles, Cal.

Answer: I don't know what you mean by very cheaply. It costs money to own planes, operate them and keep them in good condition, so I doubt if you can get a flying course cheaply. Try joining a good light-plane club; there must be several in the vicinity.

Question: Because of the great number of planes to be manufactured in the next few years, would a first-class die-maker of twenty years' experience have a chance to get work in one of the airplane manufacturing plants? J. D. M., Pottstown, Pa.

Answer: Suggest that you write to personnel directors of various aircraft manufacturers stating your experience.

Question: I would like to know if I can become a test pilot. Does an enlisted man have a chance to become a flying officer in the air corps? M. L., Atlantic City, N. J.

Answer: You can become a test pilot if you have the qualifications. You have to be an expert pilot and a skilled engineer to become one. For an enlisted man to become a flying officer, he has to be appointed as a flying cadet. The percentage of such appointments is very small.

Question: In a back issue my attention was called to the trim Flying Flee plane. I would like to know if it is being built in the U. S., as I would like to own one. G. H., Jr., St. Louis, Mo.

Answer: The Flying Flee, built by Mignet, is not manufactured in this country. There were two of them over here, but they were not successful.

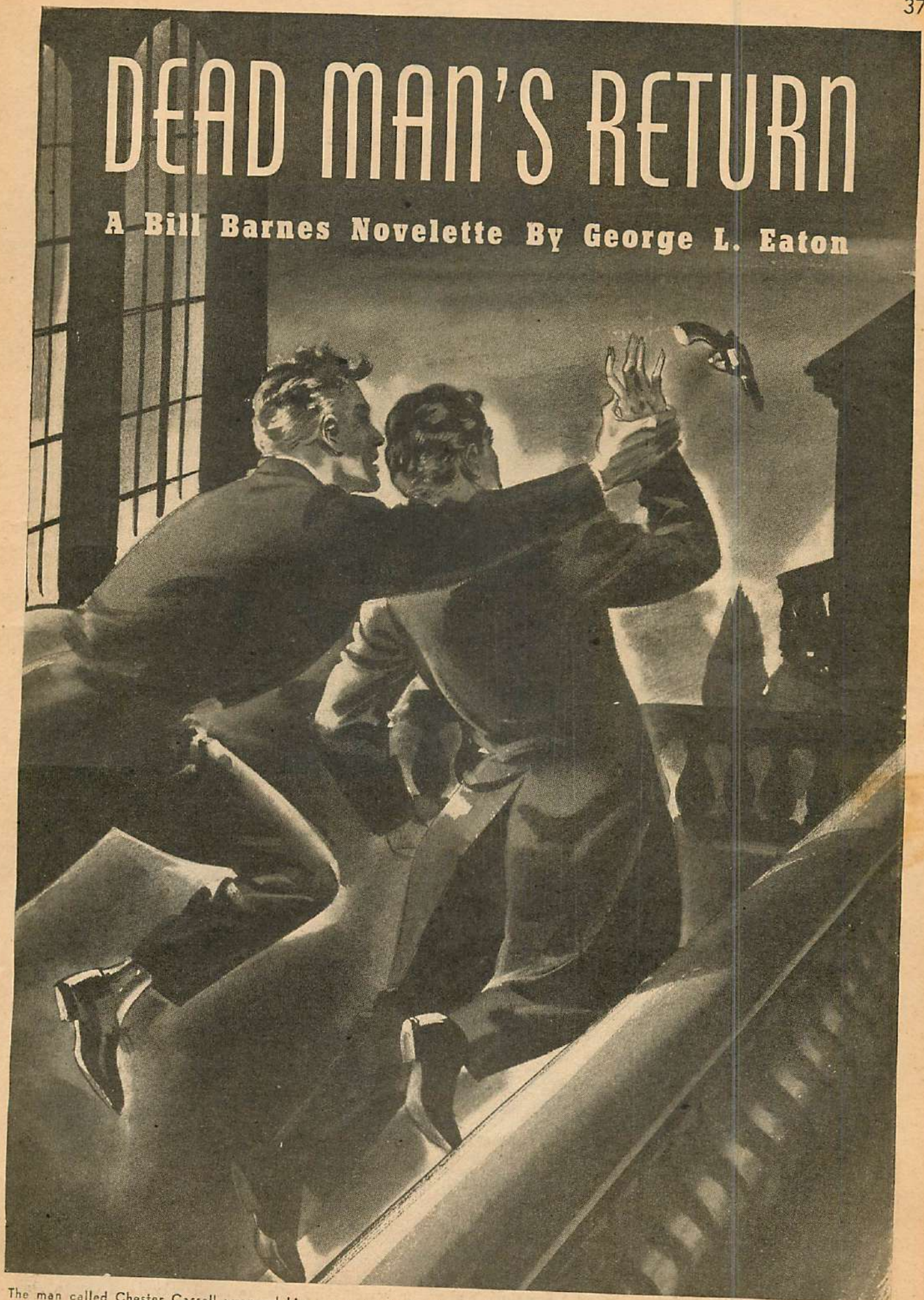
Question: Will you please send me the back issues of your magazine for the months of June, July, August and September of this year. Do you still have last year's issues of Air Trails? How far back can one obtain back issues? How does a gunner swing his gun in a glass-inclosed turret? Is there any magazine or booklet on model airplane building? T. L., Toronto, Can.

Answer: If you send sixty cents to Mr. Clifford, Subscription Department, Air Trails, he will send you the four issues requested. All 1937 issues are available except those for October and November. The whole glass-inclosed turret on a bomber rotates, permitting the gunner to aim his gun in any given direction. Write to the Model Aeronautics Publications, 83 East 10th Street, N. Y. C. They publish a book on model construction called the Model Aeronautics Yearbook. *(Turn to page 80)*

This department will attempt to answer any questions concerning aviation. Those of general interest will appear on this page; others will be answered by mail. Inclose a three-cent stamp to insure a reply. ★ All inquiries regarding appointments for U. S. army air corps flight training should be addressed to the Adjutant General of the Army, Washington, D. C. Those concerning application for naval aviation training should be addressed to U. S. Navy Bureau of Navigation, Washington, D. C. ★ Persons interested in applying for air corps ground training, such as that for airplane and engine mechanics, riggers, instrument and radio men, as well as aerial photography and parachute work, should address the Commandant, Aircraft Technical School, Rantoul, Ill.

DEAD MAN'S RETURN

A Bill Barnes Novelette By George L. Eaton



The man called Chester Cassell wrapped his own powerful hand around the wrist of the Belgian as he lifted the gleaming revolver.

DEAD MAN'S RETURN

A BILL BARNES NOVELETTE BY GEORGE L. EATON

EDITOR'S NOTE—Combining the unquestioned progress of the next few years, or even months, of aeronautical drafting and design with the skill of the author, these Bill Barnes novels are designed to entertain and to give you a prophetic glimpse into the future of aerial transport and adventure.

THE MAN in the back seat of the long, glistening Bentley spoke a single word of instruction through the speaking tube to the swarthy-faced chauffeur as the car glided, almost silently, along the road toward the Casino of Monte Carlo.

As the car came to a halt beneath the porte-cochère of the most luxuriously appointed gambling establishment in the world, a smile that was both pensive and hard flitted across the horribly scarred face of the man who called himself Chester Cassell. For an instant his hand covered his face, then dropped to finger his close-cropped goatee as the lights of the Casino played full upon him. He seemed to be shrinking away from the gaze of the people on the veranda.

The next moment his poise asserted itself and he stepped jauntily out of the Bentley, his long, thin hand wrapped around the gold top of a black walking stick. His clothes were draped on his lean, powerful frame as only a Bond Street tailor can drape them. His hair was gray at the temples under his high silk topper. His age might have been anywhere from forty to fifty.

He went up the steps of the Casino with the easy swing of a man who knows the strength that is in his body. A uniformed attendant relieved him of his topper and stick as the portly manager bowed from the waist and murmured, "*Bon soir*, Monsieur Cassell."

With a nod of his head he passed through the room where *trente-et-quarante* and craps were being played. The shaded, overhead lights seemed to double the avidity of the players' faces as they crouched over the tables and exclaimed noisily.

In the roulette room he watched the players with amused eyes while the little ball spun around and around and the croupier quietly, mercilessly raked the chips off the table. After a few minutes of watching he bought a thousand dollars' worth of chips and began to play them methodically and systematically.

The room grew heavy with the smell of tobacco smoke and perfume as a second thousand followed the first. Only two people were playing besides himself when the hands of a gilded wall clock rested on eleven.

But the room was full of people—people who were watching the clock and the door that led into the room. There was a breathless expectancy about their watching that reached the surface in the too-shrill laughter of a woman or the booming guffaw of a man who had had too much to drink. As the clock reached eleven the room fell silent as though at a prearranged signal, and all eyes were turned upon the doorway.

Under cover of night the two strange craft slowly settled to the roof of the building.

"*Il est arrivé!*" an excited woman shrilled in French as a tall, thin man with the deeply lined face of the incorrigible plunger appeared in the doorway with the manager trotting at his side.

"He is alone tonight," a man beside Chester Cassell said to him.

"The lone lamb come to be sheared," Cassell said evenly.

"You do not think his system will work?" the man asked excitedly.

"No system has ever worked," Cassell said. "The only way to break the bank at Monte Carlo is to rob it!"

The man looked at Cassell strangely and moved closer to the roulette table, where the manager was arranging the sale of fifty thousand dollars' worth of chips to the man who had just entered.

A dozen men and women bought chips ranging from one to ten thousand dollars. Breathlessly they waited for the man to begin his play.

His expressionless eyes roved around the faces at the table as he took a little black book from his pocket and began to place his bets. He had placed ten thousand dollars on single numbers, combinations, and the black to show, before the little ball began its mad scramble within the turning wheel.

All eyes were riveted on the dancing ball as the wheel went around and around. It seemed like all eternity while they watched, tense and rigid. Then their breaths hissed through their lips in a wave of hysteria as the glistening little ball dropped into thirty-six.

The tall, thin man with the deeply lined face smiled as his hawklike eyes rested on the two thousand-dollar chips he had played on the thirty-six to win. He had more than doubled his stakes at the first turn of the wheel!

At twelve o'clock the manager of the Casino stood behind his croupier, and

his face was ashen. It was to be the last turn of the wheel if the tall Belgian won again. The bank could no longer stand the run he had made on it, winning time after time as he took his combination of numbers out of his little black book.

As the ball settled into a number that was not covered, the Belgian frowned in perplexity. He raked in a few hundred dollars' worth of chips on the red and consulted his little black book again. He spoke quietly to the manager. Waiters appeared with ice-filled buckets of champagne. The people in the room drank greedily, their voices rising hysterically while they discussed the play.

The scar-faced Chester Cassell curtly refused the champagne that was proffered him. His eyes were studying the tall Belgian as the other waited in complete relaxation for the play to begin again. There was doubt and not a little anxiety in Cassell's eyes, and also not a little of admiration.

People crowded around as the manager indicated that play would begin again. Those who were still playing had won more money than ever before in their lives from following the leads of the Belgian, and now they were avid to win more.

Then the little lady that is luck flipped up her heels and turned her back upon them all. Again the croupier began to rake in the chips, quietly, mercilessly.

At half past twelve, his face drawn, the Belgian had lost his original stake and was forced to buy again. Little sobs of hysteria escaped the people crowded around him as their own stakes dwindled with his. At a few minutes before one he pushed the last of his chips toward the croupier.

"*C'est fini,*" he said. It is finished. His face was the face of a man who has wandered through hell in a lesser time than he could tell about it. He swayed dangerously as he pushed himself to his feet.

"Your car, monsieur?" the manager said to him as he started toward the terrace.

The manager did not know the name of this tall, thin Belgian who had appeared mysteriously a week ago to plunge as no one had plunged at Monte Carlo in years. He knew only that now he wished to get him out of the Casino. Desperate men did desperate things.

"I will get some air on the terrace, alone," the Belgian said, and stepped through a French window onto the terrace.

Chester Cassell was only five feet away from the man, or he would never have been in time. He had followed him to the terrace through another window, and he was ready when he saw the gleam of metal in his hand.

His own powerful hand wrapped itself around the wrist of the Belgian as the other lifted the gleaming revolver toward his temple. There was a brief struggle, then the revolver clattered on the stone floor.

"It's not as bad as that, Monsieur Seraing," he said as he stooped to pick up the nickel revolver and slipped it into his pocket.

"You know who I am?" the Belgian said dazedly.

"I know," Cassell said. "I know, too, that you are minister of colonial affairs to your good government, and that you are in trouble. Let's sit down and talk it over. I think I can give you a sporting chance to survive honorably."

"Why should you?" Seraing asked.

"Let's call it humanitarianism," Cassell said easily. "I've watched you all the past week and I found out you were trying to win enough money to pay back what you have appropriated. I want to help you. I know it is suicide or jail if I don't help you."

"You would do this for a stranger? I don't understand."

"I think," Cassell said slowly, "that you will be able to help me if I help you. That is only fair, isn't it?"

A faint glimmer of light appeared in what had been an abyss of blackness to the desperate Seraing. "It is fair," he said. "I don't understand, but if you will help me now I will do anything in my power to repay you."

"We won't bother about that now," Cassell said. "How much will you need to take you out of trouble and retain your post as minister of colonial affairs?"

"Nearly . . . nearly five million francs," Seraing said, and he held his breath.

"We'll arrange the loan in the next couple of days," Cassell assured him. "Don't worry about it."

"It is like a fairy story," Seraing said as Cassell led him inside for a drink. "It is beyond my comprehension."

"Just be glad I happened to be handy."

II—STOLEN FORMULA

BILL BARNES cursed softly and ran his hand through his shock of sun-bleached hair as the telephone on his desk rang to bring him out of his complete absorption in the weekly, individual reports of his little squadron of combat pilots.

"I told you I didn't want to be bothered!" he snapped into the instrument.

"O. K., sourball—I mean sweetheart," the voice of Sandy Sanders, the youngest of his pilots, said in his ear. "But I'm not going to sit here and listen to this kiwi rave all day. He says he must see you. That it's something important."

"You can find out what he wants, can't you?" Bill shouted. "You're a lousy secretary!"

"I don't know what he wants! He says Bev Bates brought him to see you last summer about a secret formula for a metal alloy. He says someone has stolen it and he sounds as though he thought you were the guy. You figure it out, because I'm sending him in!" There was a click.

Bill was scowling at the door when it opened to admit a tall, stoop-shouldered man with a high forehead and eyes that bulged behind double-lensed glasses. His arms were so long his hands dangled almost to the knees of his baggy tweed trousers.

"You remember me, Mr. Barnes?" he said, and Bill was amazed at the deep tone of his softly modulated voice. "I'm Dudley Mearson. Mr. Bates brought me to see you last summer."

The scowl disappeared from Bill's bronzed face, to be replaced by an apologetic smile.

"Certainly I remember you," he said. "You wouldn't have had so much trouble if Sanders had come in to tell me you were out there."

As they shook hands Bill remembered only too well the man's visit several months before. Bev had introduced him as an old friend of his father. Bill remembered his disbelief when Mearson told him he had almost perfected a metal alloy that was as light as aluminum plate, but tough enough to withstand machine-gun fire. He had gone on to say that his stressed, flush-riveted alloy plate could be used to completely armor the wings, fuselage and tail assembly of a fighting plane. And he had demonstrated the effectiveness of his invention. Bill had told him that he would be more than a little interested in the alloy after he, Mearson, had filed his patents or had taken precautions to protect his secret formula.

"I'm afraid I didn't make myself very clear to Sanders," Mearson said now as he dropped into a chair. "I . . . I'm too agitated to make myself clear to anyone."

"If there is anything I can do to—" Bill began.

"There is! There is!" Mearson said in a broken voice. "I've worked five long years—five years to perfect my formula—only to have it stolen from under my nose."

"You didn't have it patented?" Bill asked quickly.

"No. I thought it was safer if I kept it a secret. I wanted to turn it over to the government for the army and navy."

"Do you have any suspicions about who might have stolen it?"

"Very few people knew anything about it," Mearson said. "I went to Europe three months ago to study some

alloys the Germans and British have developed. I thought they might be of some value to me."

"Did you talk to anyone about it while you were in Europe?" Bill asked.

"Only one person," Mearson said. "Like myself, he was interested in metallurgy. He was a capitalist. An American, I think."

"How did you happen to tell him about it?"

"Oh. I just met him in Berlin, in a hotel. We found we were interested in the same things. I told him about my experiments and what I had developed."

"Did you tell him your experiments were successful?" Bill asked. "Did you tell him where you kept the formula and what you were going to do with it?"

"Why, yes," Mearson said nervously. "But—"

"Did this man tell you much about himself?" Bill went on. "What was his name?"

"Cassell," Mearson said. "Come to think of it, he didn't tell me much about himself. Just that he was a capitalist interested in mining in South America and Canada and Africa. We got on the subject of alloys, and I told him that you were going to make tests for me. I thought for a moment he was going to strangle. He didn't seem to like you. He warned me against you. He said you would steal my formula from me if you had the chance."

Bill's face changed from bronze to crimson as Mearson peered at him more intently. Then he got control of himself and managed to laugh. "Well," he said, "do you think I stole it?"

"No! No! I only mentioned the fact to warn you that he seemed to . . . to—"

"Hate my guts!" Bill supplied.

"That's it," Mearson said. "I would remember it and keep his name in the back of my mind if I were you."

"I will," Bill said. "I'll catalogue him along with a lot more. Can you describe him?"

Mearson gave a halting description of Chester Cassell's scarred face and of his amazing strength and vitality.

"I'll file him away in my mind," Bill said. "And I'll keep in touch with you."

They shook hands again, and the visitor left. Bill at once reached for a telephone and asked Tony Lamport, the chief of communications on Barnes Field, to connect him with Beverly Bates, the intrepid young Bostonian who was one of Bill's veteran pilots.

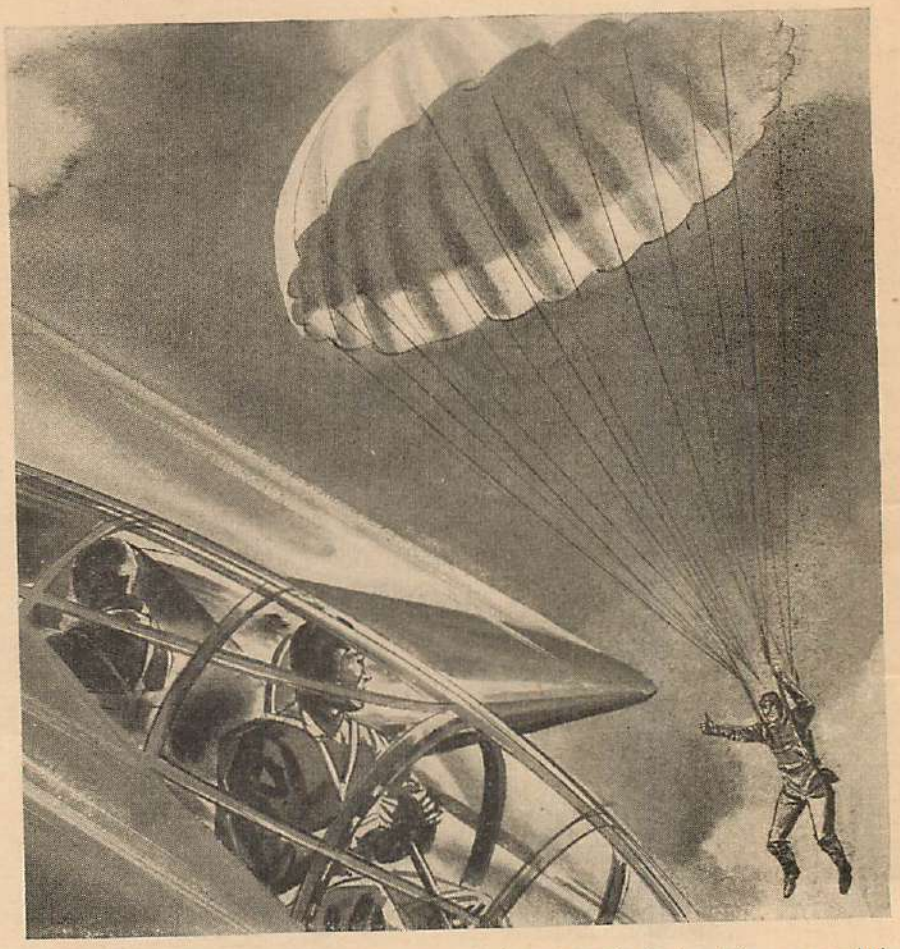
"Listen, Bev," he said. "Dudley Mearson, your father's friend, just left my office. He can't be off the field yet. Catch him at the Wauchuck gate and take him to luncheon. Find out everything you can about his trip to Europe, a man named Cassell, and his alloy formula. You know—find out what's on his mind."

"Right," Bev said. "I'll report later."

Bill put the telephone in its cradle and stood gazing into space. Some inherent instinct warned him, as it had warned him a hundred times before, that this was the beginning of trouble.

DEAD MAN'S RETURN

A BILL BARNES NOVELETTE BY GEORGE L. EATON



Shorty raised one hand with thumb sticking up to show he had not been wounded.

III—A PLANE EVAPORATES

A FEW DAYS later Bill Barnes pressed a button on his desk that summoned young Sandy Sanders into his private office. It was nine o'clock in the morning, and Bill was going through his usual assortment of mail. As he pressed the button for Sandy he laid one letter aside. When the door of his office opened he pointed at the letter without even looking up.

Young Sandy's freckled face puckered into a frown of concentration as he picked up the letter and saw that it was from the office of the president of the Coronation Gulf Mining Company, located in Toronto, Canada He read:

My Dear Mr. Barnes:

As you are probably aware, our organization has recently discovered a new and valuable deposit of radium ore north of the Arctic Circle in the Coronation Gulf sector.

We believe that within a few months our miners will be delivering over a hundred tons of ore daily. It takes about 450 tons of ore to produce a single gram of radium, worth in the present market approximately $25,000.

This ore is conveyed to our two grinding mills at the Coronation mine which pulverize it into mud and send it to the flotation tables where the silver, cobalt and pitchblende are separated.

The pitchblende, after being concentrated by a further process, is packed in sacks and stored until the summer. When the ice breaks we then have the problem of transporting the concentrated pitchblende to our refinery south of Toronto on Lake Ontario, where it is further processed into radium to be shipped

to London for distribution to the hospitals of the world.

We hope to raise our total production from thirty to forty-five grams of radium within the next year. Our greatest problem is the transportation of the concentrated pitchblende from the mine to our refinery.

Knowing your enviable record in the transportation of important and valuable properties, I would like to arrange a meeting with you to give you the facts to help us solve our problem.

A prompt acknowledgment will be appreciated.

Very truly yours,
N. T. BARKER.

When Sandy finished reading the letter he said: "O. K., what do you want me to tell him?"

"I don't want you to tell him anything," Bill said. "I want you to take the Eaglet and hop up to Toronto and get the facts from him. It sounds as though it might be a sweet job that would only take a couple of weeks each year. Get all the dope. Maps, charts, locations, and all the rest."

"When do you want me to go?"

"Right away," Bill said. "Red and Shorty and Bev are busy. Tell Scotty to check the Eaglet and shove."

"O. K., Butch," Sandy said.

Old Scotty MacCloskey, the mechanical genius who was the major domo on Barnes Field, turned the little fighter they called the Eaglet over to Sandy an hour later.

Young Sandy climbed into the cockpit of the ship that had been built around him and opened the throttle of the eight-hundred-and-thirty-horsepower twin Wasp wide. As a light flashed in the control tower he lifted a hand to those watching and released his wheel brakes. A few minutes later his ship disappeared in the northern sky.

Bill, returning to his office, did not realize that this was the real beginning of the trouble his hunch had warned him about a few days ago.

Shortly past noon a frantic radio message came through from Sandy: "I'm making a landing on the beach between the Canadian line and Hamilton! A couple of two-seaters jumped me over the lake! They shot away my rudder . . . forcing me down . . . I—" Then there was silence.

That silence was to continue.

Bill's desperate dash in his Charger to the position given revealed traces of the Eaglet's crash, but of the plane itself there was no sign. Certain tracks indicated it had been dragged to the lake and placed aboard a boat, which evidently had been waiting.

Shorty Hassfurther, Bev Bates, and Red Gleason, the remainder of his pilot staff, flew up in their Snorters to aid Bill in the search. The four ships honeycombed the ports and inlets of Lake Ontario from Hamilton to the Thousand Islands.

They finally had to admit failure.

Inquiry by Bill brought out the fact that there was no such firm as the Coronation Gulf Mining Company. The letter had been a fake, a trap. But why?

Bill immediately contacted his friend, James Morton, of the bureau of criminal investigation, in Washington, demanding complete secrecy on any search that Morton conducted. Morton's far-flung system uncovered no lead. The perpetrators of the crime did not get in touch with Bill to make demands or stipulations. Bill's carefully worded "personal" ads in newspapers went unanswered.

For the next two weeks Bill was almost at his wit's end. He had checked all possible enemies, combed the country, and yet he could think of no one who might have done this thing.

Late one night came the first real gleam of hope. It came in the form of a cablegram to James Morton from one of his operatives in Europe. It was in code, but Morton had deciphered it and read it aloud to Bill:

"Have reliable information that leads me to believe young Sanders is held captive near Brussels, Belgium. More information follows. Handley."

Bill stared at Morton with sleepy, bewildered eyes for a moment. Then he suddenly came to life. "Do you believe there is anything to it?" he asked Morton as he bounced off the couch on which he had been sleeping.

"Handley is a reliable man," Morton answered. "I don't think he would have sent such a message unless he was almost certain."

Bill reached for the telephone, and he was a new man now. He barked an order into the mouthpiece and waited. "Hello, Scotty," he said in a moment. "Bill. We've got something at last. Get the Charger and two Snorters out on the line, carefully checked."

"How long a flight, boy?" Scotty asked.

"Belgium," Bill snapped.

"I think I can have them ready by dawn," Scotty said after a pause.

"I want 'em ready in two hours," Bill said. "Tell Shorty and Red where they are going."

"Have you checked the weather, boy?" Scotty asked.

"To hell with the weather!" Bill hung up the receiver.

"Look here, Bill," Morton said, "I don't think you ought to go off that way—half cocked. We ought to wait until Handley comes through with more information."

"You said he was reliable," Bill pointed out. "This is the first reliable lead we've had. I'll go nuts if I sit around here any longer. I'll get the rest of Handley's information from him personally tomorrow afternoon. I'll leave Bev Bates here to work with you. Red and Shorty will fly their Snorters. We'll find out who is running this show. I can't sit here on my thumbs any longer. I'm not built that way."

"You'd better go cautiously, Bill," Morton said. "There may be more behind this than you think. It may be bigger—"

"The bigger the better!" Bill snarled. He began to climb into his clothes.

IV—HANDLEY'S TELEPHONE CALL

AT ONE O'CLOCK in the morning Barnes Field became a madhouse as old Scotty MacCloskey and Martin lashed their men to greater efforts. By two o'clock the three ships had been checked from their spinners to the trimming tabs on their rudders. They were ready to go.

The two single-blade, automatic, variable-pitch propellers that were faired into the leading edge of the Charger's wings became two shimmering disks as Bill dropped into his parachute chair and poured soup into the two eighteen-hundred-horsepower Barnes-Diesels.

He made a last check on the pair of fixed .50-caliber Browning machine guns that were mounted on either side of him beneath the bank of engine instruments. They were easily accessible to his reach in case they jammed. They were each fitted with large ammunition reels that could be loaded from inside or outside the cockpit, and the ammunition counters were plainly visible to his gaze.

He lifted the trapdoor immediately behind his seat to check the breech mechanism of the sleek, long-barreled 23mm. Madsen automatic cannon that nestled snugly within the triangular section of the main beam of the ship. Last he checked the single telescopic sight mounted above his radio panel and the retractable infra-red ray telescope that permitted him to see through fog, rain or the darkness of the night.

The props of the two black-and-yellow-and-scarlet Snorters were ticking over slowly on the apron beside the Charger. The goggled, white-helmeted heads of Shorty Hassfurther and Red Gleason jutted above the rim of the two fast amphibians. They were waiting impatiently for Bill to signal the dispatch tower.

"Have Tony make arrangements for us at Brussels," Bill shouted at Scotty MacCloskey. "I'll keep in touch with him as long as I can. Our weather men say we're going to strike some soupy weather."

"O. K., boy," Scotty said. "Good luck to you."

Bill's hand flipped above his head and a light flashed in the control tower. Red Gleason's Snorter raced down the con-

(Turn to page 88)

The new Boeing Stratoliner comes in for a landing at Boeing Field after a test flight.

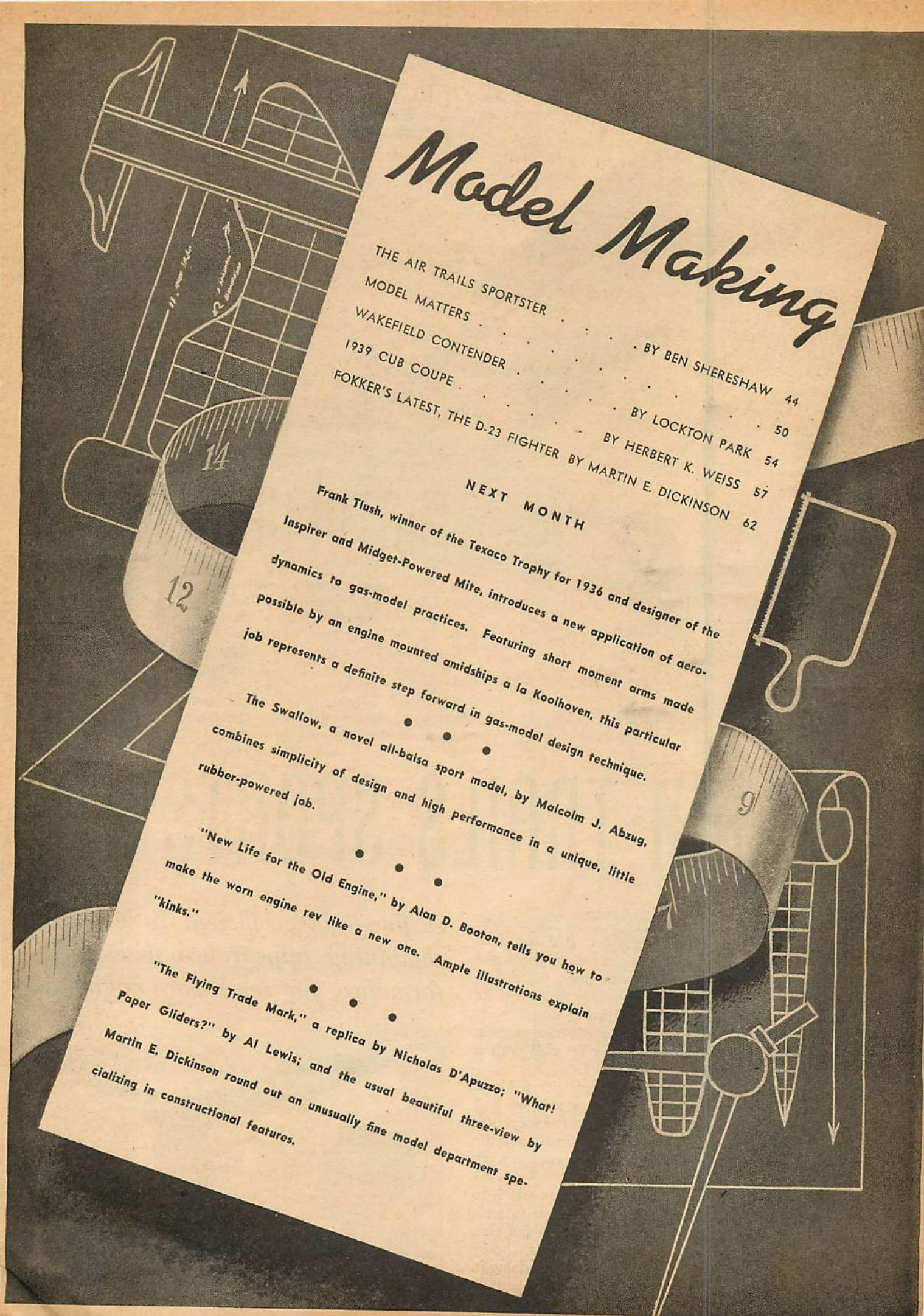
STRATOLINER

The Stratoliner test crew: L. to R.—E. Ferguson, E. Allen, and J. Barr.

The stratosphere offers additional speed, comfort, and safety for the future air traveler. The Boeing Stratoliner is the first four-engined transport designed for "upper level" flying. The sealed cabin contains, in addition to accommodations for 33 day passengers or 25 at night, automatic temperature and pressure regulating devices for maintaining natural low-level atmospheric conditions at higher altitudes. Four 1,100 h.p. Cyclones power the 107-foot all-metal ship, affording a cruising speed of 240 m.p.h. at 20,000 feet—one-third the speed of the flight of sound!

How the Stratoliner looked as she taxied onto the runway for the first test flight.

Gordon Sear Williams



Model Making

NEXT MONTH

Frank Tlush, winner of the Texaco Trophy for 1936 and designer of the Inspirer and Midget-Powered Mite, introduces a new application of aero-dynamics to gas-model practices. Featuring short moment arms made possible by an engine mounted amidships a la Koolhoven, this particular job represents a definite step forward in gas-model design technique.

● ● ●

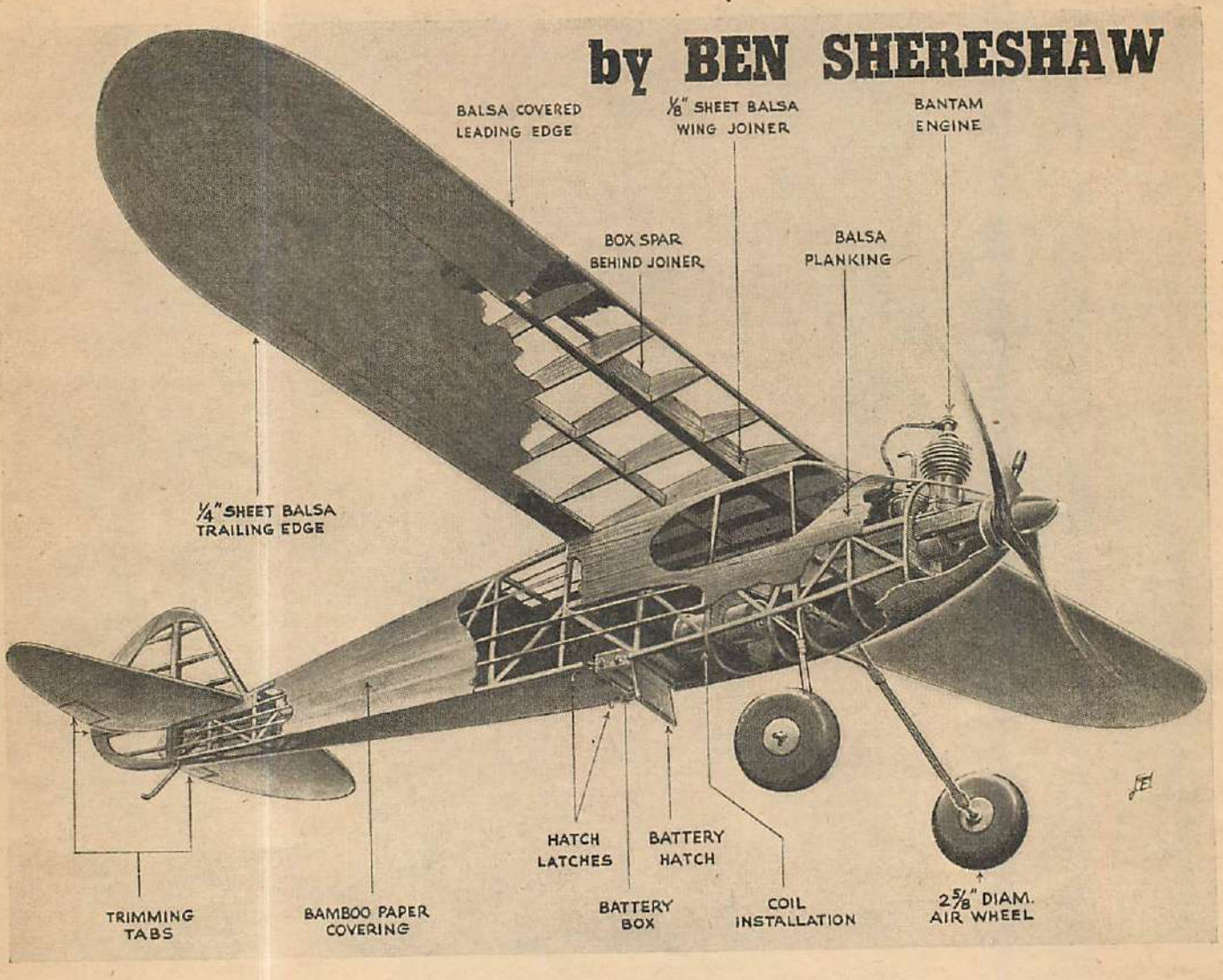
The Swallow, a novel all-balsa sport model, by Malcolm J. Abzug, combines simplicity of design and high performance in a unique, little rubber-powered job.

● ● ●

"New Life for the Old Engine," by Alan D. Booton, tells you how to make the worn engine rev like a new one. Ample illustrations explain "kinks."

● ● ●

"The Flying Trade Mark," a replica by Nicholas D'Apuzzo; "What! Paper Gliders?" by Al Lewis; and the usual beautiful three-view by Martin E. Dickinson round out an unusually fine model department specializing in constructional features.



by BEN SHERESHAW

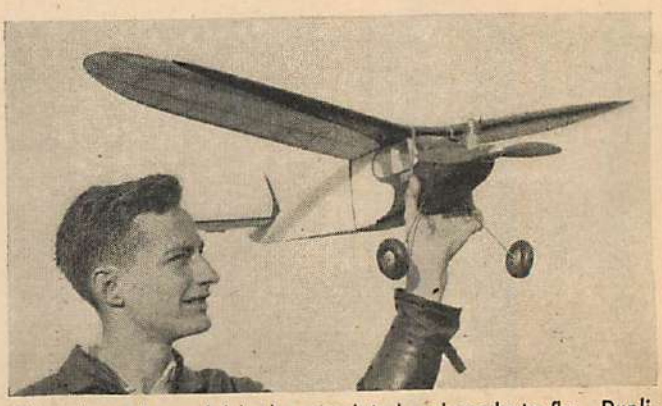
THE AIR TRAILS SPORTSTER

A fine-flying, efficient little ship combining appearance with performance, for small-bore engines.

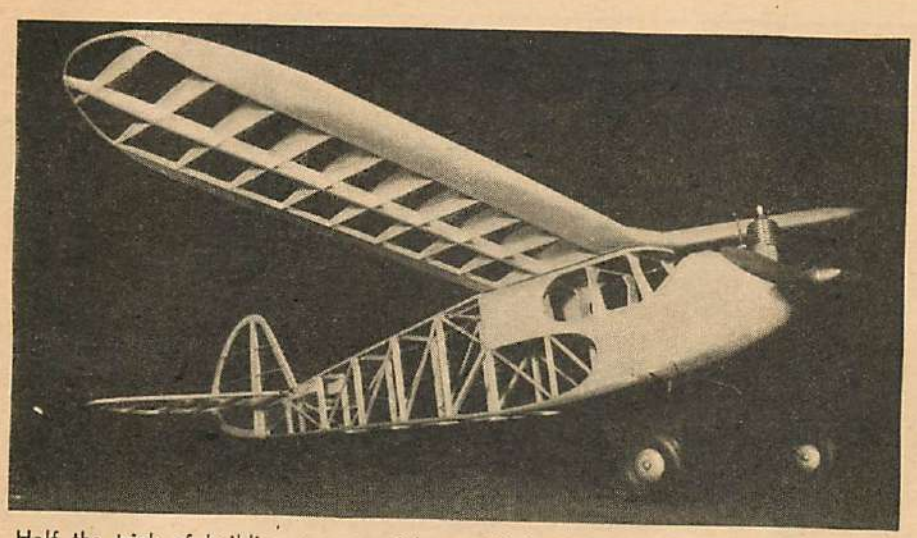
THE AIR TRAILS SPORTSTER is an efficient little gas job for small-bore engines. Although it is said that small gas models suffer losses in glides and other important performance characteristics, the difference in the performance of the Sportster to that of its big brothers cannot be denoted. Having ample wing area to take care of the larger of the small-bore engines, it is yet light and efficient enough to fly well with a ½"-bore motor.

This little ship is simple to build, and with a bit of painstaking care in its construction you will be well rewarded with a model that possesses a smart appearance and contest performance. Read the text and study the plans minutely before any of the actual construction work is attempted.

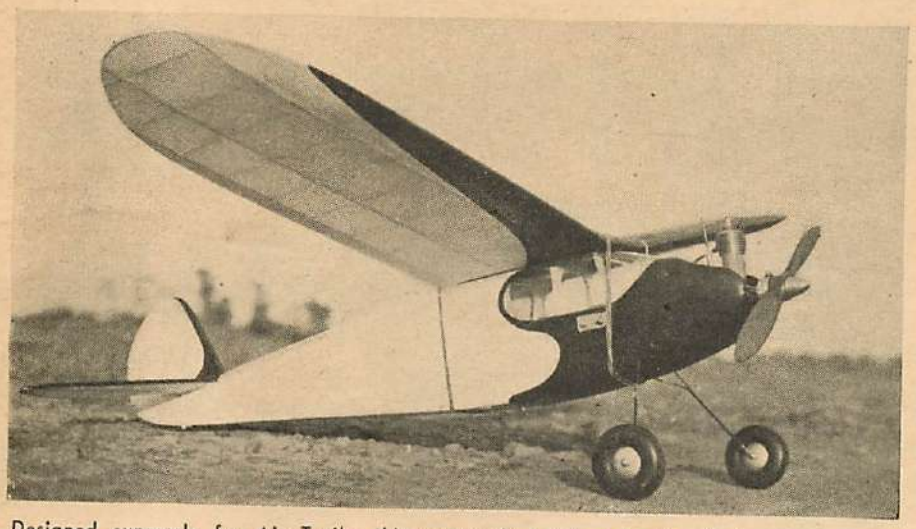
First select a flat seasoned workboard upon which to build the fuselage and wing. The next step is to scale all of the drawings which are quarter scale to full size. Do your utmost in doing an accurate job of this, and by all means use a set of draftsman's instruments in doing it. After the fuselage layout drawing has been completed, it



This is how the model looks completed and ready to fly. Duplicate this ship faithfully and you will have a job to be proud of.



Half the trick of building a successful gas job lies in the proper structural design. Standard and proven practices are evident in this photograph of the completed frame.



Designed expressly for Air Trails, this outstanding job embodies that certain something in appearance which is so characteristic of its designer's work in the field.

can be fastened down to the workboard. Above the entire drawing tack a sheet of wax paper.

Small ½" brads are used to construct a jig which holds the longerons and diagonal members in place over the drawing while the cement is drying. The brads should be affixed in such a way that when they are tacked in place on either side of the longerons, they will hold the members absolutely in line. Lay the longerons in place and proceed by cutting all the diagonal and vertical cross-members. Cut two like members at a time, as this will help to insure identical sides. When fitting the cross-members in place be sure that they fit in firmly between the longerons, yet not too tightly as to cause distortion when the sides are lifted from the jig. Also, be certain that the diagonal and vertical members butt both against the longerons and its adjacent member. After all of the braces have been inserted, a coat of good cement is applied. It's a good idea to build the other side of the fuselage over the half just completed, but before doing this, apply three more coats of cement and allow the side to dry at least two hours. (Four to five hours if weather is wet.)

Our next step after completing both sides is to assemble the sides to form the fuselage understructure. The fuselage is assembled over a full-size top view in an inverted position. As in the construction of the sides, it is best to cut all like cross-members simultaneously. The stern post should be joined first, the portion around the greatest cross-section next, and then the nose end. After allowing the assembly thus far to dry, you may join together the portions not previously joined. Allow every joint to dry thoroughly before proceeding to the next step. Keep a constant check on the alignment of the fuselage with a set of draftsman's angles.

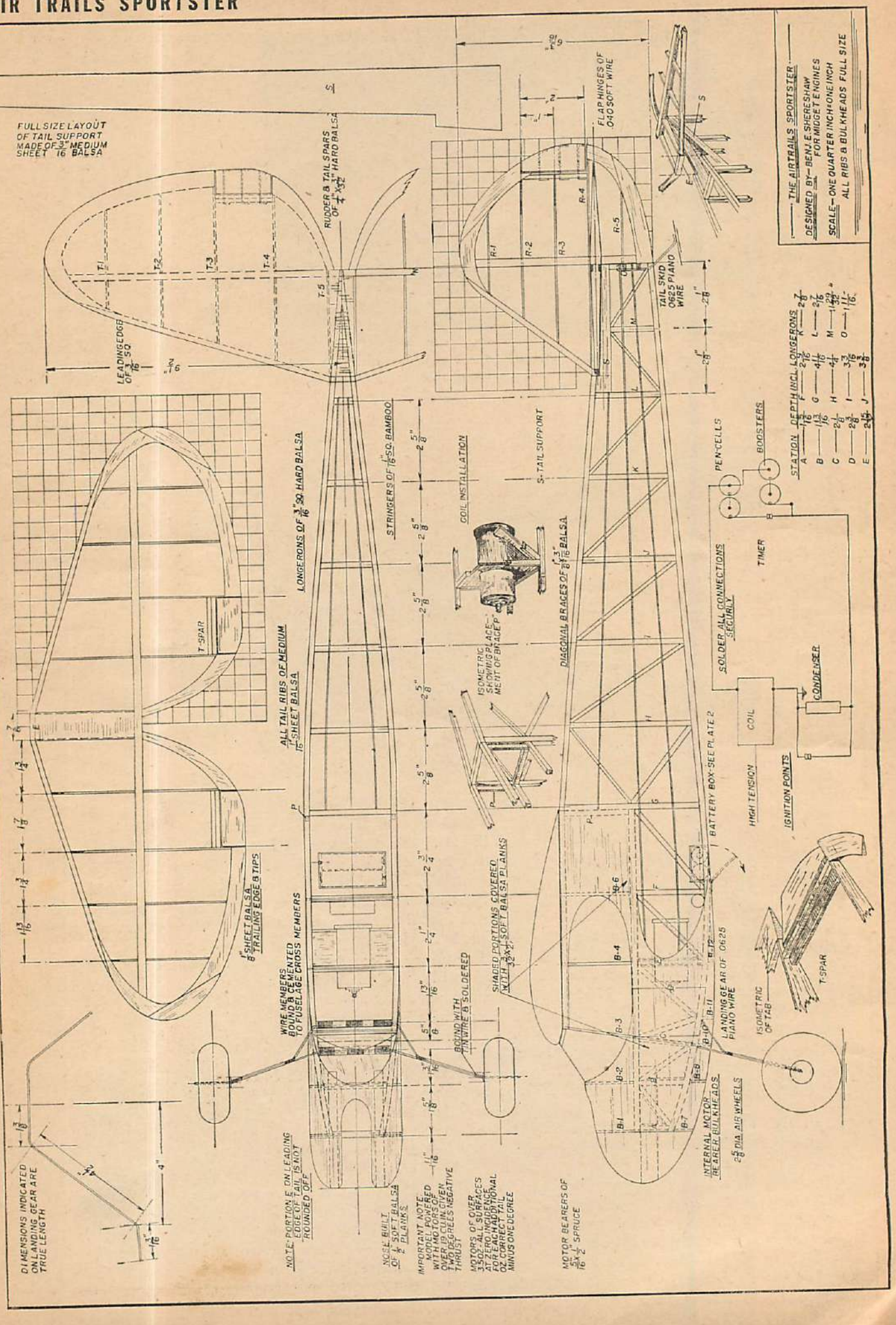
In the next step the landing gear requires our attention. The wire members are bent relative to a layout, giving the true length of each member. The rear strut is formed only after it has been bound to the fuselage cross-members. It is then brought to its designated position where it contacts the front landing gear member, bent parallel to it, and is bound and soldered. Take care not to bend sharp corners in the bending of the piano wire, as this is apt to encourage fatigue in a hard landing. The axle is incorporated with the front strut and a small brass washer should be soldered in place at the root of the axle to keep the wheel from rolling against the gear. A small washer of the same diameter should be soldered at the end of the axle to keep the wheel permanently on.

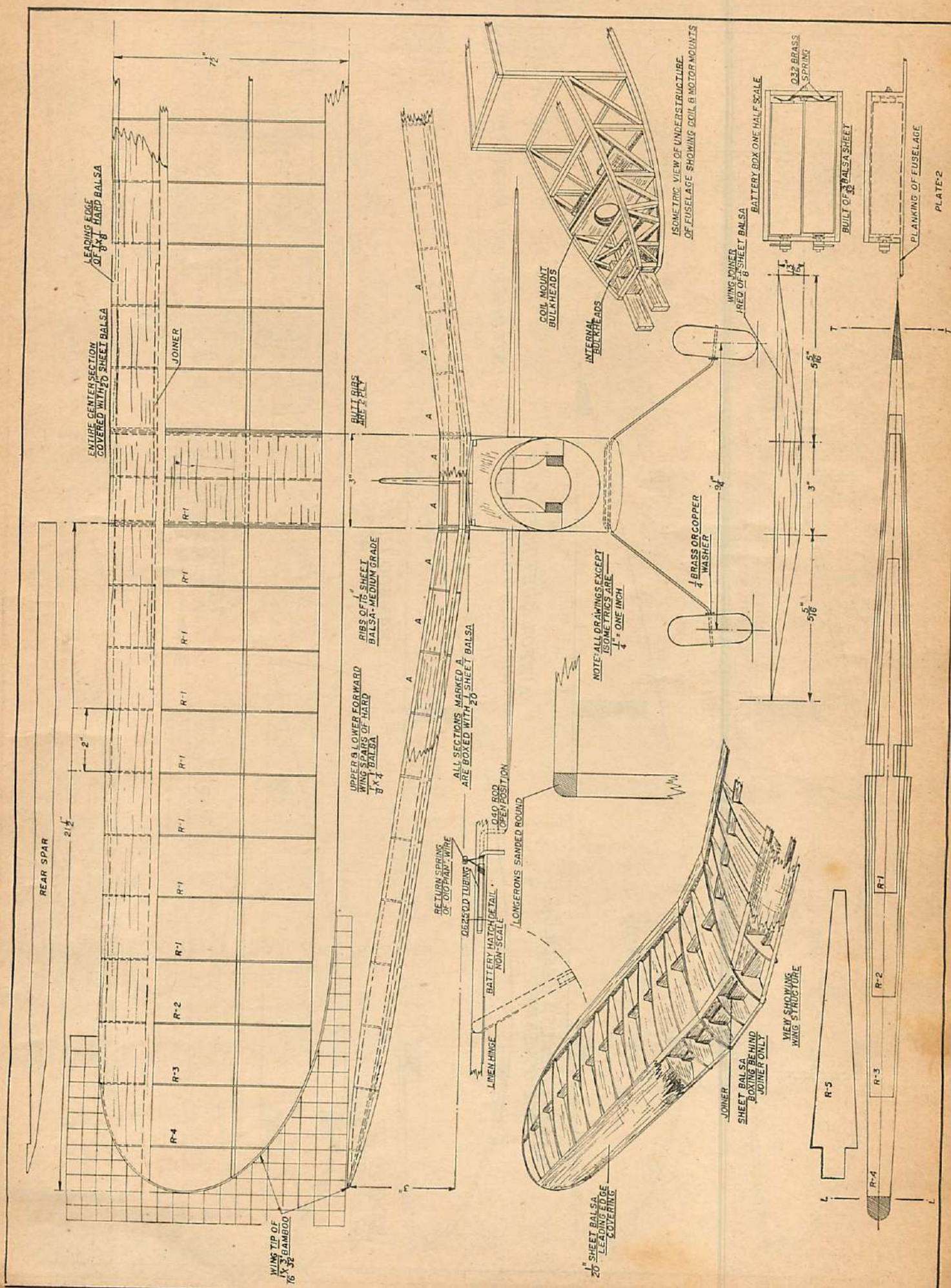
We return again to the fuselage, and cut all internal motor bearer bulkheads to their correct sizes. The motor bearer size is large enough to accommodate the larger of the small-bore engines. Therefore do not alter their dimensions. You will note on Plate 3 that the vertical brace at Station A is chamfered away to make room for the motor mounts. It is obvious that the dimensions between the bearers will vary, relative to the type of motor used.

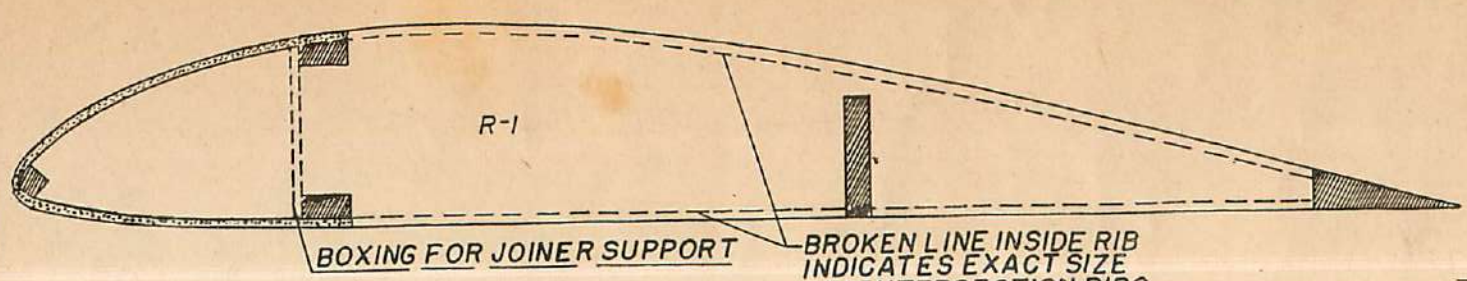
The internal bulkheads should be laminated of two-ply 3/32" medium sheet balsa. After they have been cut and notched, they can be inserted at their proper stations. The motor bearer can then be slipped into place and cemented securely with several coats of cement.

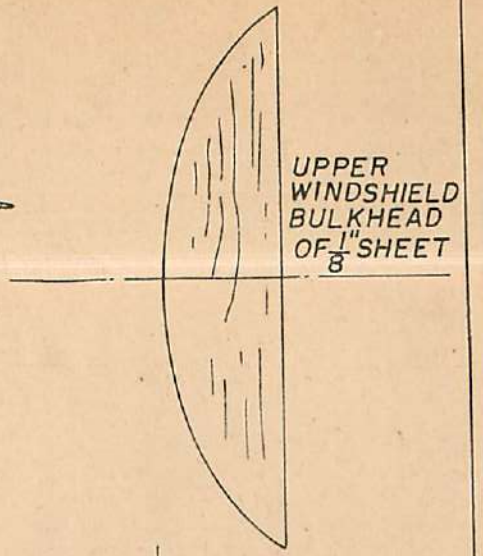
The fairing bulkheads at the nose should then be cut and cemented at their proper locations. They contain no provisions for stringers, as the planking holds them in place. Bulkheads 3-4-6 constitute our superstructure and the wing mount of the fuselage. They are cut from a medium grade of 3/32" sheet balsa. The superstructure of 3/16" square longerons should be cut from a medium grade of sheet balsa possessing good bending characteristics. Cross-members C. R. of 1/8 x 3/16" hard balsa are then cemented to the bulkheads as indicated on Plate 4. After all of the bulkheads and wing mount members have been attached to the fuselage frame, we can proceed to plank the fuselage with *(Turn to page 87)*

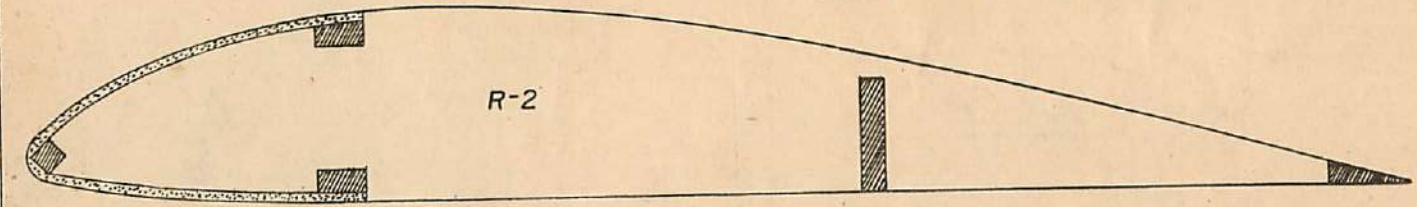
AIR TRAILS SPORTSTER




ENTIRE CENTER SECTION COVERED WITH 1/20 SHEET BALSA
LEADING EDGE OF 1/8 X 1/8 HARD BALSA
JOINER
REAR SPAR
2 1/2"
2"
UPPER & LOWER FORWARD WING SPARS OF HARD 1/8 X 1/4 BALSA
BUTT RIBS ARE 1/8" SHEET
RIBS OF 1/20 SHEET BALSA-MEDIUM GRADE
ALL SECTIONS MARKED A ARE BOXED WITH 1/20 SHEET BALSA
3"
R-1
R-2
R-3
R-4
RETURN SPRING OF PIANO WIRE
.040 ROD OPEN POSITION
BRAZED TUBING
BATTERY HATCH DETAIL NON SCALE
LONGERONS SANDED ROUND
LINEN HINGE
WING TIP OF 1/8 X 3/32 BAMBOO
1/20 SHEET BALSA LEADING EDGE COVERING
COIL MOUNT BULKHEADS
INTERNAL BULKHEADS
ISOMETRIC VIEW OF UNDERSTRUCTURE OF FUSELAGE SHOWING COIL & MOTOR MOUNTS
NOTE: ALL DRAWINGS EXCEPT ISOMETRICS ARE 1/4" = ONE INCH
1/4 BRASS OR COPPER WASHER
WING JOINER MADE OF 1/8 SHEET BALSA
BATTERY BOX ONE HALF SCALE
.032 BRASS SPRING
BUILT OF 1/32 BALSA SHEET
5 5/8"
5 5/16"
PLANKING OF FUSELAGE
PLATE-2
JOINER
SHEET BALSA BOXING BEHIND JOINER ONLY
VIEW SHOWING WING STRUCTURE
R-5

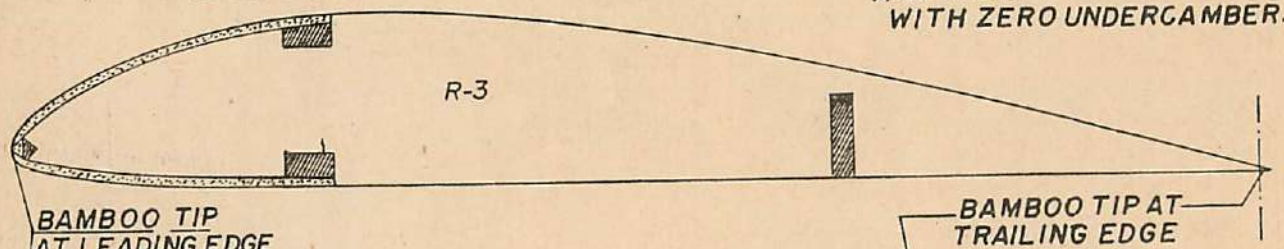


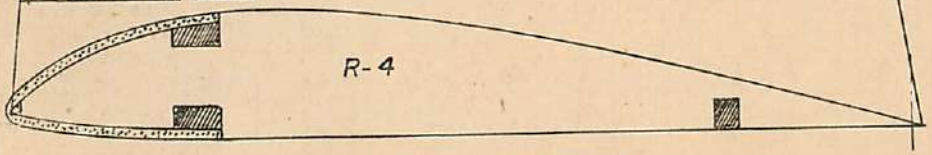


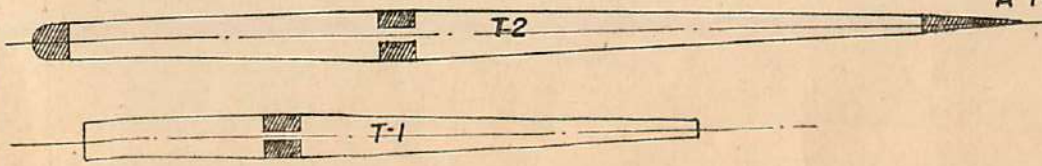


AIRFOIL GÖETINGEN 549 WITH ZERO UNDERCAMBER.

STRINGERS NOT REQUIRED







NOTE: VERTICAL MEMBERS AT STATION A TO MAKE ROOM FOR MOTOR BEARERS

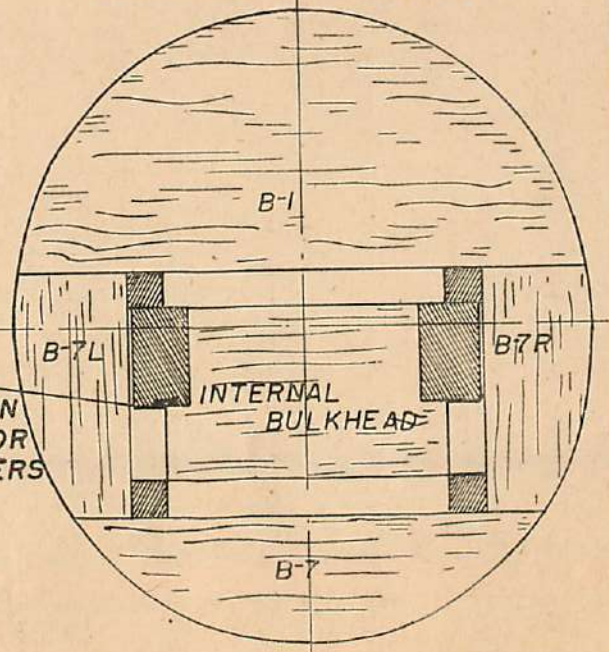
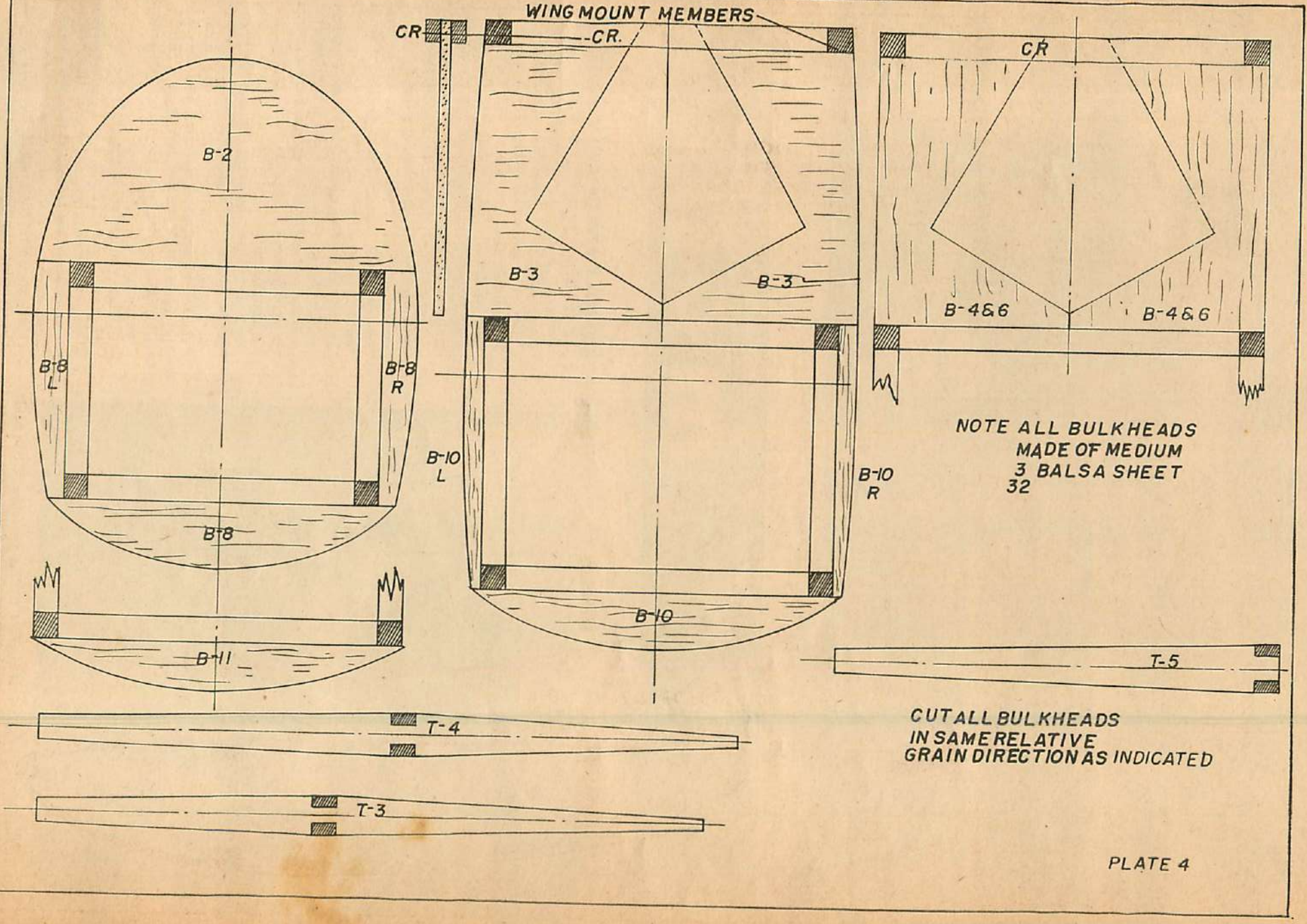


PLATE-3


WING MOUNT MEMBERS
CR
CR.
CR
B-2
B-3
B-3
B-4&6
B-4&6
B-8 L
B-8 R
B-8
B-10 L
B-10 R
B-10
B-11
T-5
T-4
T-3
NOTE ALL BULKHEADS MADE OF MEDIUM 3/32 BALSA SHEET
CUT ALL BULKHEADS IN SAME RELATIVE GRAIN DIRECTION AS INDICATED
PLATE 4

Sovfoto
Rais Murtazin, Russian model builder, with his gas job flown at a contest in Crimea. Russian government fosters model construction.

FLIGHT RECORDS AND CONTESTANTS IN COMPETITIONS.

model

This is officially "the 1939 model airplane retrieving machine." It is said to come in handy chasing model airplanes across fields. We wonder.

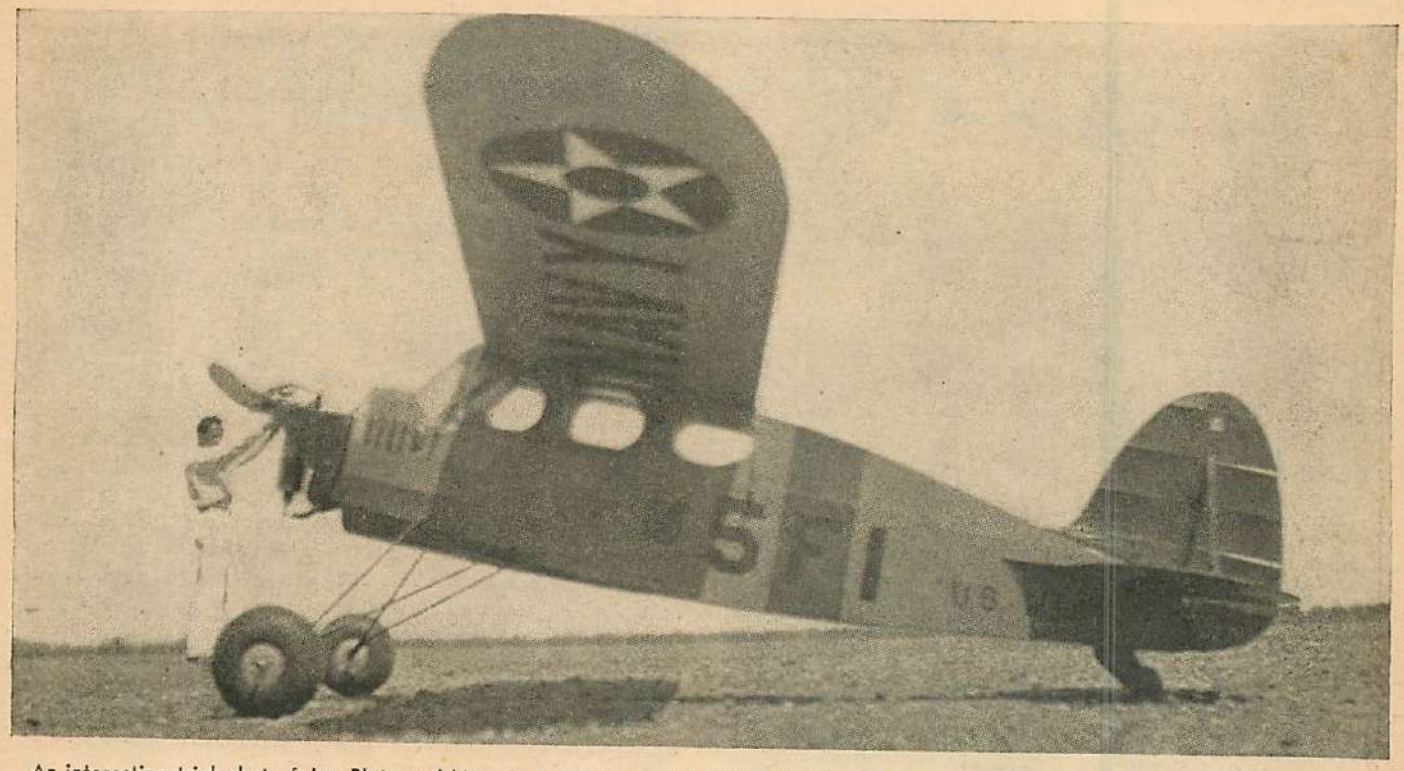
THIS EVER HAPPEN TO YOU? Carroll Moon, of the Brooklyn Skyscrapers, reports that the following case history was gleaned from the bitter (cold) experience of fellow club members:

Boy, it sure is cold. That old thermometer is pounding the zero mark, and the sky is "mur-r-r-r-rky" overhead, but still the gang is going flying, so pack the wings under your arm, grab the fuselage and troop to the field.

You've tested the inner batteries the night before and made sure that they both give out ten amps by the tester. Oh, yes, the boosters are tested and found to be in good shape, with wires in good order, and you've put a cloth around them to keep out possible moisture and to keep them from freezing (sure, "dry" cells will freeze) and you carry the inner batteries in your pocket.

You're bringing a special can of winter fuel, with a mixture somewhat thinner than used in the summer, as high as six or even seven to one. You've strained the gasoline through chamois or fine mesh screening, and the night before you took the gas tank apart, cleaned it, and likewise you gave the motor a thorough going-over.

When you arrive at the field you heat the plug with a match, insert it, put in the batteries, connect the boosters and pour in the gasoline. You close the air vent to choke, spin the prop, and prepare to start. On goes the switch, you check the spark (listening for the plug to spark by shorting the timer and listening when the



An interesting trick shot of Joe Plute and his 4-foot, 9-inch gas job with which he won 2nd place in a contest held in Pueblo, Colorado.

matters

CLUB NOTES AND NEWS OF MODEL ORGANIZATIONS.

cylinder is all the way down). She's sparking, you flip her, she puffs, and you cautiously start the motor. She runs!

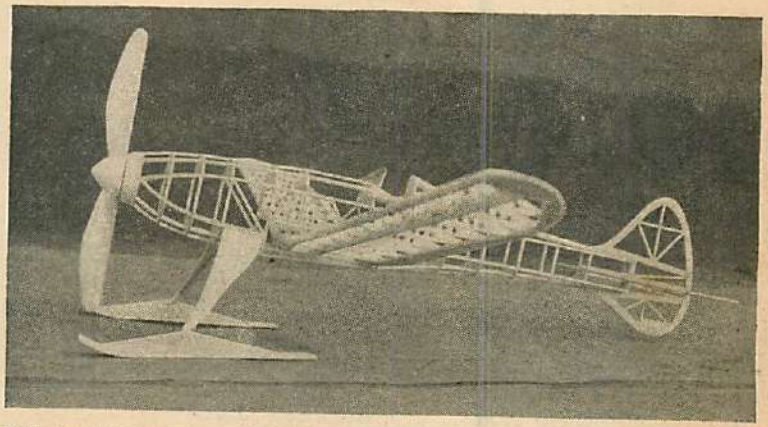
You put on the wings and tail, check the timer (for they sometimes run poorly in the cold weather) check the gas supply, and start the motor once more. She starts easily, being warmer. With the motor going, you carefully open her up, losing a fingernail advancing the spark because cold does odd things to hands and skin and raps from a propeller don't help much.

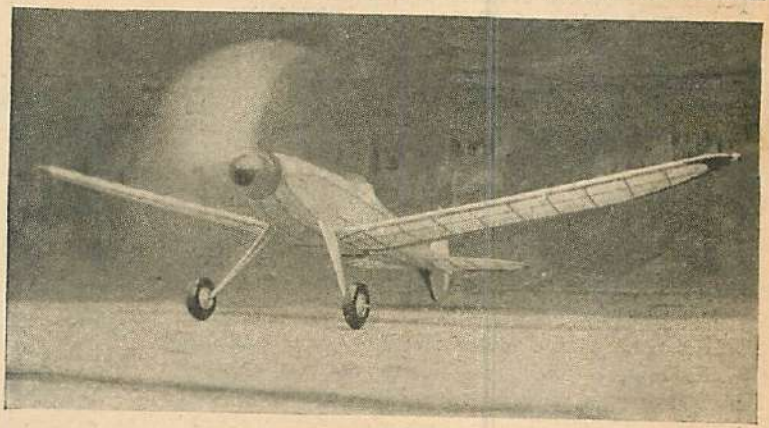
You get the wind direction and carefully launch the plane. She zooms, roars, and—where did she get that spin?—*crash!*

Oh, yes, you forgot to test-glide her before flying. We knew you'd forgotten something.

ACADEMY OF MODEL AERONAUTICS. The Academy of Model Aeronautics' semiannual conference was held in New York City shortly before Christmas. The new officers presiding were Edward Roberts, president; Carl Goldberg, vice president; and Irwin S. Polk, secretary-treasurer.

The Academy planned to strengthen its own organization by appointing in each State a State director, and where activities required it, one or more assistant directors. This plan would provide a suitable man in each State who could make proper recommendations to the Academy or the National Aeronautics Association, upon which action by either organization may be





A neat 32-inch rubber job by Scotty Mayors of New York City has interchangeable wheels or skis. Note the perforated wing ribs for lightness.

model matters

The original Bowlus Baby Albatross model, held by its builder, Paul Plecan. Plans appeared in the July, 1938, Air Trails.

based. This setup, paralleling the National Aeronautic Association Senior Division plan, would tie up very closely with each State aviation commission, and would allow closer coöperation within the Senior National Aeronautic Association, aviation groups and the model activity. Selection of these State directors would depend on their activities in model work, interest, ability, et cetera, and the choice of the residents in the State concerned. In order to start things moving, the executive board has issued a call for names of suggested State directors. Appointment will be made for a trial period from the names submitted by the builders in each State as well as the executive board. After the system gets under way, reappointments or continuance of these State directors will be determined by the model builders themselves.

The national model rules were studied, and recommendations were made for changes which, upon their approval by the National Aeronautic Association contest board, will be released.

A resolution was passed to accept the proposal for gas-model-airplane insurance. The Academy urges that all model builders apply for this insurance immediately, so that the insurance can go into effect as soon as possible or at least in time for spring and summer flying.

The time of the motor run for power models was reduced to twenty seconds for competition flying. For sport flying, the thirty-second rule remains in effect. The eight-ounce-per-square-foot wing-loading rule and limitation per weight of model of seven pounds remains the same. Winners are to be selected from a total of three flights. Up to two hundred and twenty-five square inches, piston displacement is not to exceed .20 cubic inches; two hundred and twenty-six to four hundred and fifty square inches, .30 cubic inches displacement; four hundred and fifty-one to unlimited area, 1.25 cubic inches piston displacement.

A power-model committee consisting of Elbert Weathers, Irwin Ohlsson, Barney Snyder, William Atwood, Michael Roll, J. R. Forster, Alan D. Booton, Bob Summers, Pappoon, Bob Allen, and Charles Grant, was appointed. Maxwell Bassett was appointed chairman of the power-model committee. This committee will study the power-model rules proposed at the Academy meeting, after which time a ballot will be issued to all the Academy members for their final approval before submitting the results to the National Aeronautic contest board. The Academy recommends that essentially the same rules and events as were held last year be used again at this year's national contest. Should sponsorship be forthcoming, it was recommended that an exhibition scale model event also be conducted.

Individuals whose active interest, desire to foster model aviation, and outstanding performance and recognized leadership in model aeronautics qualifies them for membership in the Academy of Model Aeronautics, are invited to write to the Academy secretary for applications.

The Academy accepted the invitation from David Click, president of the Greater New York Chapter of the N. A. A., to conduct the Wakefield International Cup Contest in New York in conjunction with the New York World's Fair.

Weather's "Mystery Man" leaves chassis on ground when taking off. Landing is effected by the monowheel built in fuselage.

Below—Newly elected officers, Academy of Model Aeronautics. L. to R.—C. Goldberg, vice pres.; E. Roberts, pres.; I. Polk, sec-treas.

Kelick

A Baby Albatross being launched by Elton Ballas, of Queens Aero Modelers Assn., at Holmes Airport. Interesting points in the design are the balsa monocoque fuselage or "pod" and the novel boom support for the tail surfaces. Ship is a nice performer. Span is 4 feet.

WAKEFIELD INTERNATIONAL CUP CONTEST. For the fifth time out of the eleven years that the Wakefield Contest has been held, the Wakefield Cup was won by an American. James Cahill, of Indianapolis, was the winner last year at Guyancourt, France, thereby bringing the famous Wakefield Cup and the contest to the United States for 1939.

The Greater New York Chapter of the National Aeronautic Association, in coöperation with the New York World's Fair, has undertaken the sponsorship in this year's Wakefield International Contest and promises to make the event in keeping with the magnificence of the New York World's Fair.

An invitation is hereby extended to all nations to send their teams to compete in the International Contest. Those fortunate enough to place in their National Elimination Contest and win a place on their country's Wakefield team, will be fêted as they never have been before in their lives. A gala program of entertainment and sightseeing has been arranged for the visiting teams. A cash prize of two hundred and fifty dollars will be awarded the winning team.

Irwin S. Polk has been named Wakefield International Cup Contest manager. Model aeronautic officials of all nations are invited to declare their intent to participate by writing to Mr. Polk at 429 Seventh Avenue, N. Y. C. It is hoped that many nations will send teams or their winning models to be flown by proxy.

COME ON, YOU MONEY-MAKERS! In the January issue, Pete Dillon's Corben Super-Ace gas model was mentioned as an outstanding money and trophy winner, having seventy-five dollars and forty cents, and several trophies and kits to its credit. Elbert Weathers of San Diego answered the request for other big-money winners by sending the list of prizes won by his gas model Westerner. This model was test-flown in June, 1937, and is still in active service.

Total cash won to date—one hundred and twenty dollars; total value of merchandise—forty-six dollars seventy cents; and two trophies. Merchandise includes such items as subscriptions, two motors, six propellers, and three quarts of oil. Incidentally, the first prize won by the Westerner was a subscription to Air Trails back in June, 1937.

Mystery Man, another model by Weathers, has already started on a prize-winning run. It was test-flown October, 1938. By the end of 1938 it had already won a dollar in cash and thirty-seven dollars forty-five cents' worth of merchandise. Mystery Man is scheduled for a near-future issue of Air Trails.

NEW NATIONAL RECORDS. Some new national records that have been established recently are:

INDOOR MODELS

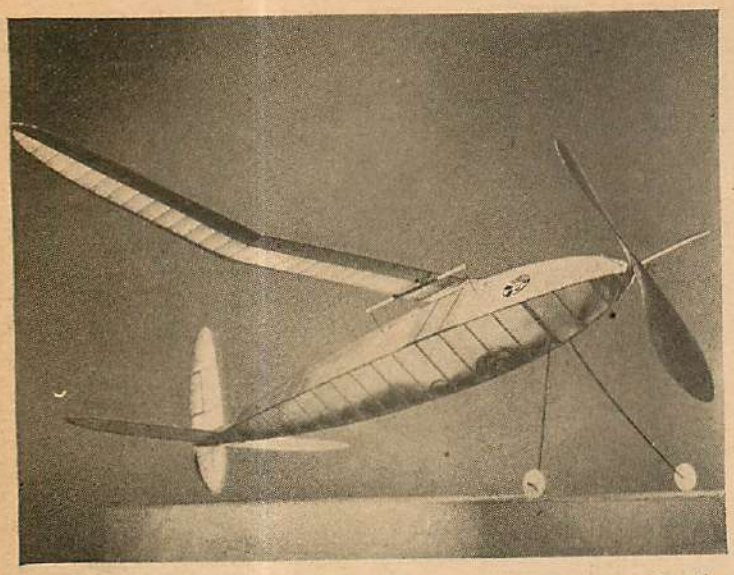
Fuselage, R. O. W., Class B—Senior: Mathew S. Smith, Washington, D. C., 7:10.4.
Autogiro—Senior: Ralph Brown, Boston, Mass., 2:47.0.

OUTDOOR MODELS

Stick Model, R. O. W., Class D—Junior. Arthur Beckington, Rockford, Ill., 10:10.0.
Glider, H. L., Class B—Senior: Herbert Friedlander, Brooklyn, N. Y., 2:58.0.
Fuselage Model, R. O. W., Class E (Gas)—Junior: Arthur C. Schroeder, Jr., Syracuse, N. Y., 1:41.5.

These records are recognized and compiled by the National Aeronautic Association, Dupont Circle, Washington, D. C.

G. M. A. A. OF SOUTHERN CALIFORNIA. At the Gas Model Association of Southern California contest, December 11th, there were two hundred and ninety-three entries. Between 7:30 a. m. and 1:30 p. m., with a recess of forty-five minutes called at eleven o'clock, four hundred and forty official flights were turned in. Credit for this efficient *(Turn to page 84)*



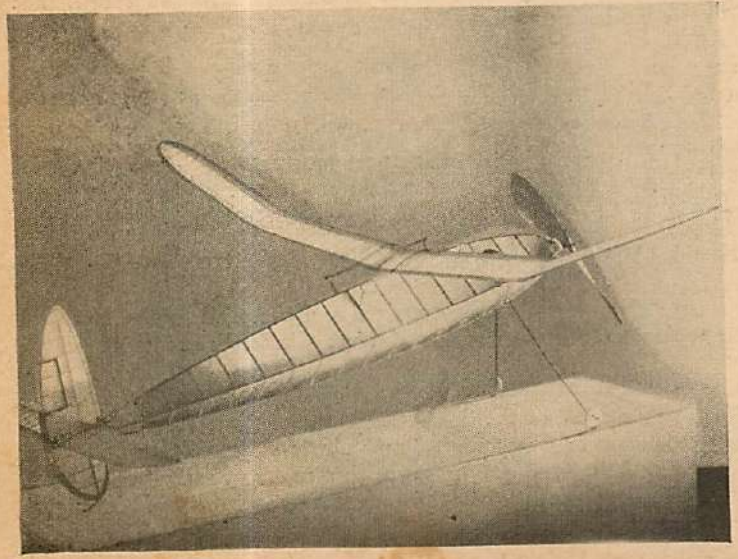
Most unusual feature of the proven design is the 18—1 aspect ratio.

WAKEFIELD CONTENDER

by LOCKTON PARK

A design that really is different, one that has flown as much as 35 minutes.

The diamond fuselage is used here to excellent aerodynamic advantage.



THE design of this Wakefield entry is somewhat extreme with the high aspect ratio wing (eighteen to one) and the long, thick fuselage. The real beauty of the design can be appreciated only when the model is in full flight. The best flight of the original model was twenty-odd minutes out-of-sight. A duplicate of this model built at a later date has flown as long as thirty-five minutes. These flights are the only soaring flights of new weight rule Wakefield designs in southern California. The thermal on the twenty-minute flight was weak, since the flight was made about eight o'clock in the morning before the fog had evaporated.

The striking part of the model's performance is the gliding speed and the sinking speed. The climb is as fast as any modern Wakefield, but as soon as the power is off the speed is cut in half—reduced to the gliding speed of one ounce to fifty square inch jobs of a few years back.

CONSTRUCTION

(Material for each part can be identified in the bill of materials through its part number)

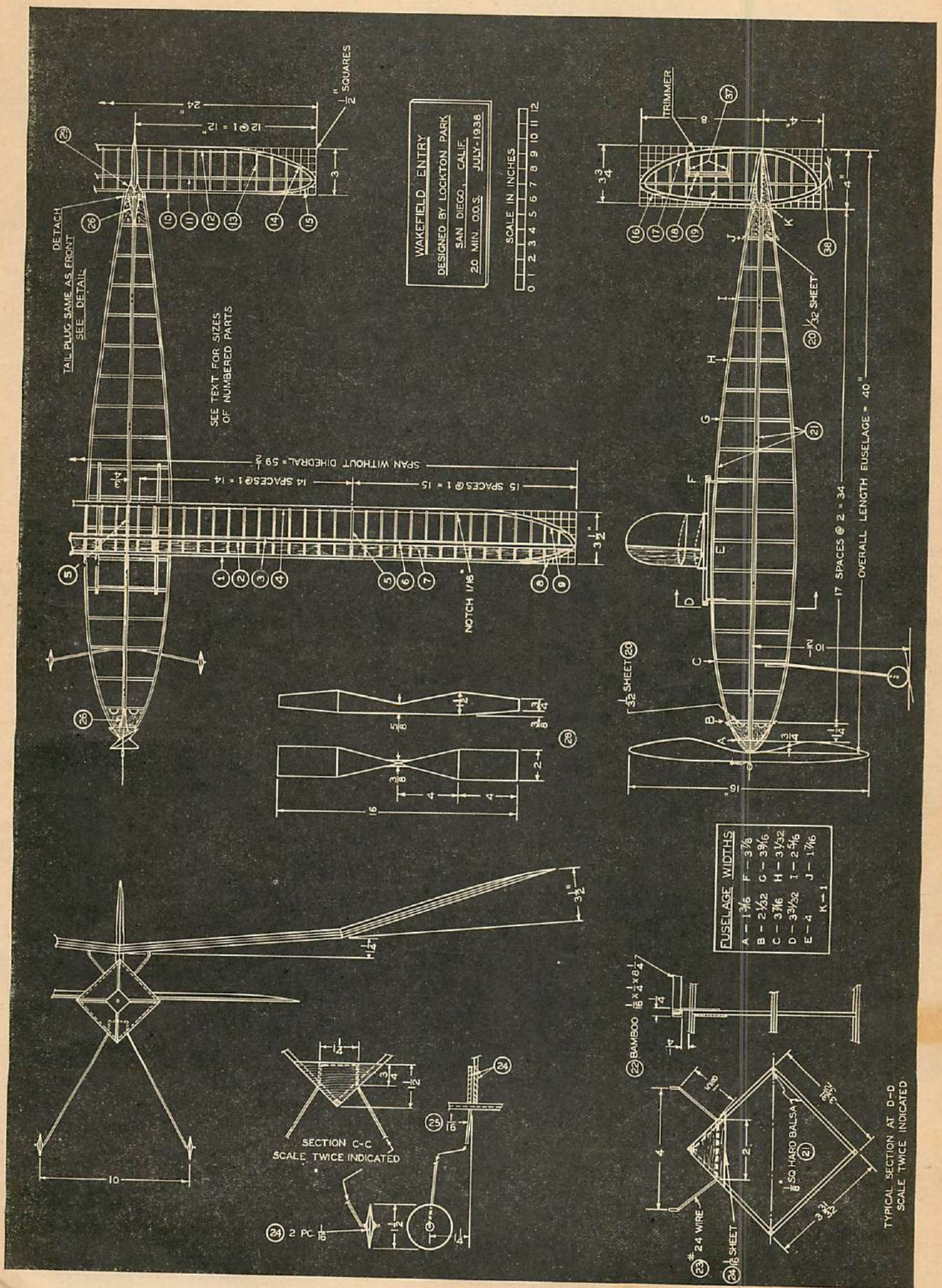
Fuselage is square cross-section set on edge. It is built in the same way as any square design. The fuselage widths tabulated in the drawing are measured on the sides of the square as shown in the section D—D. Attachment of the wing mount and the landing gear is shown in the enlarged details of the fuselage at these points.

The nosing is seven ply of 1/8" sheet balsa cemented cross-grain. The inside lamination fits inside the nose of the fuselage. The rear tail plug is fitted to the fuselage in the same way. Both are secured with rubber bands and hooks.

The thrust line is not offset in any direction. The adjustments are made solely through the tail and wing settings. The shaft is held in alignment by a piece of aluminum tubing. The rear hook is bent to conventional shape with the end bent back to prevent rubber slipping off. (Similar to the rubber end of the propeller shaft.) Anchor firmly to the tail boom. #24 wire (about 3/64" diameter) is used for the rear hook, shaft, S hook, freewheeling, and wing-mount attachment. S hook and rear hook are covered with rubber tubing to prevent wear. (The model can be wound through the front or rear. The front seems more convenient for holding the model.)

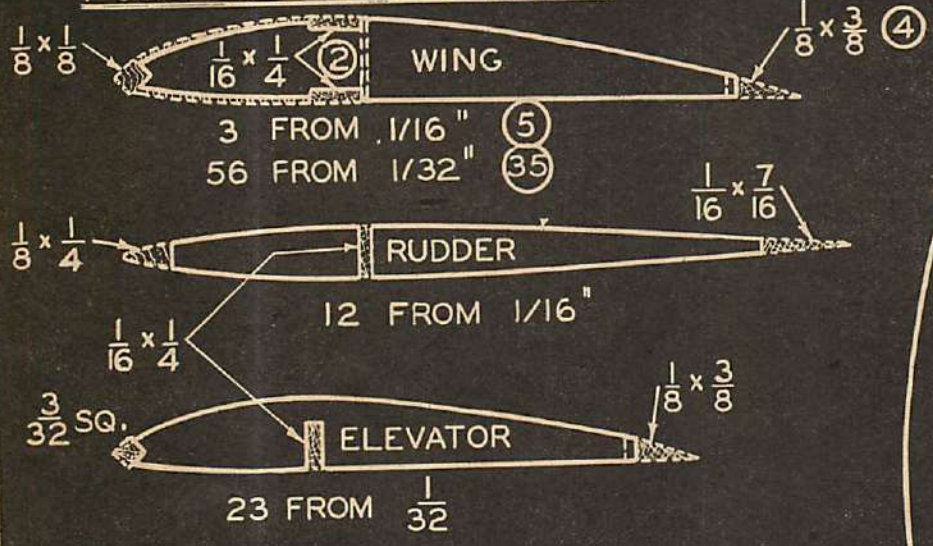
There is a ball-bearing washer used between two 1/4" diameter copper washers between the nose plug and the propeller. The propeller is carved from medium-grade balsa 1½ x 2 x 16". The full-size blade shape and the freewheeling are included on the page of full-size parts. The propeller is silk-covered, then add six coats of dope, sand, then two coats more, sand, and then keep doping and sanding until the propeller passes the test of scraping your fingernail over the blade without any scratching sound. Use silicon carbide #400 wet paper.

Wing mounts are set parallel *(Turn to page 64)*

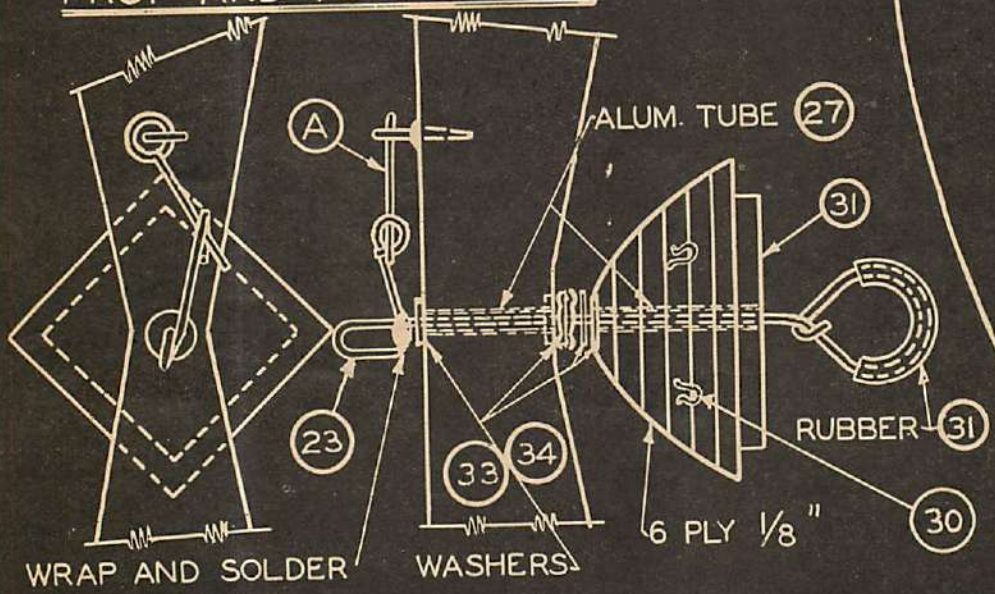

WAKEFIELD ENTRY
DESIGNED BY LOCKTON PARK
SAN DIEGO, CALIF.
20 MIN. 00 S. JULY-1938
SCALE IN INCHES
0 1 2 3 4 5 6 7 8 9 10 11 12
SEE TEXT FOR SIZES OF NUMBERED PARTS
TAIL PLUG SAME AS FRONT SEE DETAIL
DETACH
SPAN WITHOUT DIHEDRAL = 59 1/2"
14 SPACES @ 1 = 14
15 SPACES @ 1 = 15
NOTCH 1/16"
TRIMMER
17 SPACES @ 2 = 34
OVERALL LENGTH FUSELAGE = 40"
FUSELAGE WIDTHS
A - 1 3/16 F - 3 3/8
B - 2 1/32 G - 3 9/16
C - 3 7/16 H - 3 1/32
D - 3 31/32 I - 2 5/16
E - 4 J - 1 7/16
K - 1
SECTION C-C
SCALE TWICE INDICATED
BAMBOO 1/16 x 1/4 x 8 1/4
1/8 SQ HARD BALSA
24 WIRE
TYPICAL SECTION AT D-D
SCALE TWICE INDICATED

WAKEFIELD CONTENDER

FULL SIZE RIB SHAPES



PROP AND PLUG DETAIL



FREE WHEELING SHOWN ENGAGED – PC. A FALLS FREE OF SHAFT-END WHEN FREE WHEELING

FULL SIZE PROPELLER BLADE

COVER RROP WITH SILK AND 10 COATS OF DOPE – SAND BETWEEN COATS.

DIHEDRAL ANGLE PLUGS 1/8 SHEET 36

INSERT BETWEEN UPPER AND LOWER SPARS

TIP VIEW OF WING SPAR SHOWING RIB HEIGHTS

TIP VIEW OF ELEVATOR SPAR SHOWING RIBS

1939 CUB COUPE

by HERBERT K. WEISS

CUB AIRPLANES are well on the way to being to the airplane industry what the Model T Ford was to the automobile industry. Selling a third of all commercial airplanes purchased today, the Piper Aircraft Corporation offers airplanes on the installment plan, and a free course of flying instruction with each ship. And the success they have gained is in spite of the fact that Cubs could carry only a negligible bomb load, would be outclassed as fighters even if armed, and have limited reconnaissance value. Great credit is due a firm whose success has come from airplanes which free the average man from the earth rather than bury him under it.

Newest of the Cubs is the Cub Coupé. Offering side-by-side seating for those prospective purchasers who were not quite won over by the tandem arrangement of earlier Cubs, the Coupé has been designed for the new 50-horsepower engines, and with the Continental A-40 cruises 340 miles at 83 m.p.h., has a top speed of 93 m.p.h., and carries a useful load of 490 pounds. The Coupé lands in 200 feet, takes off in 300 feet, and climbs at 500 feet per minute. Additional luxury touches are the fully upholstered cabin with two entrance doors, and the pants supplied as standard equipment.

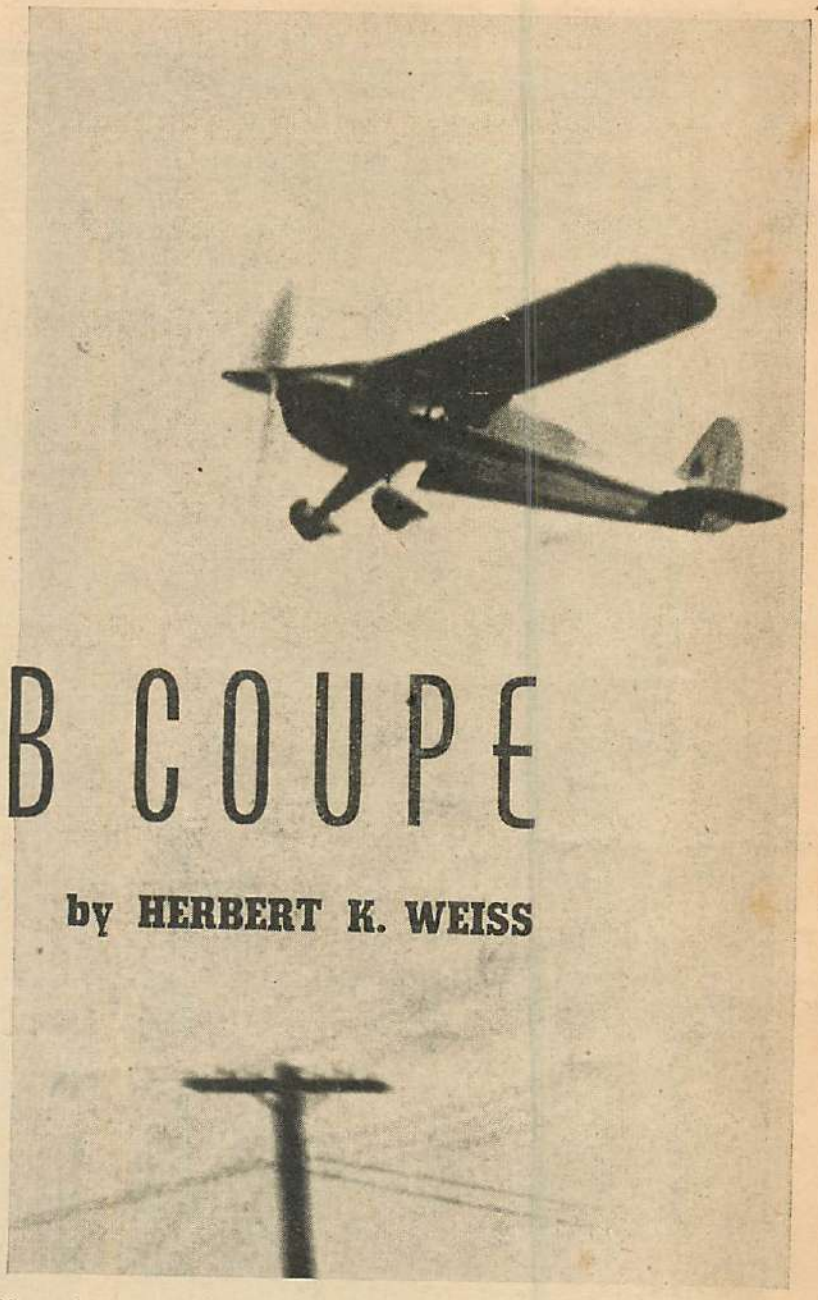
The model plans have been carefully prepared to the three-quarter scale so that they will serve as the basis for either a flying model or a scale model. In construction care should be taken to cement all joints securely, and to keep the structure true at all times.

WING

Begin construction with the wing. This is made in one piece. As it is untapered, no difficulty should be encountered in laying it out on your work bench by simply carrying over dimensions from the plans with a ruler. If desired, a full-size layout can very quickly be traced. Movable controls are optional, and a flying model will usually perform better without them. If controls are made movable, use soft iron wire as hinges.

Sand the wing frame after its assembly to prepare for a smooth covering job. Crack the spars to give dihedral, and recement.

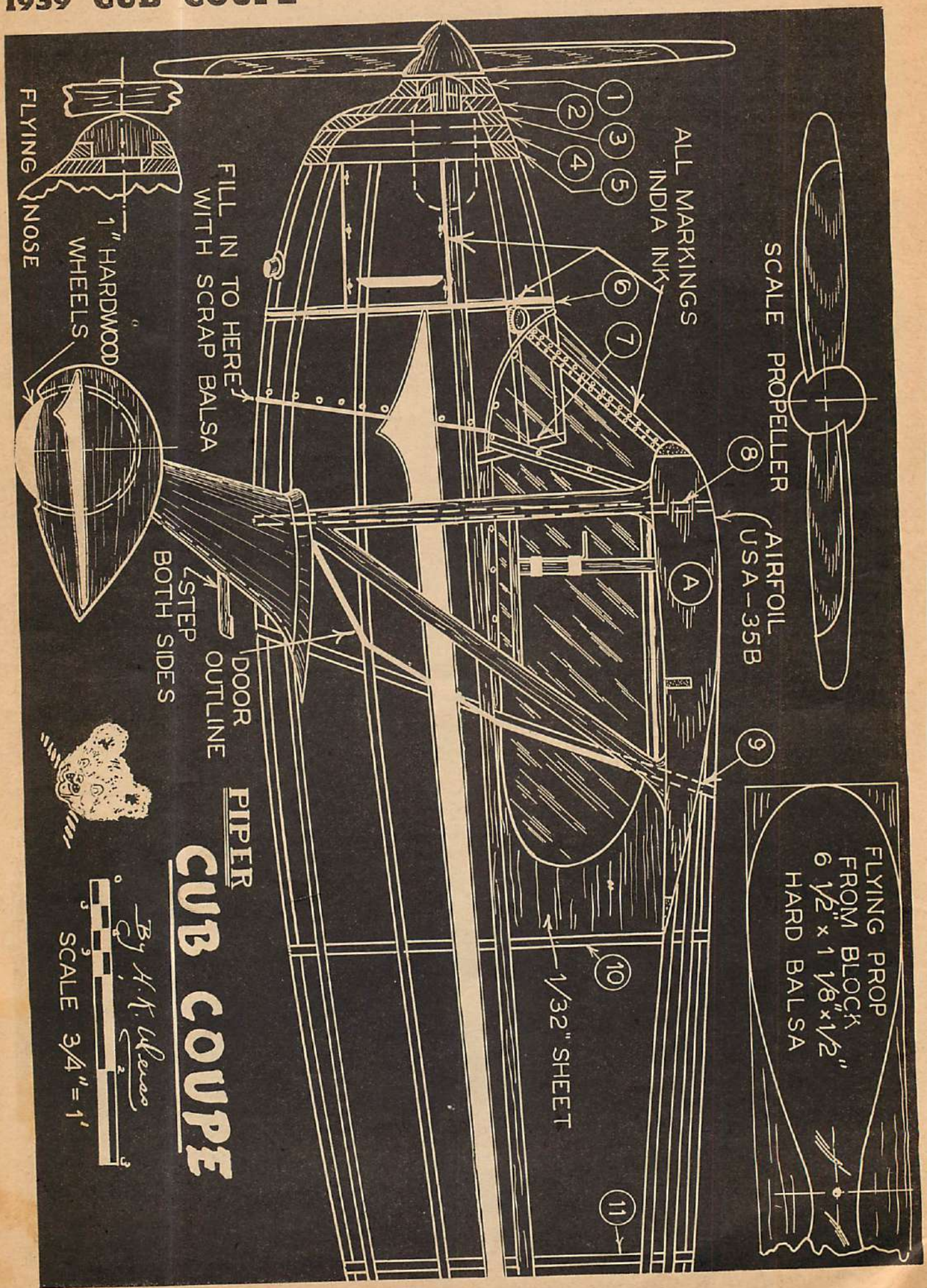
(Turn to page 85)

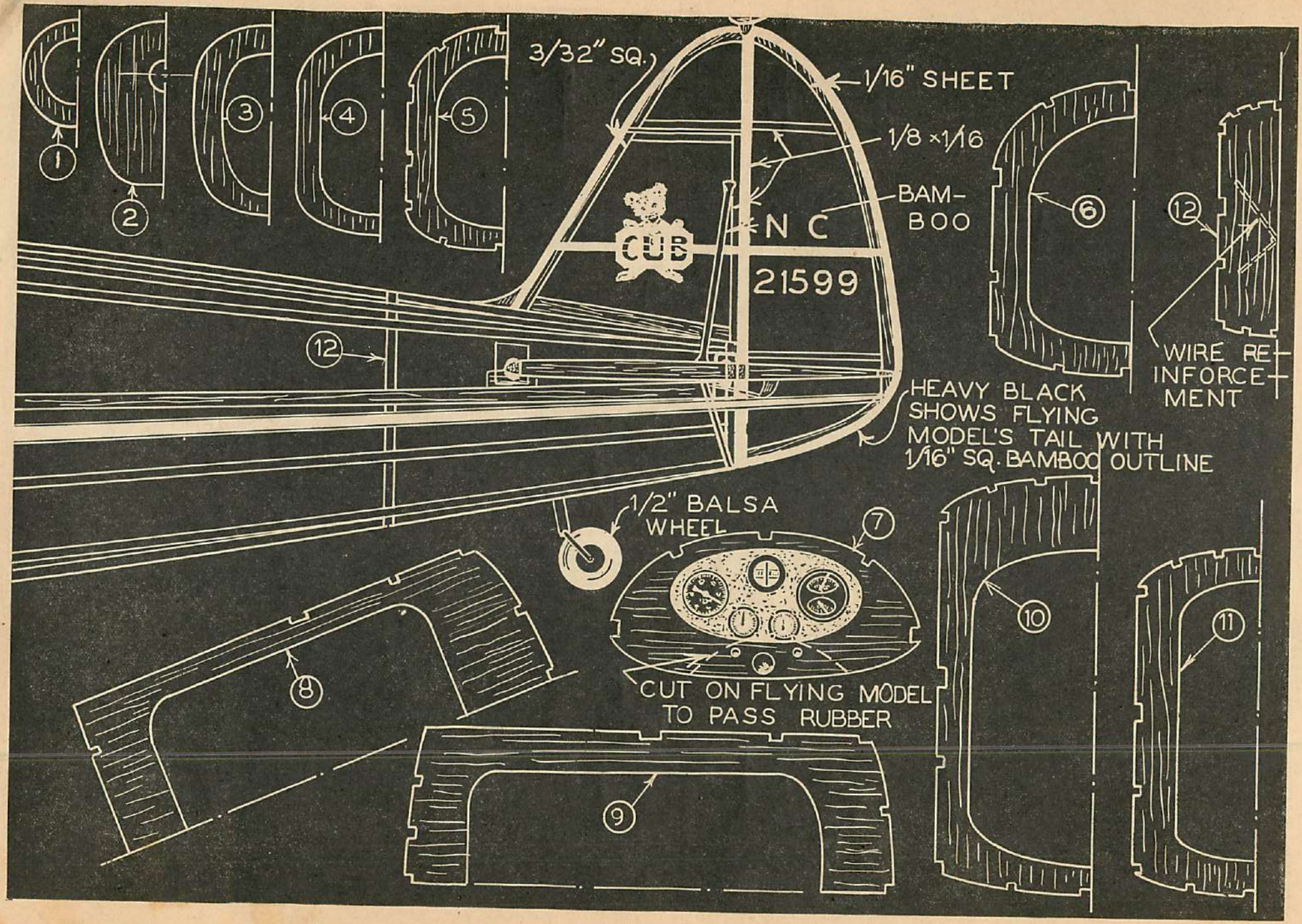


No, you're wrong. It's not the real ship coming in over the wires at the local airport, but the model. Good flying characteristics are insured in a Cub.

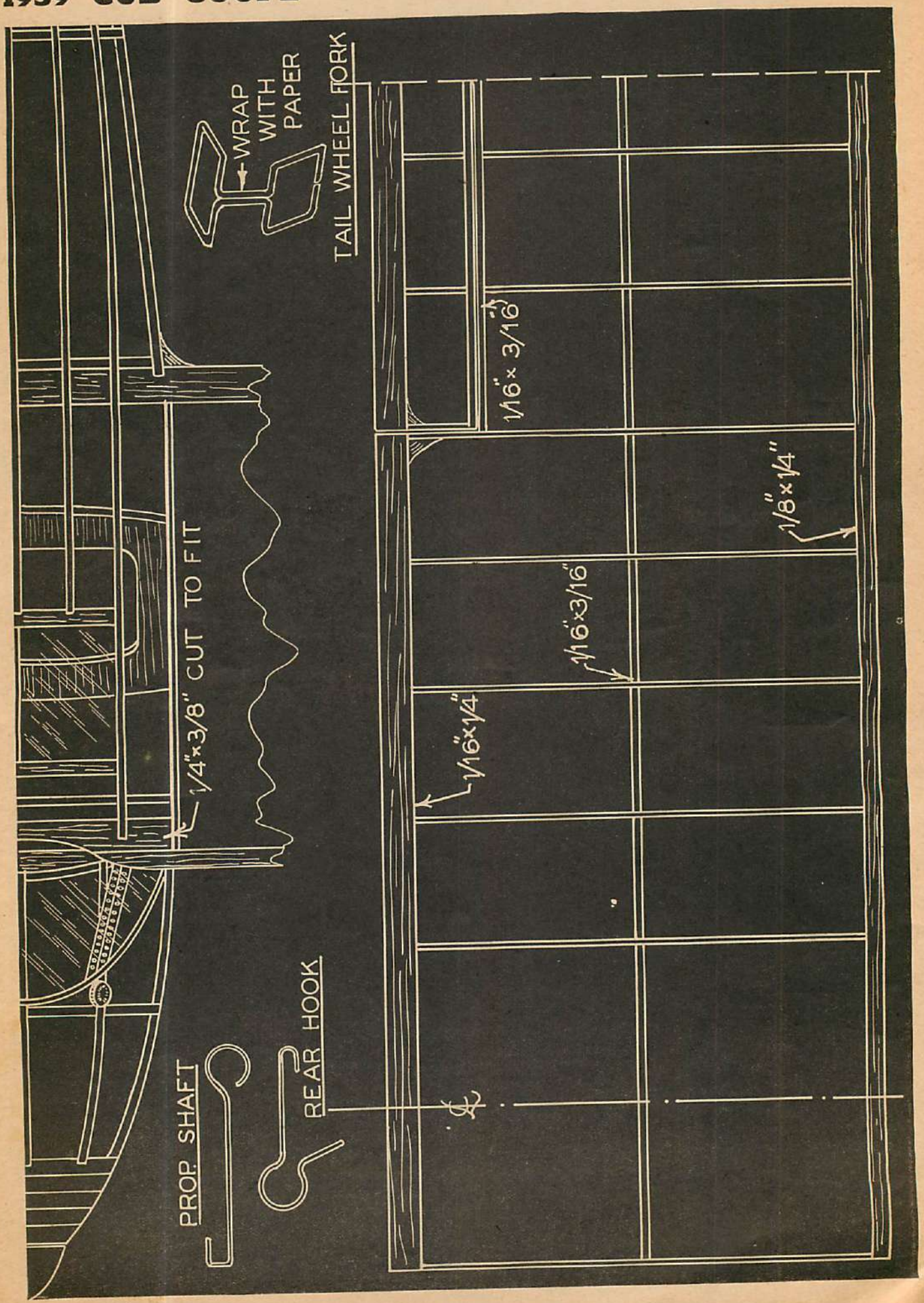
There is something about the new Cub that gets you. It really is a very big-looking little ship. Build and fly the model and you will be well repaid.

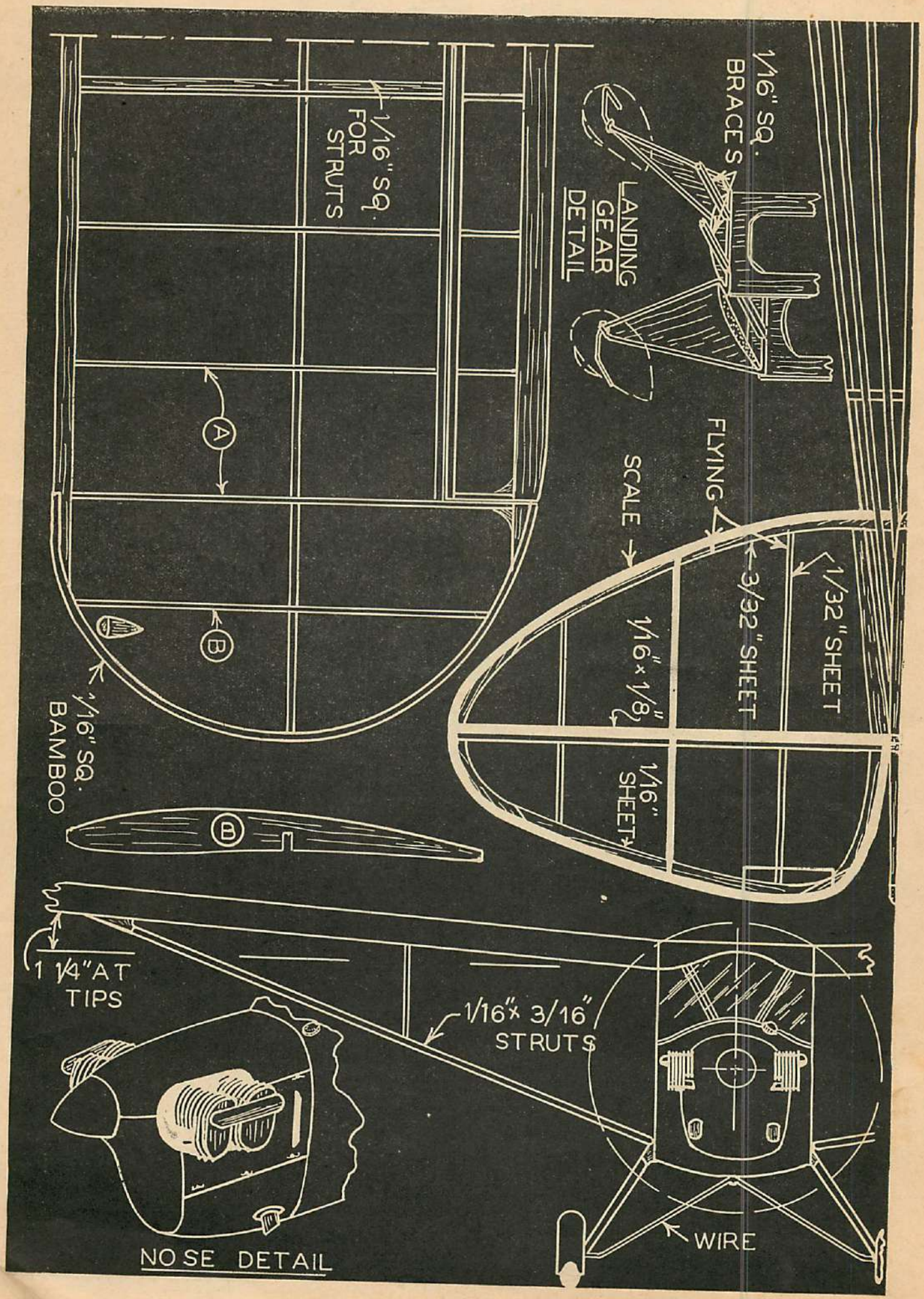
1939 CUB COUPE



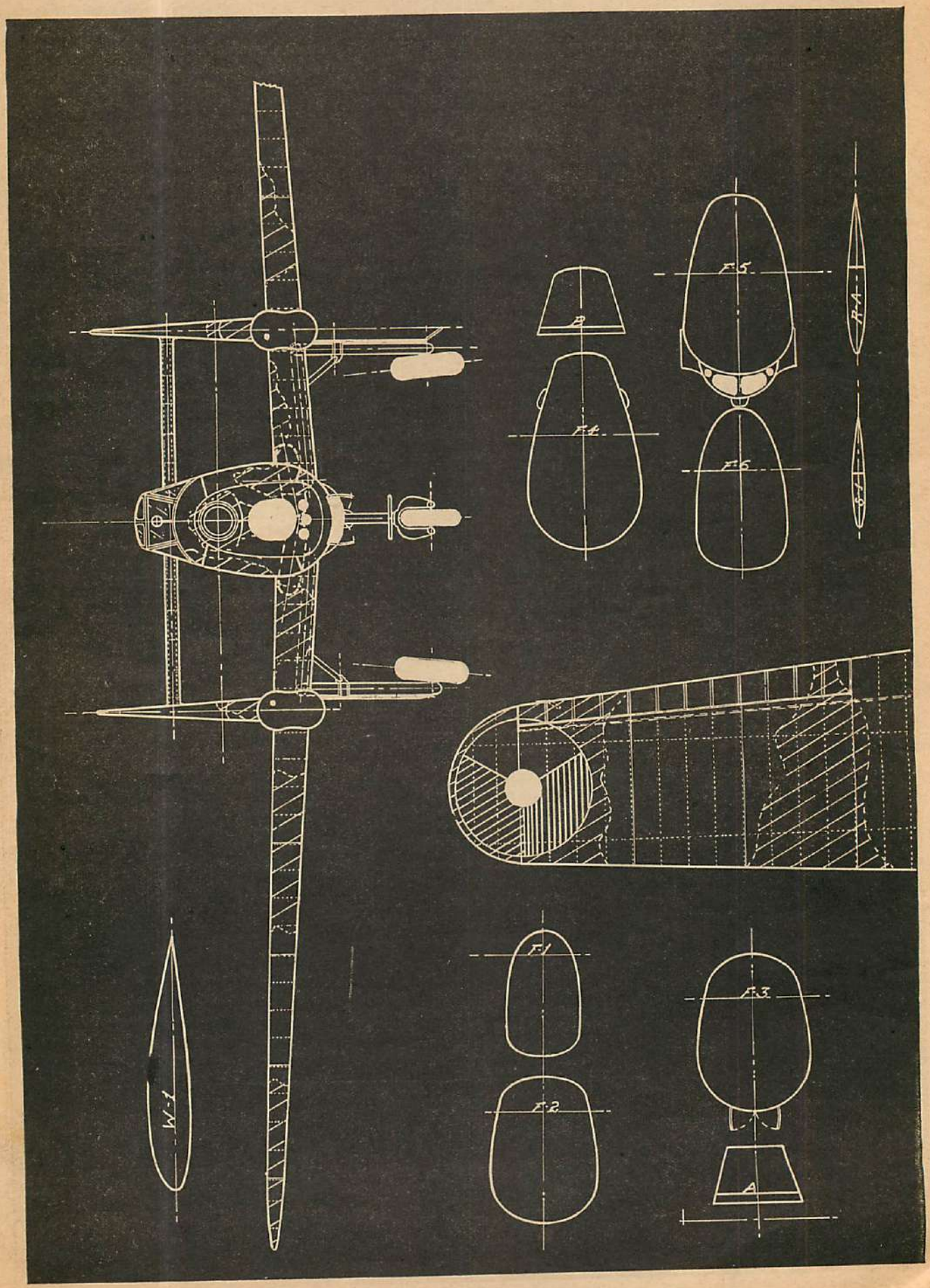

1
2
3
4
5
3/32" SQ.
1/16" SHEET
1/8 x 1/16
BAM-
BOO
CUB
N C
21599
6
12
12
WIRE RE
INFORCE
MENT
HEAVY BLACK
SHOWS FLYING
MODEL'S TAIL WITH
1/16" SQ. BAMBOO OUTLINE
1/2" BALSA
WHEEL
7
8
9
CUT ON FLYING MODEL
TO PASS RUBBER
10
11

1939 CUB COUPE

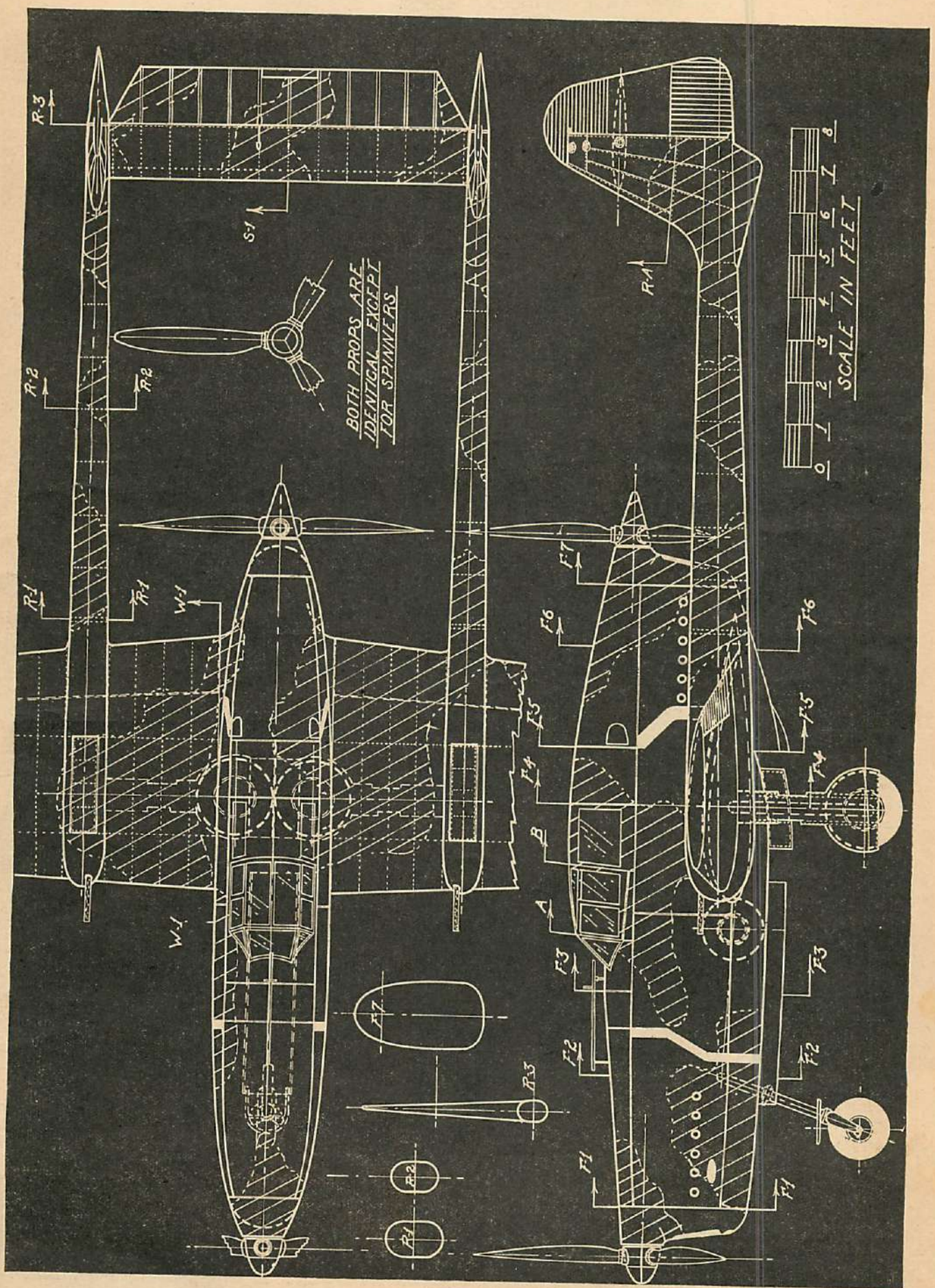



1/16" SQ. BRACES
LANDING GEAR DETAIL
1/16" SQ. FOR STRUTS
A
B
1/16" SQ. BAMBOO
B
FLYING SCALE
1/32" SHEET
3/32" SHEET
1/16" x 1/8"
1/16" SHEET
1 1/4" AT TIPS
1/16" x 3/16" STRUTS
WIRE
NOSE DETAIL

Fokker's Latest, the D-23 FIGHTER



scale drawing by Martin E. Dickinson



WAKEFIELD CONTENDER

(Continued from page 54)

to the center line of the fuselage. The wire supports are sandwiched between two 1/16" sheet gussets. The landing gear is bent from a single piece of wire and attached in much the same fashion.

Wing is the only part of this model not made in the conventional manner. The trailing edge and bottom spar are first laid down on the full-size wing layout (to be made from the dimensions furnished in the reduced-scale drawing). The ribs are then set in. Next the leading edge and top spar are cemented in place. The leading edge (top and bottom) is covered with 1/64" sheet balsa. Sheet balsa pieces the full depth of the rib are cemented to the back of the spars between the ribs. The drawing and the bill of materials will point out the sizes and locations.

The wing was designed with an area of 199.5 square inches and an aspect of 18:1 for less tip loss. It seems that it is the main factor contributing to the model's slow flying speed. The wing construction is amply strong with 7/16" distance between the compression and tension spars. The attachment to the wing mount is with two light rubber bands. They will break before the wings will in a crack-up.

The wing is built in four pieces. The center and outboard joints in the spars are reinforced with two balsa plugs inserted between the spars.

Elevator construction is similar to the wing. Its area is 65.5 square inches. It is built in one piece and inserted through the tail boom.

Rudder is built in two pieces—upper and lower portions. They are both cemented to the tail boom. The movable portion of the upper rudder is fastened with soft copper wire hinges. Balsa fillets are added to the top of the tail boom between the rudder and the top of the elevator.

Covering is conventional outdoor tissue. Water-dope before applying the usual dope. The grain of the tissue runs spanwise. No special finish is used other than three coats of dope.

Rubber motor is thirty strands of 1/8 x 1/30" brown. Make up the fresh motor to about 36" length. It will be about forty inches after the first few windings.

Flying and adjusting should be carried out methodically. The model needs practically no torque adjustment. If possible, the model should be flown with no wing incidence. The center of gravity is at the trailing edge of the wing. The elevator is set with about three degrees negative incidence. Adjustments are made by moving the wing. The rudder is set for neutral and the tab used for trimming.

Two models which I have made of this design were both lost on their first, fairly full-wound flight. In each case the motor was about seven eighths fully wound. (About five hundred winds with six hundred and fifty maximum.) The climb is steep and fast. The turn is right on the climb and the glide. On each climbing turn the model gained an altitude about three times the radius of the turn. With full winds the model should average two and a half minutes in still air.

It glides in about sixty-foot circles. The glide is slow and I attribute it to the fact that the vertical silhouette of the fuselage is at the same incidence as the wing. With the wing naturally seeking its most efficient angle of incidence, it brings the fuselage along with it to the same angle and thereby contributes to the lift. I won't attempt to estimate the altitude on the climb as I know I'm liable to overestimate. But according to the way we boys have been doing it in the past it is about four hundred feet.

After the elevator has been set, the only adjustment is moving the wing. However, depending on the model, the incidence or thrust may have to be changed. It should not be allowed to go into steep stalls because immediately after a steep one it tries to do an outside loop of about five hundred feet radius. To prevent this it should be test-flown in still air. Hand-launching fully wound is not to be encouraged.

Rubber lubricant is tincture of green soap obtained at drug stores. The finished weight should be just eight ounces.

BILL OF MATERIALS

Wing

4 pcs. 1/8 x 1/8 x 15", #1
8 pcs. 1/16 x 1/4 x 15", #2
30 pcs. 1/32 x 7/16 x 15/16", #3
4 pcs. 1/8 x 3/8 x 15", #4
1 pc. 1/16 x 7/16 x 9", #5
30 pcs. 1/32 x 7/16 x 15/16", #6
8 pcs. 1/64 x 1 x 15", #7
2 pcs. 1/8 x 1/4 x 4", #8
2 pcs. 1/8 x 1/2 x 8", #9
14 pcs. 1/32 x 7/16 x 12", #35
1 pc. 1/8 x 7/16 x 8", #36

Elevator

1 pc. 3/32 x 3/32 x 24", #10
1 pc. 1/16 x 1/4 x 24", #11
1 pc. 1/8 x 3/8 x 17", #12
6 pcs. 1/32 x 3/8 x 12", #13
2 pcs. 1/8 x 1/2 x 5", #14
2 pcs. 1/8 x 1/4 x 5", #15

Rudder

1 pc. 1/8 x 1/4 x 10", #16
1 pc. 1/16 x 7/16 x 15", #17
2 pcs. 1/16 x 1/4 x 9", #18
6 pcs. 1/16 x 1/4 x 6", #19
1 pc. 1/32 dia. x 2" copper wire, #37
1 pc. 1/32 dia. x 3" piano wire, #38

Fuselage

2 pcs. 1/32 x 2 x 12", #20
12 pcs. 1/8 x 1/8 x 36" (hard), #21
2 pcs. 1/16 x 1/4 x 8 1/4" (bamboo), #22
3 pcs. 24-gage wire x 7", #23
1 pc. 1/16 x 1 1/2 x 12", #24
1 pc. 1/16 dia. x 24" piano wire, #25
4 rubber bands, #26
1 pc. 3/32 O. D. x 1 3/4, aluminum tubing, #27
1 pc. 1 1/2 x 2 x 16", #28
1 pc. 1/32 x 7/8 x 3 1/2", #29
1 pc. 1/32 dia. x 8" copper wire, #30
1 pc. 1/8 x 1 1/4 x 9", #31
1 pc. 1/8 O. D. x 1" rubber tubing, #32
4 1/4" dia. copper washers, #33
1 ball-bearing washer, #34

Additional Items

4 sheets outdoor type tissue
6 ounces dope
90 feet 1/8 x 1/30" rubber
3 ounces cement

ABOUT LOCKTON PARK

Lockton Park is probably the only veteran modeler in San Diego who has not forsaken rubber for gas models. But his capable work goes a long way in making up for this lack of interest. Park is eighteen years old—started modeling about three years ago. 1936 was a big year. He made a flight of ten minutes with a rubber-powered model—which was the first soaring flight of any rubber model in San Diego. A few weeks later he made a twenty-two-minute flight with a stick job. The Junior record for stick models was only eight minutes at the time of this flight. In January, 1937, Lockton turned in a flight of one and a half hours in a flight from the flying field into town, a distance of nine miles, where the exact landing time was recorded by the person who saw it land. Only a while ago the model photographed for this article flew out-of-sight after thirty-five minutes on one of its first winder-wound flights. A rabbit hunter found this model about a month later.

Lockton Park would like to see increased rubber modeling activity on the West coast. Many modelers will agree with his thought that rubber-powered models still pack the biggest thrill. All model aviation on the West coast is gas except for some of the old champions like Henry Stieglmeier, Don Donahue, and Lockton Park, who stick to their first model loves. But the rest of the country shouldn't count the West coast out as long as such capable modelers remain active.

The plans of Lockton Park's Wakefield design were prepared by Gordon S. Light. —*The Editor.*

SCIENTIFIC MODELS WILL MAKE YOU "PLANE" CRAZY!

COMMODORE deluxe GAS MODEL

This new Scientific gas model has been designed by the well known "Eaglet" gas model designer, Ben Shereshaw. The "Eaglet" proved so successful that demands were made by hundreds of modelers for a larger model of this type by the same designer. Any inexpensive 1/5 horsepower engine such as the Brown Jr., Ohlsson, Midget, Gwin, Dennymite, Syncro, or any other reliable make motor may be used with success. Kit is 100% complete, including highest quality sheet and strip balsa, finest spring steel wire, all metal fittings, ignition wire. Complete kit, less wheels

Wingspan	6 feet	Airfoil section	Gottingen 549
Overall length	50"	Glide Ratio	16 to 1
Wing Area	5.2 sq. ft.	Rate of Climb	
Total weight with motor and ignition mounts	3½ lbs.	Approx.	700 ft per min

$6.95 Postpaid

Complete kit, including a pair of 3½" Scientific Pneumatic rubber wheels **$7.95** Postpaid

The New JITTERBUG Endurance Model

25" Wingspan
Length 20½"
Light Weight

FLIES OVER 1 MILE (6,000 FEET)

Here's another famous Flying Model originated and designed by Scientific. It speeds along the ground for a few feet, climbs into the sky—spirals up . . . and up . . . then gradually glides to a perfect 3-point landing! Look at that shapely wing—detachable, too!—that classy little cabin—streamlined nose—that graceful, thoroughbred appearance that simply spells "Class" and long flights. The construction is so simple that anyone with little or no past experience can easily build the "Jitterbug" in a few hours. Kit is complete with all materials including streamline wheels and a ready made propeller, full size plans and explicit instructions.

Priced exceptionally low. Complete kit ONLY 50c
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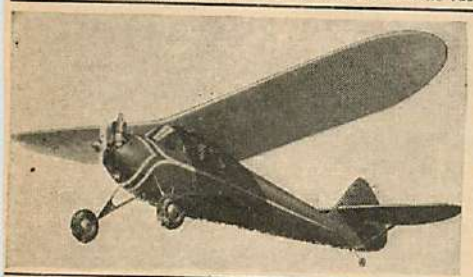
THE EAGLET for Small Gas Engines



Wingspan 44". Length 32" Flying Weight with Motor 17 ozs. Finest small gas model in existence. Kit is 100% complete.

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CONTEST ENDURANCE MODEL AIRPLANE

FLIES 2 to 3 MILES

So simple, even the beginner can complete the model in a day. This Model will clear the ground in a short take-off and climb with amazing speed. Every detail of the "Oriole" conforms with N.A.A. Contest requirements. Kit is 100% complete

THE BIGGEST KIT VALUE IN AMERICA TODAY!

50 inch Wingspan
OVERALL LENGTH 34"

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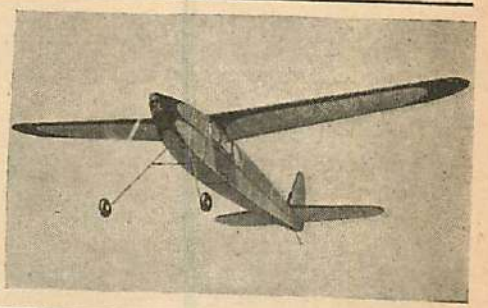

The STREAMLINER Gas Model

ft. wing, length 43", weight (less motor) 2¼ lbs. Complete kit less motor and wheels $4.95 postpaid. Price including pneumatic rubber wheels.

$5.95 POSTPAID

MISS AMERICA

Deluxe Gas Model

7 foot wing, weight (less motor) 2¾ lbs. 22 minutes on 1 oz. Climbs 800 feet per minute. Complete kit including pneumatic rubber wheels.

ONLY **$7.50** POSTPAID

Thousands sold at former price of $9.50.

RED ZEPHYR Gas Model

ft. wing, length 56", weight as motor) 2½ lbs. Complete kit ss motor and wheels Postpaid rice including pneumatic rub- r wheels POSTPAID . . .

$4.95

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BUNCH MOTORS

Mighty-Midget Uprt. Asbld.	$9.50
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All prices are postpaid. Including Propeller, S.A.E. 70 oil and Double Guarantee.

BRAT

Ht. 3¼": 15/32" Bore: 1/10 H.P Approx. 3 ozs $16.50 Postpaid

OHLSSON MODEL "23"

Small Bore Engine Ht. 3 9/16": ⅝" bore, 1/7 H.P. Approx. 4½ ozs. $16.50 Postpaid.

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Clear Nitrate Dope Colored Nitrate Dope. Nitrate Thinner. Gas Model Cement. Regular Cement. Bamboo Paper Cement. Banana Oil.

1 oz. bottle	$ .10
2 oz. can	.15
3 oz. bottle	.25
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1 qt. can	1.40

ROBOT TIMER

100% Accurate and Guaranteed. Price

$2.50

Without Automatic Attach. $2.00.

Ready-to-Fly Stick Models

25c POSTPAID

All the Thrills of Gas Model Flight

THEY LOOK, FLY AND SOUND LIKE REAL GAS MODELS

MISS AMERICA

GAS TYPE — RUBBER POWERED MODEL AIRPLANE

40" Wingspan, Weight 4½ ozs., Length 27½". Flies 1 Mile (5280 feet).

This is an exact replica of the full size Miss America gas model. Recently a Miss America gas model flew for 46 minutes on a motor run of only 27 seconds breaking all world's records for so short a motor run. This new small Gas Type Model has all the features of the large model. Can easily be built.

PRICE $1.95

Postpaid including a pair of M&M pneumatic rubber wheels.

GAS TYPE RUBBER POWERED MODEL AIRPLANE

The "FIREFLY"

Wingspan 36". Length 28". Weight 4 ozs.

The kit is complete. All formers printed on balsa; tru-pitch 10" balsa wood propeller; rubber lubricant; brown contest rubber; wire; washers; tissue, motor hooks; cement; and all necessary metal for building the ratchet motorhum effect; full size detailed drawings with explicit instructions. A real value. Order your kit now!

$1.95

Postpaid, including M & M Pneumatic rubber wheels

"SCIENCE-CRAFT" GUARANTEED KITS

50c each postpaid - - 20 inch wingspan

MONOCOUPE-90-A 50c

Waco Custom Cabin
Waco F-5
Waco "D"
Grumman Fighter
Curtiss Hell Diver
Mr. Mulligan
Curtiss Hawk P6-E
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VALKYRIE

GAS TYPE MODEL AIRPLANE

Flies ⅛ mile. 24" Wing. Length 13½". Complete kit

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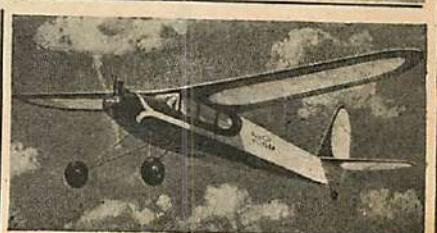


The FLEA

Gas type, rubber powered. Real motor sound. James Clark's Flea flew 10,000 ft.

Complete Kit Postpaid, including M & M Wheels **$1.95**

Add 15c postage on orders up to $1.50, and 10% postage on orders over $1.50. Orders over $4.00 are sent postpaid. Kits and motors are sent postpaid.

SCIENTIFIC MODEL AIRPLANE COMPANY

218-220-AT3 Market Street
NEWARK, N. J.

BOMBERS ABOVE

(Continued from page 19)

Spain. And the name most frequently heard in this controversy over bombardment is that of an Italian, General Giulio Douhet.

As early as 1909 General Douhet was talking about "mastery of the air," saying it would become more important than mastery of the sea. During the World War he criticized the Italian high command so severely for what he considered stupidity in regard to the use of aviation that he was sent to prison by a court-martial, only to be hailed as a prophet by 1918, and placed at the head of the Italian Central Bureau of Aviation. He was under-secretary for air in Mussolini's first cabinet, but resigned to study and write. By the time he died in 1927 military aviators the world over were quoting his famous dictum:

"To insure the national defense it is necessary only to insure to one's country the mastery of the air." To gain this mastery one must destroy the enemy's planes, in the air, on the ground, and in factories and depots. And this, he said, could be done only with bombing planes.

Thousands of them. The air army, the dominant arm of the nation's fighting machine.

With mastery of the air, that is, with a strong air force and the other side kept out of the air, Douhet believed that the enemy's will to resist could be broken, and surrender obtained, independently of land and sea operations.

The economic life of the enemy would be paralyzed with demolition bombs. Transportation would be stopped by bombing railroad and highway bridges, gasoline refineries, wharves, docks, canals and ships in port. Electric power stoppage would halt a great deal of manufacturing, and factories would be bombed. Water supplies would be cut off from the cities. With the morale of the people broken by this terror from the skies, surrender would be quick.

Douhet's nine principles of warfare are reflected in the policies of the nations today. He advocated an independent air army, of offensive and reconnaissance planes. We have our GHQ air force, with its bombardment, pursuit, attack and reconnaissance squadrons.

He said the best defense against air attack is offense in the air—and the nations buy more bombers.

He said the air force must be made ready in peace—and that is becoming more true as planes become more complex and time to build them and to train pilots becomes longer.

He said the strength of the air army should be limited only by the national resources. And England begins expanding her air force by four hundred percent, whereas other arms are being merely doubled. In a major war every wheel and nerve would be strained in the production and operation of planes.

But General Douhet's ideas have come in for a lot of criticism, too. It is now said that the Spanish and Chinese experience shows that bombs can't break the will of the enemy, or, for that matter, paralyze the enemy economic life. After two years supposedly at the mercy of Franco's friends' bombers, Madrid's street cars still run, her people go on living amid the ruins, and are now looking forward to a sort of boom of plenty when the new railroad from the coast is completed! In the meantime the city's million or so people who didn't run away, together with the defending forces, have been supplied over one highway, despite bombers. The road is repaired and trucks move at night.

In China it is much the same. And General Malin Craig, our chief of staff, tells a Senate committee that bombarding civilians does not break the morale of the fighting forces. Even Mussolini announces that Italians scorn the bombing of civilians as a military measure.

But—Douhet was right when he took it for granted that a plane bombed on the ground will never fly; that gasoline which goes up in one big boom will not propel enemy bombers, and that man power and resources spent on keeping railroads running, rebuilding factories, and even partially defending cities cannot be used in a front-line offensive.

As to the purely economic results of bombing, however, there is still dispute. Costly damage has been done in the Spanish and Chinese zones of the interior, and the fact that transportation is able to continue does not disprove the Douhet theory. For only a few hundred bombers have been used, and Douhet envisaged thousands. Moreover, neither Spain nor China is a highly industrialized, and therefore vulnerable, country. Much military equipment, including all airplanes, have come from outside.

Yet the predominantly losing sides, China and the Spanish Loyalists, have had the most man power, and the tide of victory has gone to the side with superior air strength most of the time. None will deny that air strength has been tremendously important, if not decisive. When the Loyalists had air supremacy (though not mastery) for a time last year, they won the spectacular victory over the Italians at Guadalajara, in which planes pounced on men, trucks and other equipment confined to narrow roads by mud, riddled them with bullets and fragmentation bombs.

That, of course, demonstrated the power of attack aviation tactics—a great lesson of the war. But the heavier demolition bombs, which are the particular weapon of bombardment aviation, have also been effective in Spain and China, though the scarcity of vulnerable objectives of a true military nature in relatively nonindustrial countries means that a true test of modern bombing is yet to be made. The truth is as usual probably between the extremes. Douhet exaggerated, and his detractors have done likewise.

Returning to this matter of death over the cities, one may ask why, if it has been shown that a people cannot be terrorized into a quick surrender, do women and children continue to suffer, and why does England, for example, prepare for raids on London? And most important, can we expect our cities to be bombed in case of war?

Within the past year all the great nations not in the current fights have condemned the recent bombings as barbarous. It has been made clear that it is not the policy of the United States. Great Britain, somewhat embarrassed by her "police" bombing of various independent-minded folks in her colonies, has offered to quit if everybody else will agree to quit for good.

The Hague convention of 1907 forbade various kinds of bombing; the World War paid no attention. The International Disarmament Conference six years ago discussed a specific prohibition of aerial bombing, but it fell through. If there were a specific international law on the subject it goes without saying that it would probably amount to little in a modern war. If treaties were observed we wouldn't have a war.

If we had a rule, it probably would not forbid the bombing of military objectives. These were defined in 1907 as including military works, military or naval establishments, depots of arms or war materials, workshops or plants which could be utilized for the needs of the hostile fleet or army, and men-of-war in harbors.

And if a rule not barring such objectives as targets were observed, one is given pause by the realistic remarks of Mr. C. G. Gray, the English authority, which were doubtless applauded in air force headquarters all over the world as explaining the dilemma of the really humane air soldier.

Mr. Gray, after some facetious remarks to the effect that there are no noncombatants in a modern war, for everybody ought to be helping his country win, and if not, he ought to be bombed for not doing it, went on to point out how "military objectives," especially airplane and munitions factories, are always surrounded by workers' homes.

In Spain it has been repeatedly found that bombs which killed women and children had missed what is ordinarily considered a legitimate target. As for warnings in advance, one high-ranking air corps officer to whom I talked recently remarked that in this day of rapid-tempo fighting, it can't be done. It would be folly to call the pursuiters and the mobile antiaircraft. Civilians near objectives must stand warned.

Of course, like the mothers and babies in the nursery across the street from the stored gasoline in Barcelona, they may not be warned by their own side.

Cities as such, and civilians as mere citizens of the enemy side, will probably not be bombed much "deliberately." The reason for this was clearly stated when Admiral Arthur B. Cook told a Senate committee that the bombing of cities is a losing proposition. In spite of the spectacular damage to cities in China and Spain, the fact remains that it would take twenty-five hundred large bombs, properly spaced, to demolish a square mile of area. They can't be properly spaced; many fall in streets and do little damage. And such bombings, the admiral concluded, arouse more opposition than terror.

But the military objectives in cities would undoubtedly be targets of enemy raiders, and every miss might hit a home. These might not be counted misses altogether, however, for the danger to civilian population stimulates defense measures like nothing else, and keeps the industrial and other workers awake and anxious (even if not panicky) when they ought to be resting. A survey of sixty-six out of one hundred and forty German cities bombed during the World War showed that the cost of protection and losses in factory production amounted to one hundred and fifty-seven million marks, when only thirty-five million marks of actual material damage was done.

Yes, it looks as though our industrial population centers would be attacked, even in an unlikely war fought by the old-time rules, in which bombs would be *aimed* at military objectives only, but would fall all over the landscape. AA guns shoot five miles high now. And balloon barrages can be sent up to four miles or more. And what with dodging around to confuse the AA gunners, with jittery pilots and bombardiers, bad weather and what not, accuracy with even the best of modern bombsights is far from perfect, from five miles up.

Thus it is easy to see what the most important military objective would be upon the outbreak of war. The enemy's bomber fleet would come with its tons of destruction, and against it we would throw all the might of our air arm. Our attack planes would not have the range to go far enough to bomb them on the ground. Our pursuit and multiplace fighter squadrons, built for high altitude, would do their best, but it would not be enough. We would have to depend on our long-range bombers, for they have become literally the first line of our defense. Whether they belonged to the army or the navy would make no difference, for plans have already been worked out under which the army's flying forces would be at the disposal of the navy, or vice versa, depending on whether the need were greatest by sea or land.

The bomber is the first defender, for it can reach the enemy quicker and farther away than any other weapon. And it is the weapon most likely to stop air raids, for it is the only weapon that can go and blast the invading war dragons in their nests, whether those nests are on land or sea. Fire must be matched with fire, of the same variety but hotter if possible and more of it.

Pursuit aviation can help. But the Spanish war, among other lessons, has confirmed what military men long ago suspected. Pursuit cannot be depended upon to defend a frontier or coastal area from attack by bombers. Modern bombers are too fast, and warnings have to come from too far away.

Incidentally, Britain's and France's solidarity today is largely due to that fact. Britain is concentrating on bombers, whose bases France will try to guard with pursuit against raiders crossing France. London knows its own pursuit can't defend it today. And Britain with her longer range bombers will try to bomb the enemy air bases beyond France, thus protecting both. Thus Britain is protected by both bombers and pursuit, but France, or at least parts of France, only by Britain's (and her own) bombers.

As for us in America, our France is our coastal areas, containing almost all of our aircraft factories and many other important industries, our national capital, and our chief financial centers. Our Britain is our interior, which pursuit can do much to protect. But as to our coasts—

You are the commander of a squadron of 350 m.p.h. multiplace fighters, on the alert at Mitchel Field. You know that a "coalition of enemy powers" has gotten all-fired tired of American airplanes being supplied to another coalition they are fighting in an undeclared war. These powers are going to bomb either Grumman or Seversky on Long Island, or Sikorsky at Bridgeport, Connecticut, or Martin at Baltimore, or, more alarming, one of our two all-important engine factories, Pratt & Whitney at East Hartford, Connecticut, or Wright at Paterson, New Jersey, all military objectives of the choicest sort. Or if for some reason they don't bomb one of these objectives they may let rip a few over Washington and drop a note on the White House lawn saying, "Please sell enemy no more airplanes."

You, the pursuit commander, figure your chances. It will take you thirty minutes after the warning to get off and up to twenty-five thousand feet. That's time enough for the bombers to travel one hundred and twenty-five miles at cruising speed. If you climb toward the bombers, twenty-five miles must be added to make one hundred and fifty, the distance away the bombers must be when the warning comes if you are to have even a remote chance of meeting them as much as twenty-five miles away.

If you were unbelievably lucky enough to get the warning from some ship at sea, and incredibly lucky enough to actually meet them twenty-five miles away, you would have only six minutes to fight before they reached their target—for they would fly steadily on while you and their flexible cannon exchanged one-pound explosive shells—or bigger ones.

You probably wouldn't get enough warnings from off-shore to tell you where to fly, for the bombers would change course before they arrived, perhaps several times. If it were at night you would never find them, and would have to stay within range of your own searchlights, and then you would interfere with your own AA guns, and at best wouldn't have time to shoot down more than a few of them before the rest laid their eggs.

Even if it were a day raid you would be very lucky to meet them on the nose. At a meeting speed of some 600 m.p.h. you might miss them completely on a hazy day. If you saw them off to the side, or after they had passed, with a speed differential of only 60 m.p.h. or so, you could overtake them six miles in six minutes, and that means you would catch up just over the target. You could watch the bombing, hooray, and from off at the side if there were antiaircraft guarding that objective.

Then you could chase them, after they had done their dirty work, and perhaps shoot down some of them with your air cannon. But their defensive formation would probably have more air cannon than you, although on flexible mounts they probably wouldn't be as accurate as your fixed cannon for diving attacks. But they could hold you in their sights longer.

They also might be escorted by a convoy of large aerial destroyers, such as were advocated by Douhet and are championed by the more recent theorist, Lieutenant General N. N. Golovine. These machines would have more speed and tremendous fire power instead of bomb loads. They would form a protective formation above and behind the bombers, exactly blocking your only satisfactory approach, and proceed to test out General Douhet's theory that superior fire power in the air can always whip the speed and maneuverability of pursuit. While you were fighting the convoy planes the bombers would lay their eggs. Speeds would be too great to permit successful diving attacks from the side or front.

If the bombers were headed for some point far inland, you could probably do a lot of damage to them before they reached their objective. But it is apparent that for the defense of our strategic seaboard areas, pursuit is a frail reed upon which to lean. We might keep pursuit planes in the air a hundred miles out all the time, or perhaps navy patrol planes could detect the approach of bombers and radio fighter aviation on a line of carriers extending a thousand miles up and down the North Atlantic. And then some would slip through—first to the carriers, the most vulnerable of targets, and then the rest of the way without difficulty.

There is simply too much space to watch, just as there are too many objectives to guard with AA guns, marvelously improved though the best of them are, as demonstrated in Spain.

But bases from which those long-range enemy bombers might come would be relatively few. Whether they were from enemy aircraft carriers, tenders which had refueled and loaded seaplanes with bombs in midocean or some hidden cove off Newfoundland; or bases on the mainland of Europe from which such planes as are being built today could fly to America and return with at least a small load of bombs—it would be the duty of our bombardment aviation, both army and navy, to bomb those bases immediately, if not before the first raid, then certainly as soon as the bombers returned.

That is why we must have planes which can fly as far or farther and with as heavy or heavier loads than the best ships possible enemies have. And it would be well for us to have planes which could bomb the enemy airplane factories and depots and training establishments far inland, and return to our shores without landing. The "coalition of foreign powers" the tactical students talk about might after all cripple our navy in that first big battle and thereafter be able to keep our aircraft carriers off the sea. And whether battleships can be sunk by bombers or not, even big navy men admit that aircraft carriers can be rendered useless by bombers, as can seaplane tenders, small ships.

Douhet may have been wrong when he said "mastery of the air" could stampede a panicky opponent into defeat. But his error was chiefly in exaggerating the effects of totalitarian bombardment. No one has successfully denied that mastery of the air will determine *who is to be bombed.*

It seems inevitable that the outbreak of a war between two major air powers within reach of each other would inaugurate, as General Douhet predicted, a battle for mastery of the air, with emphasis on bombing each other's planes and factories on the ground. Both sides would suffer tremendously, just as both the English and German navies did at Jutland.

The nation that won that thunderous checker game would be in shape to build up a new great air force. At the same time it could, if it emerged from the first big battle with a fairly strong air force, prevent the loser from building his up again.

Then the men, women, and children in the cities of the loser would become the mangled guinea pigs on whom General Douhet's theory would finally be tested.

That's why Uncle Sam is going to have lots of men on the board when and if a game starts—aerial men of war, with long wings, to reach far out and blast the dragons in their nests.

GLIDING

(Continued from page 31)

gull wing and the straight wing, which is the same in every respect except for the gull. The deluxe features are ball-bearing control surfaces, plexiglass molded cockpit inclosure, hand-rubbed paint finish and upholstered cockpit. Universal Gliders also manufactures two-place gliders and renders stress analysis and special design services.

CLUB NEWS

Eliot Noyes helped organize the new Schussverein Soaring Club at North Conway, New Hampshire. The Schussverein is a skiing club, and the recent successful soaring flights of Lew Barringer in New Hampshire impressed members so much that they enthusiastically joined the movement. The S.S.A.'s Ross *Ibis* ship is now stored in North Conway in order to conduct further soaring tests during the skiing season.

There is a movement to organize a New England soaring center in the region of North Conway, and already a number of glider clubs in New England have voiced their desire to use it as soon as it is developed.

Kurt Sie non writes from Chicago that the members of the Soaring and Gliding Club of that city are building a new sailplane. Kurt has been giving them some flying instruction. He is also designing a sailplane with a wingspread of forty-three feet. Another group with Bob Blaine is constructing a Goeppingen Wolf.

Eugene Kettering, son of "Boss" Kettering, vice president of General Motors, has become a life member of the S.S.A. Young Kettering has the best collection of model airplanes in the world, about three hundred and forty altogether, and is now anxious to start a collection of sailplane and glider models.

Out at Inglewood, California, Roland Hall, flying his Franklin Aeolus, qualified for his "C" license with a flight of fifty minutes, during which he reached an altitude of over three thousand feet above take-off point. Another one to qualify for his "C" the same day was Fred Smith, with a flight also of fifty minutes' duration.

At Muroc Dry Lake one afternoon Volmer Jensen reached an altitude of four thousand eight hundred feet and stayed up two hours in his Soloflugen.

In the December issue of *Soaring* appeared a rather interesting short article based on a clipping sent to the S. S. A. entitled "Gliders Used A Thousand Years Ago."

To quote: "Gliding was practiced in Bengal, India, more than one thousand years ago. Abdul Kuasim Abbas bin Firnas, who died in 888 A. D., built and flew successfully the forefather of the modern glider. This was reported to the Royal Asiatic Society of Bengal by Mr. Hidayet Hosain in Calcutta. A reliable historian stated that the inventor attached two wings to his body, and getting on an eminence flew to a considerable distance. But, while alighting on the place whence he started, he was hurt, an occurrence which he avoided in later flights."

And we were always under the impression that gliding was a modern sport!

THE GLIDING AND SOARING MANUAL

The long-awaited "Gliding and Soaring Manual" has been brought out at last by the Soaring Society of America. The book was compiled by Gustave Scheurer, Prof. R. E. Franklin, Arthur Lawrence, Richard C. duPont, Lewin B. Barringer, Henry Wightman, Theodore Bellak and Dr. Karl O. Lange, and was published by the Stone Aircraft Company of Detroit, Michigan. It ought to be of real interest to all those interested and active in the sport, as its seven chapters cover the following subjects: The Glider and Its Parts, Flight Theory as Applied to Gliding, Gliding and Soaring Equipment, Launching Methods, Primary Flight Training, Primary Soaring Instructions, Soaring Meteorology, and Safety Precautions. The manual is readily understandable to the layman and has many detailed sketches and photographs illustrating the text. The price of the book is one dollar, and it is obtainable from the Stone Aircraft Company, Box 57, Detroit, Michigan. It is given free to each member of the S. S. A. whose annual dues are paid up for the year 1939. (Five cents in stamps should be added to the dues to cover cost of mailing the manual.)

WANT A JOB IN AVIATION?

(Continued from page 25)

hours of flying time has a great deal of trouble in finding a flying job. *He* may think he is pretty good, but he is competing for jobs with men who have had five hundred or one thousand or more hours.

Pay for such work varies from almost nothing up to wages as high as air-line pilots earn. Some pilots are so anxious to fly that they work for almost nothing. Others get twenty-five dollars or fifty dollars or one hundred dollars a week, depending on the amount of flying they do.

There are a great many more jobs on the ground than there are in the air. Unless a boy has quite a little money to spend for flight training, it is sound advice to say, "Keep your feet on the ground!" It doesn't cost so much to learn to fly—especially in a flying club—but it costs money to build up your time. Ground jobs are easier to train for and there are a lot more of them.

A few years ago a man could say that he was an aviation mechanic and you would know about the kind of work he did. But today there are many sorts of specialists, all under the general classification of aviation mechanic. In the air lines, for example, there are mechanics doing several kinds of work. At the principal maintenance base some mechanics work only on engines, others on sheet metal, radio, electrical equipment, wheels and brakes, instruments and other such divisions. At other airports along the line, mechanics are generally all-around workers, trained to maintain and service any part of the ship.

Basic requirements for these jobs are much the same on all air lines. Boys who are high-school graduates and who already have their two mechanic's certificates get preference. If they have had some mechanical experience servicing private ships, so much the better. If a boy has only two years of high school, he must offer worth-while aviation experience to make up for not having a high-school diploma.

The reason that air lines can demand four years of high school and additional aviation training as well is that so many boys apply for these jobs. Whenever a job attracts a great number of applicants, the employer can raise his standards and still get men for the job.

At airports where private planes are serviced, entrance requirements are about the same as for air-line work. Occasionally a young man who has had machine shop, auto mechanics or other trade or high-school courses in which he has learned to use tools, can walk right into a job. But an airport manager or hangar foreman has applicants for jobs nearly every day. Adjoining most busy airports there will be an aviation school which is turning out graduates who have their aircraft mechanic's certificates as well as their engine mechanic's certificates. If the school gives a thorough training, the airport manager knows it and prefers to take mechanics with such training.

Many large airports have hangars which offer specialized services. A repair business will be set up which services nothing but engines, another will specialize in propellers, or radios or instruments. Mechanics working in such shops do not need to know all other phases of the work.

There are about three thousand five hundred mechanics working for the air lines, and while their average pay is about one hundred and fifty dollars a month, starting pay is usually about forty or forty-two cents per hour. Outside the air lines there are approximately six thousand mechanics who work for wages from thirty cents up to over a dollar an hour.

Work in aircraft and engine factories is basically different from maintenance work at an airport. Building airplanes is similar to building automobiles, while maintenance work can be compared with doing repair work in a high-class garage.

Qualifications are not the same for beginning jobs in all airplane factories, but as a rule employment managers prefer young men who are high-school graduates and who have had some special training. When a factory gets a large order and needs to put on a lot of men in a hurry, employment standards are not quite as rigid as they are during ordinary times. Factories like to find young men who have studied chemistry, physics and mathematics in school and who, somehow or other, have also found time to take some shop subjects such as machine shop, auto mechanics, wood turning and perhaps sheet metal. Usually these subjects can be combined into one course only in a technical high school. If there is a good technical high school in your town you are lucky. Only fairly large cities can afford the equipment that is needed in such schools.

If you are in high school now and cannot combine shop courses with your general course, you can make up the lack by getting a summer job in a machine

About the SOLO CLUB and how to become a member

Feeling that there is a definite need for a means of recognizing those pilots who have experienced the supreme thrill of their first adventure alone into the blue on man-made wings, Air Trails has formulated and founded the SOLO CLUB.

This club is open only to those who have actually made a solo flight in heavier-than-air craft, either motorless or powered. It does not matter when or where such flight was made. Applicants must furnish the membership committee with satisfactory proof of their qualification for acceptance. There are no dues. Once a member, always a member.

To obtain your sterling silver SOLO CLUB lapel wings and life membership identification card, comply with any of the following requirements and sign. Send with fifty cents to the SOLO CLUB, Membership Committee, Air Trails, 79 7th Ave., New York City.

Proof of Qualification as a SOLO CLUB Member

1. Dept. of Commerce license and number if held
2. F. A. I. license and number if held_____

Or attach any of the following:

3. Evidence of military or naval air corps service.
4. A letter from your instructor testifying to your solo flight, giving his rating and license number.
5. A notarized statement, preferably with witnesses, giving all details and data of solo flight and plane used.

In submitting the above for membership in the SOLO CLUB, I certify my willingness for the Membership Committee to investigate my application.

Applicant_____ **Age**_____

(please print)

Street_____ **City or Town**_____ **State**_____

shop or in some other plant where precision work is done. Most high-school students can manage to secure at least one shop course before they graduate. Mechanical drawing is of importance. Even if a worker does not draw plans, he has to read blueprints. Knowing how to operate a lathe and other machine tools is always an asset.

The ideal preparation for getting a factory job is to finish high school and then go to an aviation school that makes a specialty of training men for factory work. There you would get some drawing, plenty of blueprint reading, sheet-metal work, machine-shop training, welding, riveting, and other basic subjects. Many boys who have completed such a course in a good school are employed in the sub-assembly or assembly departments and find their work more interesting than that in some other departments. But school training must be up-to-date and very practical if it is worth the money.

Large factories are divided into many different departments and men are employed for each department as needed. When a factory is busy the foremen have little time for training new men. Therefore the employment manager prefers to get men who have had some training or experience. Sheet-metal workers, welders and riveters are usually in demand.

Qualifications vary from factory to factory. If you live in the general vicinity of a factory where you hope to get a job, call there to talk with some one in the personnel department and ask him what the requirements are. Then you can prepare yourself for them. But don't make the mistake of thinking that anyone who has had a machine-shop course can get a job. Every part of an airplane is built according to exact specifications, often measured to a thousandth of an inch or less. There is no such thing as "approximately right." Work in some of the large factories turning out military orders is checked and rechecked by government inspectors. Men work with an attention to detail that is found in few other jobs. Employment managers must select men who have the makings of skilled craftsmen.

Beginning pay in factories runs from thirty-five to forty-five cents an hour. A man with especially good training or with work experience gets more to begin with than others. Some factories increase their new workers three cents an hour every three months until a wage of fifty-five cents is reached, then further advances depend upon the skill of the worker.

The chief disadvantage of factory work is that it may be seasonal. Some of our famous aircraft factories have huge back-logs of orders which will keep them busy for some time. Others get an order which must be finished rapidly and for a time the factory may employ men for three shifts. Then, as the work is completed, two shifts are laid off. While the aircraft industry is not unique in being in this situation, seasonal work is a possibility that all young men must think about.

Manufacturing is now the largest branch of the aviation industry. Approximately forty thousand men are employed, and a conservative estimate would place the increase at from five thousand to seven thousand new jobs each year for the next few years. But always remember that you are competing with a great many other applicants and that requirements are high.

Another field of work that is attracting many young men is that of radio operating. Anyone who follows air-line activity knows how important the radio operator is. Many boys who are amateur operators feel they could qualify for an air-line job. A high proportion of the six hundred air-line operators started that way. But somehow they managed to pile up a lot of experience before getting their job. Radio operating is an attractive kind of work and many young men have prepared for it. New York, San Francisco and other seaport towns are filled with operators wanting jobs on ships. Unsuccessful in such hopes, they turn to the air lines. But an air-line operator must be tried and tested. He must be able to operate at great speed, be a fast typist, have a good speaking voice, know how to maintain and repair his equipment and above all else, keep a cool head in a crisis. As a result, men with navy experience get the preference. Pay averages about one hundred and forty dollars a month.

Meteorology is another field of work which requires specialized training. There are less than one hundred meteorologists working for American-owned air lines and undoubtedly every one of them had some training in weather forecasting before he secured his job. The meteorologist has a responsible job and must be trained thoroughly for his work. Many forecasters on the air lines today learned their work while employed in the Federal weather bureau. Others studied at M. I. T., California Tech., Parks Air College or perhaps at the Naval Air Station at Lakehurst. This is a kind of work for which a college diploma, or years of experience, are necessary.

Air-line dispatching is another job of growing importance. A few years ago almost any clerk in the operations office could give an O. K. to dispatch a flight. But these days a dispatcher is a real expert. He must be licensed by the Civil Aeronautics Authority, which means that he must be at least twenty-three years of age and have passed a

comprehensive examination on weather information, knowledge of radio operations and many other points pertaining to aircraft and air-line operations. Many dispatchers are pilots and know their work from first-hand experience.

Many young men contemplating jobs in aviation think only of flying or mechanical jobs. They overlook the many positions in the business departments. The most apparent business jobs are in the sales, or traffic, departments, which make up one of the fastest growing divisions of the lines. Men who make reservations, sell tickets and go out to sell air travel to business men have usually had some college training. If they are not graduates, they probably have had some type of sales experience which enables them to qualify for the job. Retail-selling experience is not of much value. If you want to get an air-line sales job eventually, go to a college giving sound courses in economics, transportation and other business subjects, and learn all you can about the business end of aviation. Two or three private aviation schools have excellent courses along this line, and if you have only a year or two to spend after high school, you would be better off going to a good private school than to a regular college.

Other jobs in the business departments are those in bookkeeping and accounting, purchasing and various kinds of clerical jobs. Requirements and pay for such work is about the same as for similar positions in any large firm.

Many of the stewards now employed had club or hotel experience before signing up with the air lines. The employment managers look for young men who have had experience giving personal service to the public. Personality counts for a great deal. Speech and appearance must be pleasing. One line accepts only men who are between five feet four inches and five feet eight inches in height, between one hundred and twenty-five and one hundred and fifty pounds and between twenty-five and thirty-five years of age. Ability to speak more than one language is an asset and stewards flying to South America must know Spanish. There are only one hundred and twenty-five jobs of this kind and the turnover is small. Consequently competition is keen. One word of warning is necessary. Don't try to get a steward's job in the hope you can learn to fly, or get some other job on the line. Transfers are seldom made as stewards are hired who expect to remain in that kind of work.

The U. S. government employs about three thousand persons in aeronautical work. There are so many different kinds of jobs that it is impossible to describe them here. Some are under civil service and are secured by taking examinations. Others are appointive. With only a few exceptions, experienced workers get the jobs. The bulk of government work in aeronautics is in the Civil Aeronautics Authority, but there are aviation positions in the weather bureau, forestry service, National Advisory Committee for Aeronautics, bureau of standards and elsewhere. Both the army and navy employ civilians for several kinds of work. Requirements for many of these jobs are put up on the bulletin boards of post offices.

Another kind of work which gives jobs to about four hundred men is parachute rigging. 'Chutes must be repacked at regular intervals, but only licensed riggers are permitted to do the work. When a parachute is packed, it must be packed with great care and the rigger must follow directions exactly.

A parachute rigger must be at least eighteen years of age, of good moral character, must have packed at least twenty 'chutes under supervision of a certified rigger and must pass an examination on his ability to pack, repair, inspect and maintain all types of parachutes used in this country. One rigger can take care of all the work at a large airport, which means there are not many opportunities in this kind of work.

This has been only a brief description of some of the more common jobs in aviation. The writer has found that even in a four-hundred-page book he did not have space to describe all the many aeronautical jobs completely or give the entrance qualifications.

After surveying all the jobs in aviation and talking with employment managers at airports and factories, the best advice the writer can give to young men wanting aeronautical careers is this: Get the facts about the job which interests you. You may think you know the entrance qualifications for a job, but make sure you do by reading all you can find about jobs. Then go to airports or factories. Talk with men in the business whenever you have a chance. Ask them about training. Then set out to get the training that is necessary for the job. If you plan to go to a commercial aviation school, get catalogues from several schools. Visit them if you can. Choose your school carefully because the better the school, the better your chances of getting a job.

A word should be added about mechanical training in the army and navy. Both services give training of the highest standards. But don't enlist in the hope that you can get a transfer to some branch of the flying corps. In both army and navy the flying services are tremendously popular. Some soldiers and sailors with excellent records have been on the waiting lists for two years or more. There are two exceptions. The army air corps has a school at Chanute Field, Rantoul, Illinois, and a new army school has been started at Denver. Each school accepts high-school graduates direct from civil life. If you can get into either school you are assured of being assigned to duty in the air corps if you can complete the training. You must be eighteen or more years of age, and in good physical condition. Enlistments are for three years. For applications write to the assistant commandant at Chanute Field.

Aviation is an industry that is growing steadily. There will be new jobs every year. But if you want to get one of them, don't trust to luck. To get a job you must be better prepared than the bulk of the applicants. Air lines and airports get a steady stream of young chaps looking for work. Only the outstanding applicants find employment. If you want a job, prepare yourself for it.

Many boys hoping for aeronautical careers today will not be able to make the grade. Perhaps they will not have the money to spend for special training. Others will find they need to go to work immediately after finishing two years of high school, and there may be no aviation factories or large airports near their town. But if they have a real desire to know more about airplanes and to learn to fly eventually, there is no reason why they need to make a *career* of aviation. Nearly any young man can save one or two hundred dollars. He can learn to fly, either at a private school or from a flying club instructor. Then he can join a club and get in some flying every week. Hundreds of clubs are now organized and everyone is having a swell time.

Taubman LC-13 lightplane, powered by 75 h.p. Rover.

LIGHT PLANES

(Continued from page 28)

somewhat if and when our manufacturers can be assured of regular orders and a higher output, but the prices will be lowered because of savings made in the purchase of raw materials, not in cheap, fast production.

We of the light-plane fraternity are demanding plenty, too. We have gone beyond the forty-horsepower job and we won't accept open cockpits of the helmet-and-goggle days. We want side-by-side seating, automobile-sedan comforts inside, and instruments worthy of our proposed aërial adventures. Those I talk to are all through with the greasy-cockpit game, bare wires, and sitting on the floor. They have discovered that learning to fly is not the great problem they had supposed, and now that they have learned, they are not going to be shoved off with the old harum-scarum outfits the manufacturers were putting out a few years ago.

"If we pay fifteen hundred dollars for a plane we expect the same amount of comfort and appearance class we get in the automobile," they have said, and in no uncertain tones.

They'll get it, too, but they won't get it as cheap as it can be given by the automobile manufacturers.

Another interesting item brought out by Mr. Wright was the fact that while the cost of manufacturing fuselages had dropped during the past few years, the cost of building wings had increased considerably. This, of course, refers to the welter of slots, flaps, de-icing devices and the fact that many carry the retractable landing gear housing.

In other words, our light planes as well as the fighters and transports are entering the gadget era, and we shall have to pay for it.

Another matter that might be taken up here is that of the variable-pitch prop for the light plane.

No doubt such a device, if there were one, would have its uses, but as one enthusiast has said to me so many times: "If we keep on demanding everything the big jobs have, we shan't be in the light-plane category any more, and we'll be back where we started years ago."

But unfortunately there are many light-plane owners who want all these things, and if they squawk loud enough they'll get them. The variable-pitch prop, of course, was originally designed for planes carrying high loads and which demand certain pitch values on take-offs.

The variable-pitch prop at best is a very expensive luxury. I do not know the actual facts on prices, but they run from three hundred and fifty dollars up to two thousand dollars, and there are very few suitable for the modern light plane when we consider the weight factor involved. Just what any light-plane owner can expect to get for *his* money is something of a mystery.

STICK WITH WEBSTER

Some time ago we were telling you that things are to boom for the light-plane man soon, and we were right—for a change. Grove Webster, who took over the recently created private-flying section of the Civil Aeronautics Authority, plans a great improvement in private flying conditions.

Webster has been instructed by the Authority to specialize on the establishment of uniform and more thorough ground school and flight-training programs. He has also been advised to maintain close contact with private fliers throughout the country through an intensive field-work program so that the Civil Aeronautics Authority can maintain constant touch with the problems and the needs of the private flier.

Webster is one of the finest birds to stumble into such a job, and one of the few men in the country capable of handling it, and you need not be surprised to see him pop up from under your rudder pedals any day with requests for suggestions.

Just what all this has to do with the future of private flying as it affects national defense is quite another matter. But those in the know are of the opinion that all private flying will get more satisfactory assistance from the government, because at last someone is beginning to realize that some day we shall need all the pilots we can get our hands on, and volunteers from the light-plane ranks will be of more use to the air strength of the country than all the white-haired boys out of the universities who have the "right connections."

Light-plane men, as we have said so many times, will be able to fit in quickly. They will be over that "horrible" first-fifty-hours' period, and with very little instruction be able to take over some of the more stable of the military types. This may draw an argument, but I have been told that already a number of members of the British Civil Air Guard have passed on through their "A" license training and, with startling efficiency, have actually flown a number of Royal Air Force planes that have been turned down as obsolete. Now there may be a great deal of difference between a Curtiss P-36A fighter and a four-year-old Douglas observation, but we wish we had ten thousand pilots who were capable of flying the latter type.

Here is a point Mr. Webster might look up.

In the next few months a lot of air-corps squadrons will be getting new equipment and their old jobs will have to go somewhere. Some, of course, will be sent to the training schools, but there will be a lot left over at that. Why not provide a central training school for private fliers where they could get a few hours in on some of these so-called obsolete models? There will be dozens of two and three-seaters available for such work, and there is no reason why some system could not be devised whereby much of this could be used in giving volunteer pilots a few hours' experience, at least. There's no telling what a few hours might bring out.

Each State could have a civilian training depot where volunteers could be given time on certain multiseat ships, so that in an emergency they could be quickly commissioned, trained quickly and prepared for posts with active service squadrons. Such a plan, at least, would weed out, months ahead of time, all those unfit for such duty.

WEATHER GUIDE FOR THE AIR PASSENGER

(Continued from page 23)

layers of air. The troposphere, extending up to about six miles, monopolizes the storms, ordinary winds, rain, snow and other common weather products. Beyond, the stratosphere is the domain of roving air masses, which experimental meteorology now is feverishly probing.

Whirling movements of air or wind in the lower atmosphere are the immediate makers of weather. They are known as cyclones or anticyclones. The weather man usually refers to them as highs and lows. The one moves in clockwise fashion, the other conversely. Weather changes result chiefly from disturbances caused by differences of pressure exerted by these air movements.

They don't come from caves, either. They are bred at the equator. There the water and land surface are so strongly heated that the surrounding air rises and flows toward the poles. As it does, it gradually sinks and eventually drifts back at the earth's surface to the point of origin.

As you speed along in the plane you may notice that these winds blow at any angle to the horizon; some up and down, as thunderstorms. Most rain is due to such rising air, which cools by expansion and condenses its moisture. When these air currents surge up with force and shatter the raindrops, lightning results. It occurs from the drops being charged with positive electricity and the adjacent air with negative electricity.

The key to the circulation of the atmosphere is the cloud. It is a natural weather vane of the upper air. Peer closely from your cabin window as the glistening wing brushes the fringe of a vapory mass and you'll see that it is only fog. It has the same characteristics as the ground variety.

It consists of water droplets, ice crystals or plain dust, condensed from the cooling of the rising air. Wind-borne moisture constantly changes its pattern of distribution, but its typical forms are the same everywhere.

Contrary to the poets, clouds do not float. Their minute particles settle down very slowly against the air resistance, or are borne aloft by upward air currents.

There are ten principal types: cirrus, cirro-stratus, cirro-cumulus, alto-cumulus, alto-stratus, cumulus, strato-cumulus, nimbus, cumulo-nimbus, and stratus.

They are easy to fix in mind once their formations and textures are studied. The cirrus, high-flying, is a massive collection of drops or crystals. Its long slender streaks are caused by the strong lofty winds. Its stripes radiating from a point on the horizon and stretching across the sky are called "Noah's Ark," "salmon cloud," or "windreels." One variety swirls into giant plumes; another has skeletonlike spine and ribs; still another has the familiar mare's tail.

The cirro-stratus is a cirrus in a continuous veil of film instead of detached cloudlets. Its crystalline particles produce haloes and big rings around the sun and moon.

The cirro-cumulus, alto-cumulus, and alto-stratus are found at intermediate heights. The flecky cirro-cumulus is the well-known cloud of beauty. Its cloudlets often possess a noticeable waved structure. This is due to the flowing of two layers of air above the air at different speeds or in different directions. The alto-cumulus is a lower and coarser formation. Its long parallel rows form the familiar "mackerel sky." The alto-stratus is like a patchy high-flying fog.

The cumulus is the high common cloud you see in summer. It is born of air heated near the ground, usually from the sun. And its masses represent invisible columns of rising water vapor.

The strato-cumulus is the familiar cloud of winter: a sheet of heavy lump cloud spread over the sky. Due to its vertical cliffs, hundreds of feet deep, it is best viewed from a plane.

The nimbus, of course, is any dark, amorphous cloud that yields a steady rain or snow or looks threatening. A real thundercloud is sometimes four miles deep, spreading over many square miles. Formed of an uprushing current, it is more perilous to flying than lightning. You'll notice your pilot doesn't go above it, but tries to pierce its least active area.

A beautiful sight from a plane is the lenticular cloud, which forms around mountains. It is a lens-shaped mass with iridescent fringes, hanging almost stationary in the sky while the wind streams through it.

The stratus is really only a high earth fog. Like clouds, fog formations depend for their condensation upon ultra-microscopic particles which serve as a nucleus around which the drops form. A common supply of fog material is salt, made from evaporation of ocean spray.

When they form in mountains fogs are strictly low cloud ceilings which envelop the high points of the terrain. Valley fogs are essentially phenomena due to radiation and air drainage. There are snow fogs, too, caused when warm, moist air blows over snow-covered ground. They form when the snow reduces the air temperature.

If you make a trip across the Rockies or California's Sierra Nevadas, watch out for the pogonip, an ice fog that appears suddenly in bright weather and fills the air with icy particles.

Clouds and fogs naturally suggest those twin topics of discussion in every airliner: visibility and ceiling. Ceiling, of course, is merely the height at the cloud base. Low ceiling signifies visibility at levels dangerously low for flying. Low ceiling may be caused, in addition to low-hanging clouds, by fog, heavy snow, floating frost, smoke, dust storms, blowing snow and heavy rain.

Visibility reaches its vanishing point in a dense fog. Snow cuts it more than rain, and a heavy rain with large drops

is not nearly so bad as a fine drizzle. Poorest conditions ordinarily are in the early morning daylight when fogs and haze abound.

The problem of approaching low ceiling, as well as precipitation, poor visibility, ice and other unfavorable conditions, has been simplified by recognition of the fact that it occurs in restricted areas. The first of these is along moving fronts that separate different air masses; the second is along high mountain ranges. The worse conditions are found in the Far West, where the two coincide, that is, a front passes over a mountain range.

Look sharply when ice falls. There are three varieties: graupel, coarse like shot; sleet, bits of clear ice like frozen dewdrops, and hail, which exclusively attends thunderstorms. An ice storm, a thrill in the sky lanes, is a cold-weather rain. The descending water freezes as it strikes the plane's wings. It is one of the greatest hazards to aircraft. The plane's control is complicated by air-flow disturbances, and operation of vocal and directional radio facilities is interfered with by accompanying static. You'll find severe icing conditions in the turbulent region along a mountain crest. The pilot starts climbing when he sees them.

Speaking of climbing over mountain crests, one of the grandest spectacles imaginable is a rainbow as it greets you on the downward glide. The light reflecting, refracting and separating into the different colors of the spectrum as it passes through the drops seems much more magical than watching the effect from the ground.

Sunsets and sunrises seem similarly more gorgeous from aloft. You'll notice that the length of these twilights depends upon the weather, latitude and the time of the year. Here's what happens in their manufacture: the reflection of the sunlight shines upon the upper layers of the air when the sun is too low to be visible from the earth's surface.

Pondering these phenomena of the weather as you speed on to your destination, you get a keen appreciation of not only how they affect your course of flight but of the amazing system of weather vigilance now in operation in the United States. It's the best in the world.

There are some thirty thousand miles of airways latticing the nation. Two thirds of them are equipped with hourly teletypewriter weather reporting stations operated by the United States Weather Bureau and the Civil Aeronautics Authority. There are three hundred and fifty-two of these stations out of a total of seven hundred weather reporting points. On every fifty miles of airway the keen, trained eyes of the government meteorologist are watching out for your plane's safety—and your own.

The main detailed weather reports are collected every six hours and posted at all airports. On some airways point-to-point communication is made by radio. In addition the pilots in flight are receiving and transmitting reports. Complete weather maps soon may be broadcast to the planes. Recently, one of the first maps suitable for transatlantic flying was compiled from fourteen scattered ships at sea by Dr. James H. Kimball, New York weather bureau director.

If meteorology is less an inexact science than it was a decade ago, aeronautics is chiefly responsible. Inspired by a demand for precise indications, experiment in the more complex phases of meteorology is going on feverishly in universities, laboratories, and observatories.

Lately, the new advanced study of air mass analysis is opening up new fields of discovery and information. These movements in the dim regions of the stratosphere are now known to be the real weather factories. What is happening among them now is the indication of what is to happen down along the earth's surface a few days or possibly weeks hence. Forewarned is forearmed against Old Man Weather.

Today, tiny radiometeorographs are ascending to these frigid regions for weather dope. These are self-recording instruments which broadcast their observations on the way up. They mount twice as high as the airplanes which formerly did this service.

Yes, weather forecasters are literally looking up. By understanding the A B Cs of meteorology you have a chance to meet them halfway up and make your air trips more exciting and enjoyable.

N.A.A. NEWS

(Continued from page 33)

State and local organizations interested in flying will be asked to join in a nation-wide presentation of air progress and aviation needs.

WHAT RETARDS PRIVATE FLYING?

What is the present status of private flying? We know that there are now some ten thousand airplanes in private and miscellaneous flying. How many of this number are really private aircraft, that is, planes used by individuals for personal pleasure or business purposes? Persons qualified to make estimates give various figures, ranging all the way from one thousand to three thousand. Few, if any, however, will estimate more than three thousand. Most will say considerably less. The fact is that to date no one really knows how many Simon-pure private owner fliers there are in the United States.

By any approach, the numerical total of private owners is a sad figure. With air lines expanding their services in all directions, with military airplanes holding the world spotlight, and in many respects, the world's future, true private flying by comparison seems piddling indeed.

Yet we have the paradox that in private flying lies the principal hope for a really great aviation industry, and for truly widespread use of flying. Thus, even though we carry all first-class travel and first-class mail by air, the airline industry will still occupy only a minor place.

William Barclay Harding in his financial survey of aviation has pointed out very clearly what many persons enthusiastic about flying are prone to forget. That is, that the aviation industry is very small indeed in comparison to many major industries in the United States. Thus it is not very inspiring for most of us to have it pointed out that the bicycle industry in the United States is at the present time larger than the aviation industry.

Of course military aviation currently seems to be in line for sizable expansion, but it is certainly the fervent hope of peace-loving citizens everywhere that the present armament madness will pass. Probably, if it does not, it will end in such a holocaust that most of us will be well beyond concern over private flying anyhow. At best, military aviation can only build an industry based upon fear, and as such it will be an industry which must be kept alive through heavy taxation.

But just what are the chances for wide use of privately owned aircraft? The United States is a huge country, comparatively new, populated by some one hundred and thirty million people. Due to the advent of the automobile, its citizens now aren't satisfied unless they are gadding about. Fortunately, it is a country where many people have sufficient incomes so that they can indulge such desires, so much so, in fact, that they now own some thirty million cars. But highways are becoming more congested and therefore less pleasant each year. Also, most Americans in their "gad-about" activities have developed a growing appreciation of the advantages of decentralized living.

How does private flying fit into such a scheme of things? We already know that private flying is exhilarating and often beautiful. We know that it can even now provide fast, relatively comfortable transportation through a medium where the narrow limits of highways, the heat and dust of confining roadways and the hardships of unfavorable terrain are completely erased. For such reasons, to name a few, private flying would seem to have a great future, and to offer advantages which could go far to make the world a pleasanter place in which to live. Why, therefore, in the face of such prospects and the rapid advancement in other forms of flying, is private aviation so laggard? Is it, like many other things which seem to offer a rosy future, not practical?

Probably in the case histories of those who are now and those who have been, in the truer sense of the term, private owners, lies the soundest answer to the two important questions, namely:

(1) Does private flying have a really broad future?

(2) If so, what can best be done to accelerate its progress?

It is not the State aviation official, the flying service operator, the airport manager or the private plane manufacturer who, in the end, is best qualified to give the most practical answer to such questions. Obviously it is the private fliers themselves. In their troubles and problems should lie the real answer. And more than any others in this group, those who *have been* private owners but who are no longer can probably speak most pointedly.

Unfortunately, no such survey has been made. It might well tend to spotlight some already known facts which unfortunately are not given as much weight as they might merit. Such, for instance, as the fact that although airplanes even now can be built which are inherently stable in the air (will not stall or spin, will not "fall off" on a wing), practically all private owner planes today are, in the end, not only unstable in the air but also unstable on the ground. This, even though airplanes can now be built that are also stable on the ground (will not ground loop, will not nose up or over). The result has been too many accidents with private owner planes, both while flying and while on the ground. This in turn has meant too heavy a cost in lives lost and in operating and maintenance expenses.

But to return to the one thousand to three thousand estimates for private owners operating in the United States during 1938. How do these estimates compare with the predictions of previous years? And if expectations in the past have been more rosy, why has not more progress been made?

It is interesting on this score to review the findings of the nation-wide survey made ten years ago by Charles Coolidge Parlin, Director of Research of the Curtis Publishing Company. Parlin was given the job of surveying and forecasting at that time the possible place that aviation might take in the economic life of the nation. It was one of the most complete surveys of its kind ever made. More than a year was spent in investigation; every section was covered via air; every phase of aeronautics studied; a tremendous amount of data collected and opinions recorded. The survey carried special weight in view of the fact that Parlin, in 1914, following a similar survey, had forecast with remarkable accuracy the present-day wide use and influence of automobiles. The survey findings were summarized as follows:

"It seems likely that ultimately all first-class mail will be carried by air; that a majority of 'Pullman Class' day travel will be by air; that air express may exceed first-class mail and passengers combined.

"That a day will come when over the main airways connecting large cities, frequent planes will pass on regular schedules approaching streetcar frequency; that from minor cities will come smaller planes acting as feeders.

"That planes commuting from minor cities to major ones for shopping, for afternoon matinées, for evening entertainments will become well patronized; that many businessmen with pilot-chauffeurs will commute from estates to city offices.

"That air service twice weekly or more frequently will carry passengers, mail and express to Europe and the Orient and frequent service will connect the United States with Hawaii, the Philippine Islands, and all of its possessions.

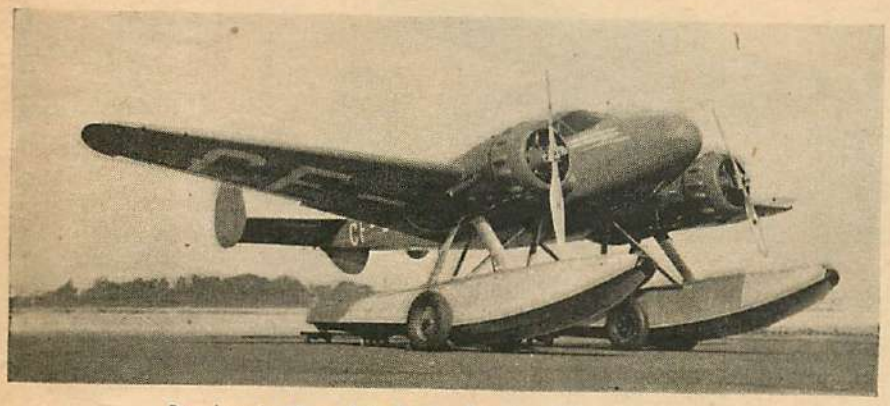
"That the number of individuals using privately owned planes for sport and pleasure will steadily increase, and, granting certain design and construction developments materialize, a total within ten years of two hundred and fifty thousand privately owned and operated planes—one to every one hundred families—is possible. It does not seem impossible that within fifteen years

there should be one million privately owned planes in operation."

There is a familiar ring about what Parlin predicted about scheduled air line and air mail developments. It is only on the private flying side of the picture that Parlin's forecast seems to have gone wild. And his two hundred and fifty thousand private owner estimate certainly sounds wild indeed when compared with the one thousand to three thousand actual craft operating in 1938. Remember, however, that his findings were not the dream of an inspired enthusiast, but the scientific forecast of the chief of many potent researches.

What, then, are the factors that have acted to prevent private flying's growth? Parlin in his survey of a decade ago gave the key. He pointed out then that three favorable factors were necessary to bring about the development he indicated as possible. These were:

(1) Local and Federal government support.



Beechcraft 18 on Edo floats; 320 h.p. Wright engines.

(2) Adequate capital for development.

(3) Education of the public to air use.

These factors remain today as the three basic needs for expansion in this field. Needs which if not met will continue to hamstring the development of the kind of aviation which offers us most.

THE CASE FOR AIR RACING

Let's pose the question: What is the point and purpose of air racing? What is its future?

The always-prolific hangar gossipers have been busy in their inimitable way, popularizing these under the head of, "Why have air racing, anyway?" As is usually the case with such gossip, much loose talk has occurred as a result. Before *you* jump at any conclusions, how about taking a quick look-see as to what it's all about?

National air racing ranks tops as a competitive sport. Here is physical skill and mental alertness at a new all-time high. A delicate touch, as fine as that of a musician, the engineer's mechanical mind, the athlete's judgment of timing and distance, the strategist's ability to act quickly and decisively, all are tested to an extraordinary degree in the person of the racing pilot. But that is not all. The best racing pilot would be helpless without the aid of the airplane designer, the engine production man, the mechanic, and the lubrication engineer. There can be no doubt that air racing, as the most modern of all sports, brings into play more factors than any other sport to date.

There are a number of hurdles you must take in arriving at your opinion as to air racing. Let's take them one by one.

Question: Does air racing tend to endanger unduly persons or property not participating? Your answer is in the record. In recent years there has been no single instance of a spectator at the National Air Races receiving injury from an airplane participating in the program. This in face of the fact that several million people during this period have viewed the races first-hand. Hardly a year goes by without additional precaution being taken to guard against such accidents.

Question: Is air racing so hazardous that it should be banned from a humanitarian point of view? Accidents occur from time to time in air racing as they do in all forms of competitive sport. Undoubtedly they will continue to occur as they will continue to occur in flying itself. Recent N. A. A. Contest Board rulings, directed toward the elimination of accidents, include such as those forbidding a pilot to enter the Nationals unless he has had five hundred hours and previous racing experience; requiring the pilot to demonstrate his ability to handle high-speed craft over the race-course before a committee of experts; stringent requirements concerning the design of the plane itself; and special qualifications for various events, such as an instrument-flying rating for the Bendix.

Question: Is air racing such a drain on the industry as to be unwise from an economic point of view? For the past ten years the races have paid their own way through spectator revenue or civic contribution. Any revenue that has come through the aviation industry as such has been in payment for advertising or publicity, which has usually returned good value. In general, it is doubtful if the industry has been out of pocket one dime during this period. On the other hand, many hundreds of thousands of dollars have been spent with suppliers of the equipment and material which go to make up racing airplanes. Too, the growing host of privately and corporation-owned airplanes (numbering more than a thousand at last year's Nationals) which were flown cross-country to Cleveland, burned up much gas and oil and added new hours toward eventual replacement or overhaul, thus increasing the dollars spent or to be spent with the aviation industry.

Question: Does air racing tend to stimulate advancement in design and serve as a proving ground for equipment? We will rest our case on a single answer. Several years ago Slim Lindbergh decided to have a personal plane built in England for use in touring about Europe. The whole world was his oyster. Obviously he would select what he considered the best engine then available for the size of ship he wanted. His selection was a triumph for the aërial race track. It is reasonable to think that the crankcase of Lindbergh's engine is stronger because the proving ground of air racing pointed toward desirable design refinement. It is reasonable to say that his engine cools better and that its supercharger functions more reliably because of the proving ground furnished by racing. Also that due to racing its valves are stronger and less liable to the corrosive action of high-octane fuels and high-compression temperatures. This does not mean that the engine would not have been a good engine without air racing. It does mean that it is definitely a better engine due to air racing.

And right here we have our key to the question, *what is racing's future?* Large horsepower engines and planes have an effective proving ground in military flying where full-out operation is far from uncommon. Planes and particularly engines in the lower horsepower private owner sizes have no similar proving ground. Rare is the private owner who ever runs his engine full-out for any period of time. Concentration of air racing in the lower engine displacement categories can furnish a needed proving ground for private-owner-type equipment. Thus, as the Indianapolis Speedway has enabled you to drive faster, safer and farther at lower cost in your family car, Nationals air racing in the future can contribute to the safety, efficiency and economy of the family airplane.

HOW WE FOOL 'EM

(Continued from page 27)

and rip open your parachute, it's going to be a one-way ride for you.

The second comes on the way down. It takes quite a while to kick your way out of the mail bag and chances are you're going to get a little timid along about the time the bag is wrapped around your legs, get awfully timid and rip the 'chute, and that leaves you hobbled in a bad way if any emergency should arise. Any such little slip-up, for instance, as cost George White his young life.

George was down in Miami stuck for a little loose change, so he thought himself up a way to get some. He arranged with someone around the Miami-Biltmore to drop him into their swimming pool from the landing gear of an airplane. George figured it need not be more than a fifty or seventy-five-foot drop, but the department of commerce people started adding up some other figures and they noted the fact that the pool was, I think, only one hundred feet long, that the plane would be going seventy or eighty miles an hour and if George missed the pool he would not only be spread all over the place, but would have a good chance of injuring some customers.

So they said "Nix," and George sat down to figure up something else almost as good. He would strap some roller skates on his feet and drop onto Biscayne Boulevard, off the landing gear of the plane. But the department boys got awful indignant when George brought the matter up, and he got sore himself and hightailed out of town and up to Tampa where the boys seemed more disposed to appreciate his art.

His first stunt in Tampa, a simple routine free fall, was his last. He got careless and forgot about pulling the rip-cord when he was facing the earth. His tripped his 'chute when his face was flat against the sky. The pressure of the wind jammed the parachute against his back and before he could shake it loose, he was buried deep in Tampa's sandy earth—dead.

The idea of doping out new thrills reached a new top in the "Drop The Pilot" stunt. That stunt is so good that in a great many places there is a law against it. There really isn't much to it from our point of view. A pilot sneaks into the waiting plane when no one is looking and ducks down low in the cockpit. Then, after a suitable announcement, the stunt man (maybe it's me) struts out and takes his place in the forward cockpit. You climb up high enough to put the ship through all the stunts in your little book—power dives, falling leaves, loops, Immelmanns, barrel rolls, et cetera. At the top of a long lazy loop, when the ship is upside down, you (the stunt man) rabbit out of the cockpit and leave the plane, ostensibly a free agent in the air.

I remember feeling a deep glow of success on one occasion, even as I was rabbiting out of the plane and through the air, when I heard a wild wail of terror bounce up from the crowd down below. They were scared, but their fright was nothing to what happened a few seconds later when the plane roared straight for the stands! Tearing like a crazy man, leaping, rolling, bounding, hopping, looping, diving and spinning, always heading for that great crowd of spectators.

The plane, of course, was always in the control of the pilot, but the crowd did not know there was a pilot and did not take time to look. They scattered like leaves in a November gale. One old lady just lay right down and fainted. When I finally reached earth, her daughter came rushing up and said, "It is all right to thrill people, but it is all wrong to scare them nearly to death, and I think you ought be put in jail for doing it." Then the boss pitched in and said, "You're not going to try anything like that around here again."

I did try it again, though, at the old Major Airport, now known as Floyd Bennett Field. The results were so disastrously similar, I just threw it out of my repertoire. This is a funny business. You charge people fifty cents for the privilege of tearing out their hearts, and if you didn't they would get sore, but I guess there is such a thing as going too far.

There are some stunts that are eye-popping to look at, but very easy to do. There are also some that are vice versa. For instance, take lighting a cigarette on the way down to earth. You hear more fool guesses about the way that is done than anything else. Most often they tell you a lighted cigarette was carried up in your mouth, not stopping to think that if you tried to do anything as crazy as that, you'd probably swallow the darn thing in all the excitement up there. I don't recall that anyone ever came over and told me the real low-down truth. Which is, simply, that you actually and literally light the cigarette on the way down to earth. After the parachute opens there is no more wind pressure than there is behind the windshield of a car going along at ten miles an hour, and you simply take a match out of your pocket, scratch it and light your smoke.

The prize vice-versa is changing planes in mid-air. That looks easy. You might think that all concerned were just yawning through it. But as a matter of fact, that's one stunt I dread to do, and I'm glad it was outlawed in 1930 when the department of commerce passed a law prohibiting planes from coming closer to each other than three hundred feet. You need too much luck to keep intact through this stunt to satisfy me. I don't mind having all the luck there is, but I'd rather have something on my side that you can depend on.

Fairchild Sekani, a Canadian ship powered by two 450 h.p. Wasps.

No doubt you've all, at one time or another in some form or other, seen this changing-plane stunt. We used to do this with those old Jenny biplanes. These were sometimes called "Flying Hencoops"—because they had so many flying wires, that were you to turn a hen loose on the wing, it would have a hard time escaping.

We would climb up on the top wing and clutch a short rope knotted on the end. Then we'd wait for a second plane, from whose landing gear dangled a rope ladder, to come directly overhead. Both planes would be going along at the same rate of speed, and in relation to you, the ladder was practically standing still. All you had to do was grab the ladder, let go of the rope, and let the upper plane pull you up off the wing. Then you'd climb the rope ladder, no harder than climbing a ship's Jacob's ladder, and you'd earned your fifty dollars.

Easy as pie if everything went right; easy as stepping from sidewalk to stoop. But the air is treacherous. It is peppered with invisible bumps, invisible pockets, and bump or pocket is a pretty hard customer to deal with where split-second timing and split-inch precision is what your life depends on.

I remember when I found out about that, and I shall never forget it as long as I live. I had gone up on Keim's plane, and Paul Jones was jockeying into position, putting the ladder in my hands. The minute I grabbed hold, Jones' ship hit a pocket and dropped. There had been maybe twenty feet between his ship and Keim's. The pocket shortened said distance. They came so close wheels and wings almost rubbed noses!

When the plane dropped, of course the ladder dropped, too, and I was dunked far down between the wing and tail assembly. There were two things that saved my life. One was that the pocket dropped Jones' ship so that I was dropped to the rear of the wing, instead of in front of it, where the propeller lay waiting to cut me to shreds. The other was the action of both pilots. Keim saw me drop past him and shot his plane straight down. Jones saw Keim's ship come up toward him and gave his the gun, and pulled straight for the sky. So I, dunked precipitously, shot up past Keim's plane and into open space, like a rocket trying to shake loose its flaming tail. On the way up I hit Keim's plane a glancing blow, ripped some fabric and dented my shoulder, but I didn't have time to get really scared until I reached earth. I couldn't go any farther after that. I just sat down and shook.

But you'd do that stunt maybe a hundred times and have that happen once. Once, you'd say—and correctly—is one time too many, but just the same, the boys got bored and started playing variations on the major themes.

"Baron Locklear," for instance. He'd change planes without a ladder, just dropping from landing gear to wing. That was risky, because you always had the chance of crashing through the fabric of the wing, or not landing squarely and losing your balance and toppling off. But as it happened, it was neither of these things that got him. It was just an air pocket. When he dropped from the landing gear, the wing simply wasn't there. It dropped from under him.

Crashing an airplane into a balloon gets a curious reaction from the onlooker. His eyes will bulge clear out of their sockets when he sees it done, as I did it in the scene from "Hell's Angels." Then when he's told how it is done he cools off and says, "What a cinch."

That stunt has only been done twice. It's an expensive one and was photographed from so many angles there has been no need to ever do it again. "Stunts Incorporated" hired me to do the trick and paid me fifteen hundred dollars for it. They trucked me out to Trajado, California, on the edge of the Mojave Desert. They floated the framework of a small dirigible up into the air, handed me an old Spad, signaled the camera ships to take the air, and said to me, "Go ahead."

That old Spad had been picked up for about thirty-five dollars. It was a honey. It had fought in the war, and its bones heaved and groaned so that I knew if I got it up off the ground I would never take a chance and land in it. That ship was rattling in every joint and I got nervous long before I left the ground.

When I got the signal to go I maneuvered the Spad under the balloon, dropped two loops over the joy-stick to hold it in a slow climb, dropped my safety belt over it to play safe and dove overboard—bailed out. This was done at four thousand feet.

I couldn't allow myself more than seven seconds for the entire operation. That is, set the plane in position, drop the loops over the stick, bail out, and drop five hundred feet before tripping my 'chute, so as to get clear of all the fuss and confusion and fire up above at the scene of the accident. Seven seconds, because I had to make sure the ship was aimed right and not too far away from the balloon for an air pocket or bump to throw it off its course.

If I had bailed out and the plane missed the balloon, I would have been ridden out of the stunt game on a greasy pole. So I had to wait until that balloon was as big as life, until I could almost reach out and pat it.

The way down was no picnic, either. The airplane, when she hit, exploded with a roar that shook the surrounding sky, and for minutes afterward I floated in a shower of burning embers. I kept looking up into the canopy of my parachute and seeing tiny holes appear as sparks zipped through it, and I hoped until I thought I would bust that those tiny fires would not spread. They didn't, I fortunately am here to say.

There is one thing sure about pulling any stunt, and that is you never can tell. A group of directors came up to me one day and said, "Mr. Austin, we are going to shoot a few scenes here for our latest aviation picture. Can we come to terms for a few stunts, and will you do them?"

I said, "What is the stunt and what is your price?"

"There is fifteen hundred dollars in it for you if you blow up a plane so's we can get a good picture of it." They also said, "We don't want you to burn it, we want you to blow it up—go bang with a big boom!"

"Man, you're a darling," I said, and sat down to figure out a way to do it.

A stunt man had tried once before to do this, but it was more blow-out than blow-up. The fire took too long to work itself up to an explosion, and by the time the explosion came the plane was too far off its course to mean anything to the camera ships.

Well, I thought I'd be a little more

sure. I'd put black powder and gun cotton in the gas tank in front of the forward cockpit, and when the fuse reached her she'd go wham all over the sky. I had a couple of holes punched in the top of the tank to make sure it would split wide open at the first impulse. I then hung a smoke pot under the motor to give it an added effect.

I tested and retested fuses till I had everyone around me nuts, but I had to have this stunt figured down to the fraction of a second. I tested them with a stop watch and found I would have ten seconds at the most to do the entire stunt. That is, contact the dry-cell battery between my feet, this to set off the smoke pot, pull the friction cap off the fuse running up to the gas tank, release my safety belt, pull a dummy up into the seat (not too much like me), and get it to sit straight, leap clear of the cockpit and free-fall one thousand feet out of the way of that tremendous explosion above.

A couple of rehearsals and I knew I could do it. I went up with an easy mind and practically a song on my lips. I sure felt quite the old buckaroo. I felt that way because everything was going to be just hunky-dory, and fifteen hundred dollars was a heap of dough and meant plenty of hotsy-totsy days to come.

And so everything did go hunky-dory, for the producers, because instead of getting a shot of a dummy blown out of the plane, they got a picture of that happening to a real man. How well I know.

What happened was, something went wrong with the fuse. The spark shot through it like lightning racing for the proverbial old barn roof. When I had one foot on the edge of the cockpit and was all ready to boost myself out into space, something did it for me. The whole darn world waltzed right up under me and smacked me in the seat of the pants, and sent me skyrocketing toward heaven amidst wreckage and fire.

What do I remember of that moment? Not very much. I do, though, remember a few things, they all happened so quick. I remember snapping the dummy into place and seeing it sag forward, and pushing it in the face to make it sit right. I remember giving one last look around the cockpit, my foot on the cowling, to see that everything was as it should be, the smoke pouring from the pot under the motor and the spark crawling along the fuse, the black of the fuse graying into ash.

And I saw suddenly a horrible flick of ash just going over the top of the gas tank and knew that in a fraction of a second it would hit the gunpowder, and I stood rooted right there. I couldn't move. I stood one short agonized moment and felt the sweat break out all over me in a flood tide. That was the last thing before the roar in my ears. The whole world crashed around me, long, jagged streaks of flame shot past, and I shook and shattered through space. It seemed to take a long time. It lasted endlessly. Suddenly the air was clear and the thundering in my head stopped and I pulled the ripcord on my parachute and floated down to a fairly easy landing.

I didn't know until after I landed that I was injured, that the explosion had blown me right through the side wall of the cockpit, and a piece of it was sticking in my shinbone. I have never duplicated that stunt again. I never wanted to, and never had the chance. We saw a shot of that in "Dawn Patrol" and "Devil Dogs of the Air." Because that's me, and no dummy, catapulted up into the air, my wife calls me her Clark Gable.

I never got a chance to do it again because they had the shot from so many angles. Literally, the whole stunt game is shot to pieces. They keep the stuff on file and they've got all they will ever need now, and it is going to take some thinking to think up a new stunt that has not already been done, and successfully carry it through.

A great many people ask me, "To what do you attribute your longevity?" They ask this because so many stunt men have passed on. The answer to this is easy. With all due regard to four-leaf clovers, horseshoes, and rabbits' feet, I am still meticulously careful in every stunt I do, regardless of its simplicity. The reason for so many fatalities in the stunt game is a very simple one: one stunt man trying to outdo the other. As I finish this story I read in the papers that a very good friend of mine and an expert parachute artist takes a one-way ride. Why? Trying to go the parachute jumper one better doing the "Bat Wing."

WHAT'S YOUR QUESTION?

(Continued from page 36)

Question: I would like to know what motor the Corben Super Ace used—what horsepower? What was its top and cruising speed? How many guns does the British Fairey Fantome carry? Where are they situated? What is the caliber of the cannon in the nose? F. G., Alberta, Can.

Answer: The Corben Super Ace was powered with a converted Ford Model "A" engine, around sixty horsepower. It had a top speed of approximately one hundred miles per hour and cruised at eighty. The Fairey Fantome has a 20-mm. cannon in the nose and four Browning machine guns: two mounted in the top cowling and two in the lower wing firing outside of the propeller arc.

Question: Will you kindly inform me of the size, speed and range of the Boeing P-26 and the Curtiss P-36? Can either of these ships be purchased for private use? S. N., New London, Conn.

Answer: Boeing P-26: Span 27′ 11″; length 23′ 7″; weight empty 2,356 lbs.; top speed 213 m. p. h. at sea level, 233 m. p. h. at 6,000 ft.; range 500 mi. Curtiss P-36: span 37′ 4″; length 28′ 10″; approximate top speed, 320 m. p. h., cruising speed 290 m. p. h. No further data available. Neither of the ships can be purchased for private use.

Question: My brother and I had an argument over this question, so I am asking you for the answer. Was the Bellanca 28-92 originally built for the late Frank Hawks before Captain Papana of Rumania obtained it for his proposed transatlantic flight? W. B., Rice Lake, Wis.

Answer: The Bellanca 28-92 was specially built for Captain Papana.

Question: In your July, 1938, issue I saw the plans of the Bowlus Baby Albatross. Can you tell me where I can get the full-size plans for it? L. D., N. Y. C.

Answer: The Bowlus Baby Albatross is manufactured by William Hawley Bowlus, San Fernando, Cal. The ship is sold in kit form only, and I don't think that plans for it are available. However, write him and find out.

Question: I would like to find out about a plane whose picture appeared on the October, 1935, cover of Air Trails, the Pitcairn Airmobile. I would like to know if the experiments were successful or not. If so, would you please tell me if the original drawings were followed to the letter or if they were changed? I would like to know the speed on the ground and in the air, the space required to take off in, and the price of the ship. H. E. S., Leavenworth, Kan.

Answer: This ship was later renamed the Pitcairn Roadable Autogyro. No changes have been made on it that I know of. It was used by the department of commerce for some tests, had a top speed of ninety miles per hour, minimum speed of twenty miles per hour, and took off in less than a hundred and fifty feet in calm air.

WHY THEY STAY UP

(Continued from page 22)

bility, hence the unstable, tricky nature of the pursuit plane.

A plane in the air is unlike ground or water vehicles in that it moves in a third dimension. This is depth. For example, an airplane, like a boat, may roll from one side to the other. It may also be steered from side to side on a level plane. Here, excepting in the case of submarines, the similarity ends, for the airplane can also dive and climb. It is evident, therefore, that in order to achieve stability, our airplane must be balanced on three separate axes. (See Figure 4.)

Longitudinal balance is secured by placing a small auxiliary wing called a stabilizer on the tail of the plane. Attached to its trailing edge is a movable control surface known as the elevator. The stabilizer is usually made with an adjustable angle of attack in order to alter its lift and thus balance varying cargo loads. The amount of stabilizer area is calculated to produce sufficient lift to support the tail only after the plane has reached flying speed. That is why the tail does not come up to a horizontal position until just before a plane takes off. A new and popular method of solving the problem of longitudinal balance is the trimming tab.

A plane flying in a straight line is frequently blown off its course by wind gusts. This is called yawing. Directional stability is achieved by means of a tail surface set vertically above the fuselage. This surface functions in the same manner as the stabilizer and is known as the fin. It also is fitted with a movable control surface called the rudder. A trimming tab set in the trailing edge of the rudder corrects the yawing movements of the plane and also overcomes the slight but constant yaw due to engine torque.

Lateral stability is secured partially by sloping the wings upward as they extend out from the center of the fuselage. The angle of this slope is called the dihedral angle. A good dihedral tends to cause an automatic recovery from side roll. This is due to the increased lifting action of the lower wing as it approaches the horizontal. (See Figure 5.) This lift, in addition to the fin's resistance to the rolling movement, plus the correct placement of the center of gravity, governs the degree of lateral stability achieved.

Any discussion of stability would be incomplete without some mention of the so-called tailless plane. This unorthodox design eliminates the long fuselage and gains longitudinal balance by means of wing surfaces whose ends are bent rearward in the shape of the letter V. This, in effect, is a form of longitudinal dihedral. The wing tips extend a sufficient distance back of the plane's center of gravity to function as stabilizers.

The lift and drag of a wing are calculated so that it will support the plane in level flight at the proposed cruising speed. The ratio of these forces provides us with a direct measure of the wing's efficiency. This depends on the wing section used, the area and shape of the wing and its angle of attack. The most efficient angle is usually somewhere between three and six degrees. A well-designed wing should produce around eighteen pounds of lift for each pound of drag force.

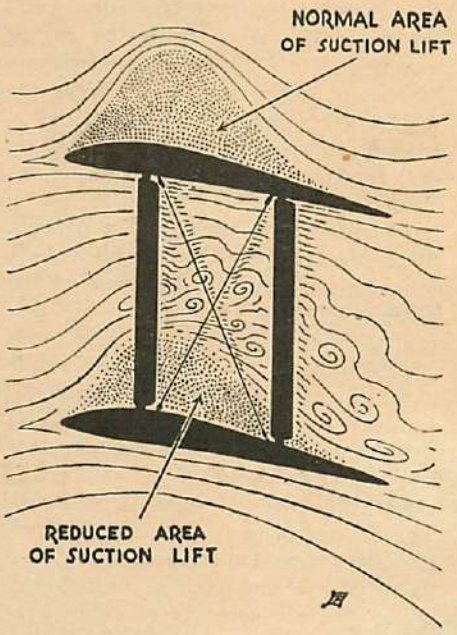


Fig. 9. A biplane section, showing the airflow disturbance caused by small gap. Note drag caused by struts and wires.

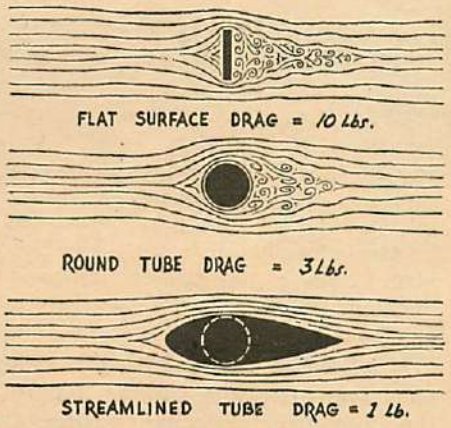


Fig. 10. Showing relative drag of various forms in motion through the air. Note how streamlining tube reduces drag.

As we demonstrated in our experiment with the cardboard, the amount of lift increases as the angle of attack increases. When the wing is tilted to an angle of about fifteen degrees, however, its lift suddenly begins to disappear. This is what is known as the critical angle or stalling point. The sudden loss of lift is the result of a break in the smooth flow of air over the top of the wing. The disturbed air churns around or "burbles" and partially destroys the lifting effect of the vacuum. (See Figure 6.) The enlarged angle of attack has also greatly increased the drag exerted on the wing. When we reach the stalling point, the lift fails, the drag intensifies, and the wing, deprived of support, slides backward and downward out of control.

Various devices are being developed for increasing the lift of an airplane wing at low speeds. The effect of all these devices is to lower the stalling speed of the wing and thus permit slower and safer landings. Slots have been used in England for this purpose for some years now and have proven quite successful. The slotted wing is equipped with a small supplementary airfoil which is hinged closely over its leading edge. At ordinary angles of attack, the slot remains closed and functions as the normal leading edge of the wing. When the stalling point is reached, however, the slot opens automatically, permitting air from beneath the wing to rush through the gap and pass over the upper surface. This flow from below prevents the air above the wing from burbling as soon as it normally would, thus materially reducing the speed at which the plane stalls and falls. (See Figure 7.)

Flaps add to the lift by partially trapping the flow of air beneath the wing with a consequent increase of upward pressure. They usually take the form of long, narrow surfaces, hinged to the underside of the wing just forward of the trailing edge. When swung downward at a right angle to the chord, they greatly increase the drag and act as brakes to slow down the airspeed of the plane. Fowler flaps are a device for enlarging the wing area in addition to performing the functions described above. They extend outward beyond the trailing edge of the wing, supported by streamlined outriggers, and enlarge its area by increasing the chord. (See Figure 8.)

During the pioneer days of flying, a multiplicity of wings were thought necessary to support an airplane in flight. Ships of the period were little more than a collection of box kites fastened to a skeleton fuselage. As more efficient airfoils became available, the number of wings was gradually reduced. The rapid development of aircraft during the hectic days of the World War

forced the abandonment of the quadruplane and triplane and witnessed the emergence of a speedier monoplane type. Today, the use of the single, cantilever wing has become almost universal.

Why, you ask, is the single wing superior to an arrangement of multiple wings? There are several reasons. First, there is the objection of the increased drag generated by multiwinged craft. The biplane, with its complicated structure of struts and bracing wires, presents infinitely more resistance to the passage of air than does the monoplane. This, of course, makes it slower. Even if cantilever biplane wings were employed and the interplane struts and wires eliminated, another, aerodynamic objection remains. This is the fact that the conflicting air currents passing through the gap between the wings are disturbed to a degree that seriously reduces both the positive lift of the upper wing and the negative lift of the lower. (See Figure 9.) This loss of lift may be reduced somewhat by staggering, or placing the wings one partially to the rear of the other. Wind-tunnel tests have shown, however, that the loss of efficiency persists unless there is a gap of at least twice the wing-chord measurement. Structural limitations make a gap of this depth prohibitive, and in actual practice the wings are usually separated by a distance equal to the length of the chord.

Due to this lowered efficiency inherent in the biplane wing arrangement, it is possible to design a single wing which, although smaller in area than the combined biplane wings, will produce an equal amount of lift with much less drag. Moreover, the vastly improved structural materials now available permit the fabrication of internally braced wings strong enough to withstand the heaviest stresses imposed upon them. The elimination of external struts and wires results in a cleaner wing with less parasitic resistance. This increased efficiency, plus lower manufacturing costs, superior visibility, et cetera, will explain the present popularity of the cantilever monoplane wing arrangement.

During the early days of flying when Wright and Curtiss pusher-type planes were popular, the pilot, power plant and propellers were supported within the framework of the wings. Stabilizing and control surfaces were mounted on outriggers, with the elevator placed well out in front. The pilot perched himself in a truly air-conditioned seat with his legs hanging over the leading edge of the lower wing. This was dangerous as well as uncomfortable.

Well aware of the disadvantages of the pusher type, Louis Bleriot, a pioneer French aviator, developed an entirely new kind of flying machine. This was the high-wing monoplane in which he made the first crossing of the English Channel. Its basic pattern has persisted down to the present day. The Bleriot monoplane introduced the modern form of fuselage with the engine mounted in front, pilot accommodations amidships, and stabilizing surfaces attached to its tail end. Along with his fuselage, Bleriot bequeathed to today's designers the problem of "parasitic resistance."

The fuselage is essentially a parasite upon the body of an airplane. It weighs more than any other part of the plane's structure, produces no lift (excepting the Burnelli type), and adds considerably to the atmospheric resistance which the plane must overcome. In order to reduce this parasitic resistance as far as possible, the fuselage is carefully shaped to facilitate the smooth flow of air around its contours. This is known as streamlining. A perfect streamline form enters the atmosphere with a minimum of disturbance, guides the air currents smoothly over its surface and permits them to close in again behind it without drag-producing turbulence. (See Figure 10.)

The only drag created by a streamlined form is the unavoidable type due to the friction of air passing at high speed over its surface. This is called skin friction and of course affects all external parts of the airplane.

Head resistance to the atmosphere increases in proportion to the square of the speed. A flat surface held at a right angle to its path of flight and forced through the air at a given speed will offer about ten times as much head resistance as a well-streamlined form of equal cross-section. This is due to the turbulence created in its wake by conflicting air currents curling over the flat edges. Even a cylinder is followed by considerable burble and produces three times as much drag as the streamlined form. That is why exposed tubular struts are almost invariably faired to a streamline section.

Any inequality or opening in the surface of an airplane greatly increases the drag by interfering with the smooth flow of air. This explains the rise in maximum speed that invariably follows the addition of a well-designed cockpit cover. From the point of view of streamlining, even this device is a wretched compromise. The ideal fuselage should present an unbroken line from nose to tail and should have no protruding structures whatsoever. (See the late Frank Hawks' *Time Flies.*) Better still, the ideal airplane should have no fuselage at all and should consist merely of lift-producing and control surfaces. This is the so-called flying wing in which the power plant, crew, passenger and cargo accommodations and control mechanisms are all contained within the thickness of the wing. A number of experiments in this direction are now in progress and it is safe to say that the day of the flying wing is not far off. If you digest this first lesson carefully and continue faithfully with the balance of your ground course, who knows—maybe you'll be flying one of them!

FORGERS OF AIRCRAFT

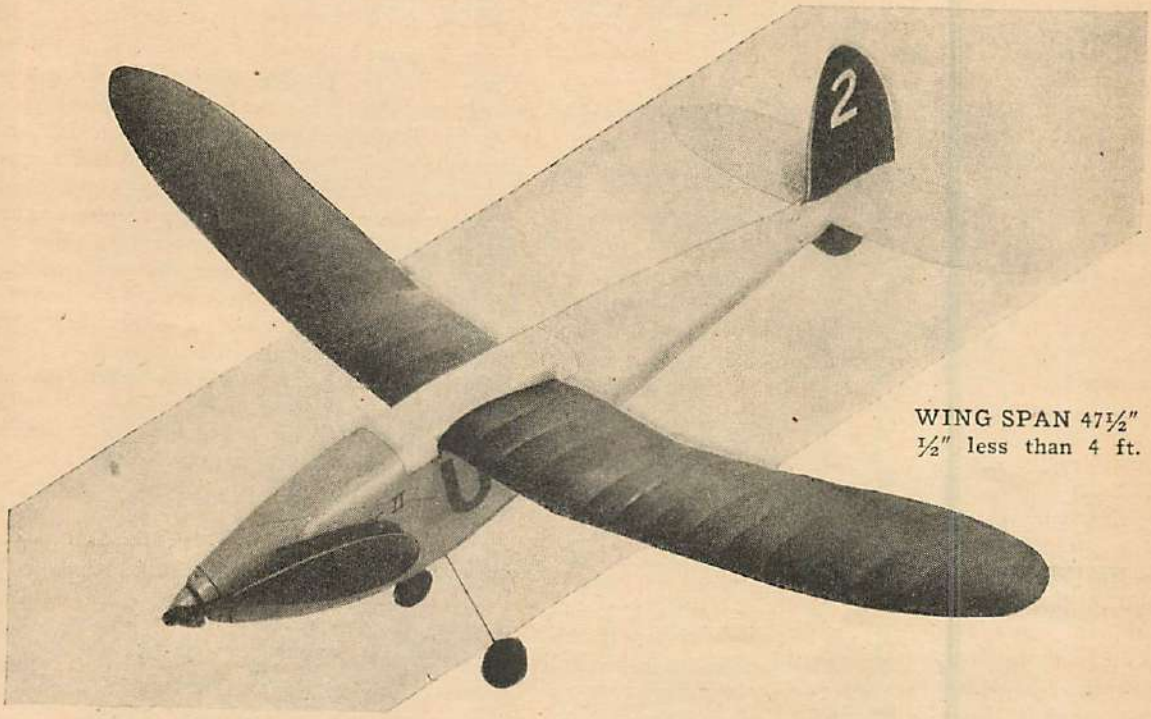
(Continued from page 7)

pany in South Chicago, where he worked through the various divisions of the open-hearth plant, laying the foundation for his later production and manufacturing experiences. It was not a royal road to success, but hard work and perseverance made it a solid one.

His next position was in 1915 with the production department of the Simplex Automobile Company. At this youthful period of the aviation industry there were no factories in this country engaged in the production of airplane engines capable of meeting the heavy wartime needs. Consequently, large numbers of them were being turned out by the automotive industry. The Simplex Company was building Hispano-Suiza motors for the French government.

Mr. Brown remained with this company and eventually became head of the Long Island assembly department when it was reorganized in 1917 as the Wright-Martin Company. This company later became the Wright Aeronautical Corporation, and he was placed in charge of the production and purchasing departments.

In 1925 the Pratt & Whitney Aircraft Company was formed and Mr. Brown went with it as factory manager. He was subsequently made vice president of the company, and in 1930 was elected to the presidency. Growing with the demands of the aviation industry, the United Aircraft & Transport Corporation, of which Pratt & Whitney Aircraft was one of the subsidiary companies, was formed in 1929, and Mr. Brown became a vice president and director. In 1934 this corporation was reorganized into the present United Aircraft Corporation, and Mr. Brown was elected president.



WING SPAN 47½"
½" less than 4 ft.

FLY A WORLD'S CHAMPIONSHIP MODEL

The model airplane pictured here, which is offered FREE with a year's subscription to Air Trails was made from the exact specifications of the Championship Model, designed by Jim Cahill, Captain of America's 1938 Lord Wakefield Team, which won the three following most important model contests in the world:

1—MOFFETT TROPHY. America's leading yearly model competition. Jim Cahill won this event with the model pictured above.

2—AMERICAN ELIMINATIONS —Against all the best models produced in America, Jim Cahill's model won this event. Then he was made Captain of the American Team and was sent to Paris to compete for the Lord Wakefield Trophy.

3—LORD WAKEFIELD TROPHY. Leading model builders from all over the world enter their ships in this, the most important of model contests. Jim Cahill's model won first place.

These three Championships make Jim Cahill's ship the World's Champion Model Airplane. This model which has been made up in kit form under the supervision of Jim Cahill is not for sale. The only way you can get it is ABSOLUTELY FREE with a year's subscription to AIR TRAILS.

MAIL THIS COUPON TODAY

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79 SEVENTH AVE., N. Y. C.

Inclosed is $1.50. Kindly send a year's subscription to AIR TRAILS and the Jim Cahill Model Kit to

NAME .....

ADDRESS .....

.....

This offer good in the United States and Canada. Canadians please add $.25 to cover kit mailing costs.

MODEL MATTERS

(Continued from page 53)

timing goes to the Sixty-third Coast Artillery boys from Fort McArthur.

Eighty-three separate places received prizes. The times ranged from 10:20 for first place to 1:00 for eighty-third place. Winners: 1. Leslie Zeiders, Romoland, Cal., 10:20; 2. Dean Banks, South Pasadena, Cal., 9:55; 3. E. J. Brown, San Diego, Cal., 6:26.

The first-ranking young lady was Kathern Butcher, of Pasadena, Cal., in twelfth place with 2:24½. The three-hundred-square-inch class did its best time with 2:15 to place twenty-fifth, flown by Richard Huber of Glendale. The biplane trophy went to Sandy Abrenica, 1:05. The low-wing trophy to C. W. Hess, 1:09.

TWELFTH NATIONAL CHAMPIONSHIP MODEL AIRPLANE MEET. The 1939 National Airplane Championship Model Airplane Contest will be held in Detroit, July 5th to 9th. This year's National Meet promises to surpass in magnificence even that of last year, which was acclaimed the best ever held.

The contest will be sponsored by the Exchange Club Council of Detroit, which consists of twenty-eight exchange clubs in the greater Detroit area. Arthur J. Vhay, operations officer of last year's meet, has been named as the general director of the 1939 Nationals. Irwin S. Polk retains his job as meet manager.

As last year, an insignia competition is planned. Those artistically inclined are asked to give some thought to an insignia which would symbolize youth in aviation through model building, support and coöperation by the Exchange Clubs and guidance and supervision by the National Aeronautic Association. H. A. Thomas, of Little Rock, Arkansas, was the winner of last year's insignia drawing competition, and his design was incorporated in the official insignia of last year's meet.

Model builders throughout the nation are developing new ideas and designs for models to be entered in this year's great classic. There is no doubt that 1939 will be a banner year for both endurance and gas-engine power models.

The detailed rules will be announced in this magazine just as soon as they are released. Watch for them!

GAS MODEL TIPS. Carroll Moon, of the wide-awake Brooklyn Skyscrapers, offers these aids:

WING SECTIONS. Use ribs with considerable undercamber, and generally $^3/_{16}$" stock. The section should be thick, giving more lift and longer glide which, as a general rule, is very slow. Taper the trailing edge into the top of the rib, thus making for a better-looking job when finished.

COVERING. Instead of spraying water on a model, try putting the water on by a sponge; this insures a more even wetting. Small sections, such as rudders, stabilizers, et cetera, may be held under a faucet. For a fine finish have your local auto painter spray the job.

MOTOR MOUNTS. Metal mounts are generally pretty efficient crankcase demolishers. Pine or bass mounts are solid, but be sure your mounts can be easily replaced and carry a spare set with you to the field, all drilled for quick replacement. The heavier the mount the better the motor will run. Inverted motors are harder to start, harder to keep clean, and it is much easier to break off a cylinder in a crash landing.

TIMERS. Check your timer with the motor running. Many timers run faster with the motor "revving up." Others stick with the motor hammering out five thousand revolutions per minute.

CONNECTIONS. Never use solid covered wire for connections—vibration breaks this type of wire very easily. Use oilproof, waterproof, shockproof wire for the high-tension lead. Use different-colored wires for the three main connections to the engine—timer, ground and plug. Solder all connections for best effects, checking your job when finished to make sure you have a solder connection and not a flux connection. Use a plug connection for boosters, and one that is quickly and easily removable. Mark your booster terminals on the plane "plus" and "minus" to avoid shorting out the batteries inside. Arrange your inner battery so that it is replaceable without taking off the wing. Check your condenser against shorts before wiring in place (or have your radio repairman do this for you). Secure your condenser with tape or rubber to avoid breaking the leads when the motor starts.

REPAIRS. Always carry plug and prop wrench, pliers, screwdrivers, knife, razor blade, glue and several pieces of balsa. Other sundry items to good flying include batteries, spare prop, extra rubber, extra plug, piece of wire for cleaning out clogged feed lines, tape (friction) and such items (which you probably would take, anyway) as gas, boosters, spare motor mounts, rag for wiping off motor, ignition wire, and two-bits to purchase such items as oranges and hot dogs. And don't forget a piece or so of paper for patching.

METROPOLITAN MODEL AIRPLANE COUNCIL. The Metropolitan Model Airplane Council, composed of model clubs in the Greater New York area, has announced its gas-model program for the coming year. It will consist first of a gas meet April 2nd, using the new National Aeronautic Association rules. There will be the regular endurance event and a specialty event for unusual ships and radio-controlled models. Entry fee will be twenty-five cents, and the meet will be open only to builders who are members of a club belonging to the Metropolitan Model Airplane Council.

An invitation seaplane event will be conducted in August. The site for this contest has not been decided upon as yet. Another invitation meet has been scheduled for September; event to be announced later.

At an election recently held, the following officers were reëlected: Irwin S. Polk, president; William Effinger, secretary; and Sam Block, treasurer.

The council is conducting a census under the supervision of Louis Garami to determine the trend in model building in this area. In this manner information as to whether model builders are swinging toward gas models, endurance models, et cetera, can be determined in advance and activities planned accordingly. The results of this census may be obtained by writing to the council secretary.

A survey is being made to determine which fields are suitable for power-model flying within the five or ten-cent-fare limit of New York. When this survey has been completed, steps will be taken by the council to arrange for the use of a field as a model airport. The assistance of city and aviation officials is being sought in order to obtain a suitable field for the model builders in the New York area.

Model-airplane clubs, rubber or gas, are invited to join the Metropolitan Model Airplane Council so that they may participate in the coöperative activities to be conducted by the council. For information write to the officers.

MORE COMING EVENTS. The Second Annual Northern Indiana Model Airplane Builders Contest, sponsored by Bram's Community Service Stores, will be held in Gary, Ind., June 17th and 18th.

The "Little Nationals," the gas-model consistency event, will take place on Sunday, the 18th. Over two hundred dollars in cash prizes will be awarded, the first prize being a hundred dollars cash. The rubber-powered event will be held on Saturday, the 17th, with numerous cash prizes, and at this time the exhibition contest will also be judged—prizes to be awarded at the gas model contest the following day.

Entrants will be welcomed from anywhere in the country. Further information may be had from Bob Roberts, contest director, 4490 Broadway, Gary, Ind.

CUB COUPE

(Continued from page 57)

FUSELAGE

Cut out two halves of each bulkhead. Bulkheads one to five are 1/8" sheet balsa, and six to twelve are 1/16" sheet balsa. Cement corresponding halves together. Then cement bulkheads eight, nine and ten to the wing center section in the positions shown on the plan. Add the four 1/16 x 1/8" side and top stringers, the remaining bulkheads, the tail post, which is 1/16 x 1/8" balsa, and finally the remaining stringers.

The nose back to the windshield is either covered with sheet balsa or filled in with scrap balsa. Sand this smooth after the cement has dried. Add the window frame and outline. Note how the wing center section's leading edge is cut back at the windshield.

LANDING GEAR

The landing-gear skeleton consists of two pieces of wire, continuous through the fuselage as shown in the landing-gear detail. These should be cemented in place before the fuselage is covered, and the braces installed to hold the wire tightly against the bulkheads. After the model is covered, the 1/8" sheet-balsa fairings may be cut and sanded to fit and then cemented in place. Pants are made in the customary way, by cutting four pieces of 1/8" sheet balsa to the side outline of each pants, cutting two of these to the dotted lines to admit the wheel and cementing the pieces together with the cut-out parts inside, and finally carving and sanding the whole assembly to streamline shape. The pants are then cemented to the landing-gear struts.

TAIL SURFACES

If the model is carefully constructed, care being taken to keep the tail light, it will fly satisfactorily with scale-size surfaces. Two types of construction are shown on the plan. The heavy black lines show a light frame, with 1/16" square bamboo outline and single 1/8 x 1/16" balsa spars for flying, while the light drawing shows the detail for a scale model with movable surfaces. The success of scale-size surfaces depends entirely on keeping the tail of the model light and the surfaces free from warping, so it will pay to take exceptional care with this part of the model.

The stabilizer is built in one piece with a continuous spar and is attached to the fuselage after assembly by slitting the tail post with a razor to admit the stabilizer.

COVERING

Because of the large flat surfaces of the model, a little care will provide a smooth covering job. Where the curves make covering a little difficult, use several small pieces of tissue. As the Coupé is a private plane, the color scheme is entirely optional with the builder. Our test model was cream with red trim.

Cover with tissue of the desired color, then spray the model lightly with water and allow to dry. Then give two light coats of colored dope of the same color as the tissue. Use dope thinned half and half with thinner for lightness and to prevent warping. *Do not dope the tail surfaces.*

Sand the model lightly between coats of dope to remove fuzz and stray ends of tissue. Dope the nose until the model balances slightly ahead of the wing's mid chord. Add insignia, striping, and details. Struts are sanded from 1/16 x 3/16" sheet balsa.

PROPELLER

Drawings are given for both the flying and scale propeller. Use hard balsa for the flying prop to bring the C. G. forward and to minimize the danger of breakage.

FLYING

Glide the model and add weight to the nose if it stalls, bending the trailing edge of the stabilizer up if it dives sharply. Then try short flights under power, aiding the model to turn in whichever direction it tends by warping the rudder slightly. If the model stalls under power, give it slightly more rudder so that it climbs in a tight spiral, or use downthrust.

The test model flew smoothly on six strands of 1/8" rubber and was flown as an exhibition model at the Peninsular Fair at Langley Field in December.

BILL OF MATERIALS

Sheet

2 1/32 x 2 x 18"
2 1/16 x 2 x 18"
1 1/8 x 2 x 18"

Strips

12 1/16 x 1/16 x 18"
6 1/16 x 1/8 x 18"
1 1/8 x 1/4 x 36"
3 1/16 x 3/16 x 36"
1 1/16 x 1/4 x 36"
1 1/2 x 1/2 x 6"

Block

1 6 1/2 x 1 1/8 x 1/2"

Miscellaneous

2 oz. cement
1 oz. clear dope
1 oz. colored dope
1 oz. thinner
2 1" hardwood wheels
2 sheets tissue
1 1/2" balsa wheel
18" #12 music wire
bamboo, rubber, washers, celluloid

AIR ADVENTURERS

(Continued from page 35)

Progress, if you will only take time to sort them out.

We got a swell letter from Warren Vreeland, a bit of a wag from Pittsfield, Mass. Warren goes into some happy detail on how to take close-up pictures with a box-type camera. He explains that with an ordinary box camera you cannot get any closer than five feet, which cuts down the detail considerably, so he suggests that you birds put on your snowshoes (he lives in an igloo, apparently) and trudge into town and get your photography dealer to sell you a portrait attachment, which can be bought for about seventy-five cents. With this supplementary lens you can get as close as two feet eight inches. Then Warren adds that if seventy-five cents is too steep you can take off the snowshoes and go down cellar and find a piece of thin sheet brass. From this you cut a disk about one inch in diameter, and in the center you bore a hole three sixty-fourths (wow!) of an inch and then paint the disk black. Ream out the edges of the small hole and then fit the finished product over the outside lens of your box camera and stalk your model to its lair. These are Warren's words, and he also adds that you must give your exposure more time, possibly as much as thirty seconds, to get a sharp negative.

Donald Banks, of Bloomsburg, Pa., was on hand at the Bloomsburg Airport recently when a Sikorsky amphibian had a forced landing there. It seems the engine "blew" one of its cylinders and the pilot had to get down quickly. Fortunately, when he looked over the side, there was Bloomsburg and there was Donald Banks with his trusty Kodak Brownie Junior. Result: no crash, but a swell shot of a ship we seldom see today. Nice work, Don.

William Keith, of Manchester, N. H., clicks for his Observer's badge with a very complete report on a day at the Manchester Airport. He checked everything connected with the Merrimac Valley Flying Service and the Boston and Maine Transport Lines and turned in a neat job. While there, Bill had an opportunity of studying and inspecting a Cub, Aeronca, Fairchild 24, D. H. Gypsy Moth and a Fleet. Quite a five-hour spell, Bill. When are you buying one?

Here's a member what is a member! Edward Negri, of Atlanta, Ga., is the prize lad for understatement. After waiting two years to decide on coming in with us, he finally signs up and sends us a photograph of a Douglas DST transport he built. And he says: "The pictures flatter the model, for they hide many of the defects that are clearly visible on close examination of the model itself." We get some shocks in this business, but that one almost floored us, and we forgive you, Brother Negri, for all the unkind things you said about the illustrations of the Bill Barnes stories.

We've nailed a Cub pilot, too, this month. James C. Perry, of Covington, O., who has been reading Air Trails for a couple of years, has finally broken down and signed up. Glad to get you pilot guys in here, Jim.

A lad who knows how to bring 'em in is Robert McMahon, of San Francisco, who not only signs himself up, but persuades Donald Guthrie, Stanley Ah Tye, Louise Schmidt, and Lester Clarke, all of San Francisco, to join up. Sounds like a League of Nations flight. Robert also successfully sat for his Flight Lieutenant's bar with a swell report on the October, 1938, issue.

Another wholesale drive has been made by Gordon A. Mekellar, a ranking Air Adventurer of British Columbia who sends in three new coupons for Rodney R. Woods, Nels Hougum, and Thommy Douglas, all of British Columbia. You can't stop these Canucks when they get going. Gordon also came up to the mark for his Flight Lieutenant's rating with a neat report on our magazine. He's a fiend for air-fiction stories and likes Bill Barnes the best, and he is loud in his praise of our Ships in Black and White.

Frank McCarthy, of McAllen, Texas, wins his Observer's badge with a very complete report on a wild air show staged by the Veterans of Foreign Wars at the Valley Airport. About fifty-five hundred spectators turned out for the display, which was put on mainly by a gentleman known as Slats Rogers. From all accounts, they do some swell cowboy stuff with airplanes down there. Frank also included a neat drawing of the McAllen Airport, situated near McAllen, and we simply have to give him his Topographer's award on that.

Speaking of Topographers, we have another. Charles Young, of Charlotte, N. C., sends us his layout of the Charlotte municipal airport now used by the Eastern Air Lines. An interesting layout of runways down there.

John Gray, of Detroit, clicks for his Topographer's ticket with a detailed drawing of the Detroit City Airport. He knows all the points to look for, too. Any pilot could get into Detroit on Gray's plan. Nice work all around, Johnny.

Patrick Ferguson, of College Point, N. Y., has rounded up three more members and sent in their names. Ferguson rates high for his Flight Lieutenant's award with a comprehensive report on our magazine and it is quite clear that he likes our model-building features. He tells us he is taking a course in aviation mechanics.

We received a neat snapshot of a Beechcraft on skis which is the property of the Mackenzie Air Service of Edmonton, Alberta, sent in by B. Mussieux of that city. Mussieux uses the Eastman Bullet camera, which is fitted with a Meniscus lens and a rotary shutter. It was sent in mainly to show the details of the unusual ski gear.

David Stevens, of Goffstown, N. H., sends in three new members, Thelma Froberg, of Lafayette, R. I., William Ahlborg, of Providence, R. I., and John Sandberg, of Brockton, Mass. The last-named also sends in his report on Air Trails for November. John does not like the Light Planes Club. He thinks we should put more American planes in and not so many foreign ships, and he objects strenuously to having to find the run-over portions of stories and articles in other parts of the magazine. Outside of that, Air Trails is the best air magazine on the stands, according to young Sandberg.

We would like to present more American planes, John, but unfortunately American manufacturers do not build enough different ones in a year to keep our pages bright. Then, if we ignore what they are doing abroad, we shall miss many fine jobs. Whether they are good or bad—and many are good—we can always learn something about aviation from them.

George T. McAdam, a new Air Adventurers member, comes to the front with an idea. He feels after five years of model making that every model, whether it be powered by rubber or a gas motor, should have a complete set of controls. He feels that if the model can be built to scale and flown, there is no reason why the maker cannot incorporate a complete set of movable controls. Then, when it is ready to fly, he argues, the builder can set the controls for any type of flight.

Another Air Adventurer doing something about it is Lester Copeland, of Canal Winchester, O. Copeland, long a regular reader of Air Trails, is now enrolled at the Lincoln School of Aeronautics and at present is taking the home-study course, prior to his resident-training term at the school. He plans to become a limited commercial pilot, at least.

Edwin Olson, of Ely, Minn., sends us a nice shot of a Lockheed Electra he took out at the Minneapolis Airport. Edwin is a great booster for Air Trails, and at last we have convinced him that Air Adventurers is the club to join.

That's all we have time for this month. Don't forget to keep your news coming in. Remember, you're all Air Adventurers.

THE AIR TRAILS SPORTSTER

(Continued from page 45)

$^3/_{32}$x$^1/_2$" soft balsa. Where sharp radius occurs, the width should be decreased to $^3/_{16}$".

Our next step is to sand the entire planked surface smooth with a fine grade of sandpaper to approximately $^1/_{16}$" thickness. Our nose block, which is laminated of soft $^1/_2$" plank, is now cemented to the lower portions of bulkheads B-7L, B-7R, and B-7. Allow it to dry before attempting any of the carving. The sides and portions of the cowl, ahead and around Bulkhead 1, are also of $^1/_2$" soft balsa plank and should be carved to shape after the planks have been cemented.

Our battery box is next constructed and cemented at its specified location. Insert the aluminum tube latch before attachment to the linen hinge. Study closely the latch cover; its location, materials, and especially the spring arrangement. The spring is sweat-soldered over an aluminum tube and fastened at the lever end with solder. Lastly, the tail skid, coil and ignition installation should be cemented in place. This procedure just about completes our fuselage, with the exception of the $^1/_{16}$" square bamboo stringers, which are affixed in place as illustrated on Plate 1. Check for alignment on all parts.

TAIL AND RUDDER

The rudder and horizontal tail should be constructed over a full-sized layout. Select the wood for its even-grain qualities. Our lower spar is laid down first, over its designated position above the drawing, or in the case of the rudder, it may be our right or left spar. The ribs are then cut and cemented in place over the spars. While doing this, keep an eye on their proper alignment. After the assembling thus far has been allowed to dry, the $^1/_8$" balsa outline should be cemented in place. The outline should be roughly carved to the airfoil contour before attachment to the ribs. After the outline has been allowed to permanently adhere to the ribs, it can be finished off with fine sandpaper. The center section of the horizontal tail is covered on both sides with $^1/_{20}$" sheet balsa. The leading edge E, at the center portion of the horizontal tail, is left square for reasons illustrated by the isometric sketch in the lower right-hand corner on Plate 1. Study carefully the construction of the tab spars. You will note that they are "T" section beams to prevent dope distortion of the tab spars.

For added rigidity the spars on the horizontal tail can be boxed with $^1/_{20}$" sheet balsa between each rib. The tail should be covered with a light grade of bamboo tissue before affixing it to the fuselage. If the tail assembly shows any signs of distortion it can be steamed out easily.

The tabs are cut from a medium grade of $^3/_{16}$" sheet balsa, and they should be carved and sanded to their correct cross-section before attachment to the tail assembly.

It is a good idea to cover the tabs with a layer of silk to prevent splitting. Either annealed wire or .030 spring brass can be used as hinges. Note that the hinges pass completely through the tabs. A minute drop of solder should be applied at the end of each hinge to keep the tab from pulling out. When cementing the tail assembly in place on the fuselage, be sure to check for alignment, both before and after the cement has dried.

WING ASSEMBLY

The wing layout must be laid out to full size very accurately before any plan of attack is considered. All of the profiles on Plate 3 should then be traced and templates made for all the R-1 ribs. Note that the overall depth of the center-section ribs are decreased equal to the thickness of the $^1/_{20}$" sheet covering. Note, too, that the leading-edge covering on all ribs is recessed.

As can easily be seen, the wing is constructed in three sections—the center section and the two panels. The best procedure to follow in the construction of the panels is to lay the lower front and the rear spar over the scaled-up drawing. In our next step, cement and insert all of the ribs at their proper stations. Be certain that the ribs are properly aligned both fore and aft, and are perpendicular to the workboard. The butt ribs, which are laminated of two R-1 ribs, should then be cemented at the roots of each panel, at an angle which will result in the proper dihedral of each panel. The wing tips, which are of bamboo, should next be stripped to $^1/_{16}$ x $^3/_{32}$" with the $^3/_{32}$" dimension perpendicular. Be certain that the glossy surface of the bamboo is always on the outside of the tip. The bamboo can be easily bent to shape over a lighted gas stove or Bunsen burner.

The leading and trailing edges should then be cemented to the ribs and carved to shape. Keep checking for panel alignment during this operation. The tips can now be cemented to the leading and trailing edges. A light sanding should be given to the tips of the bamboo to break all the sharp corners. The same procedure is followed in the construction of the center section as in the building of the outer panels.

Box the front of all spars at "A," as

(Turn to page 96)

In the April AIR TRAILS

ANDES INTERLUDE

by William Herbert Randall

Famous ex-Pan American Grace pilot with more than three hundred Andes crossings logged

DEAD MAN'S RETURN

(Continued from page 41)

crete runway and into the wind, followed by Shorty. They whipped their ships into the air in long, low climbs.

Then the thirty-six hundred horses in the wings of the Charger bellowed as its single-blade props bit into the night air. As the runway faded away beneath it the retractable gear rose smoothly to disappear into the belly.

The three ships fell into a tight formation at ten thousand feet, with a Snorter on each side of the Charger, droning toward St. Johns at three hundred and fifty miles per hour.

As St. Johns flashed beneath their wings, fog came rolling in toward them —fog that immersed them completely. In a few moments great drops of rain appeared through the licking fog and spattered against their windshields and overhead hatches. Banks of angry black clouds raced in to settle down about them. Rain lashed at them in a mad symphony of sound and seeped down through the hatches and trickled across their decks and down their necks. They were flying blind and their radios were useless.

For five long, tedious, terrifying hours they fought a head wind that was made even heavier by the lashing of the rain. Front after front confronted them until, at noontime by their chronometers, Bill picked up the Croydon airport on his radiophone.

An hour later they had left the wall of England behind them over Dover and were above the menacing, choppy waves of the Channel.

At a little after five o'clock, European time, their landing wheels kissed the earth on the Brussels airport. They rolled their ships up on the apron and killed their power plants as the commandant of the field and a half dozen of his assistants stormed around them.

"Pretend you don't speak or understand any French," Bill shouted at Shorty and Red as they stepped out of their Snorters.

"Monsieur Handley?" Bill said to the commandant as he shook his hand.

"He is here," the man said in English. "Mr. Handley has make arrangements for you. Thees is Monsieur Handley."

Bill shook hands with the tall, thin-faced man of about thirty who had pushed his way forward.

"I have arranged about your ships," Handley said after he had talked to the three of them for a moment. "And I have a cab at the gate to take us to your hotel. Nobody knows you're here. The commandant will keep it quiet until you want to talk. I imagine that right now you want to talk to me."

"That's right," Bill said. "You're sure our ships will be all right?"

"Special guards to watch them," Handley said. "Let's go!"

A half hour later they were seated before a sumptuous meal in the sitting room of their suite at the Hotel Continental in the center of the capital of Belgium.

"I haven't asked you anything about Sanders," Bill said, "because I was afraid to ask you. I made arrangements to come here as soon as we had your first message. Morton said you were reliable, so I took a chance. Now I'm afraid to ask you what more you know for fear I acted too hastily."

"Morton explained all that to me in a cablegram," Handley said, his gray eyes serious. "As a matter of fact, I don't have much more for you now than I sent in that first message."

Bill dropped the fork he held in his hand.

"Let me explain," Handley said quickly. "I received a telephone call last evening from a man I trust implicitly. He has worked with me ever since I came here. He told me he had picked up information that Sanders was being held in Belgium. But he wouldn't tell me where he got it over the telephone. He insisted it was accurate."

"You haven't been able to check with him since?" Bill asked.

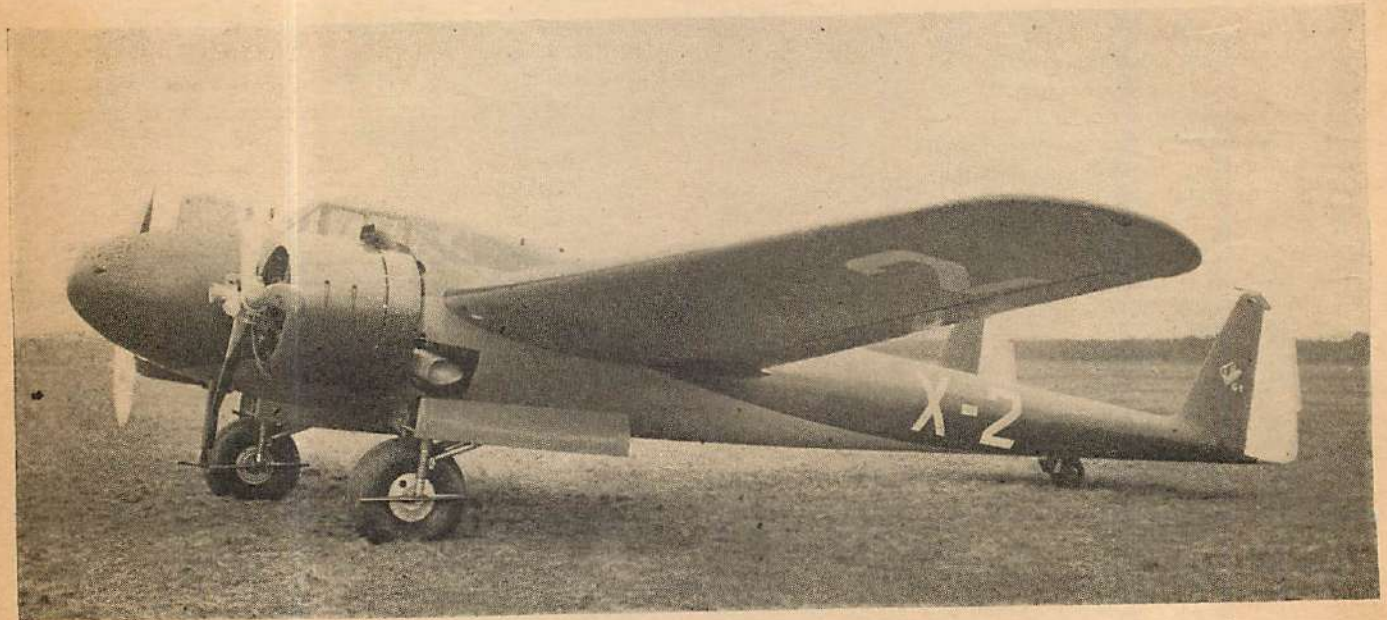
"That's it."

"Are you sure he spoke to you over the telephone?"

"Positive," Handley said. "No one could imitate his voice speaking English. But he has disappeared. I'm not alarmed yet. He may be following some clue he picked up or he may be making a careful check on the information he gave me. I won't be alarmed until tomorrow morning. If I don't hear from him by then I'll have to start moving."

"This man is one of your operatives?" Bill asked.

"Yes and no," Handley said. "He's a native Belgian, working for one of the political parties. For some reason he is trying to expose the Belgian minister of colonial affairs. A political scandal. I don't know just what is behind it. I came in contact with him because André Seraing, the minister of colonial affairs, is a friend and associate of an American I have been investigating," Handley went on. "We have nothing in particular except that we came across the fact that he has a forged passport. We're trying to find out who he is with-



The Fokker G-1 bomber-fighter on order for the Dutch government.

out letting him know it. Marat—he's my Belgian—and I have been working together because Seraing and Cassell have been working together."

"Cassell?" Bill said slowly. "That's the name of the American?"

"Yes, Chester Cassell. A big man with a scar for a face. We don't know much about him. He's supposed to be a capitalist and a metallurgist."

Then Bill remembered. He remembered the tall, stoop-shouldered man with the high forehead who had been in his office a few weeks before.

"I know!" he said suddenly. "A friend of Bev Bates' mentioned Cassell to me. He met him in Germany during the past summer. I remember the name because Mearson—that's the name of Bev's friend—told me he had mentioned my name to Cassell, and Cassell had almost strangled at the sound of it. He said Cassell had warned him against me."

"Do you know who he is?" Handley asked excitedly.

"No," Bill said, "I haven't the faintest idea. But I'd like to meet that guy face to face, find out why he hates me."

Handley laughed shortly. "I'm afraid you won't see him unless you can get an invitation to a dinner party André Seraing is putting on this evening. I know about it because it's my business to know where Cassell is and what he is doing. It's a farewell dinner given by Madame Seraing. The farewell is to Seraing and Cassell. They leave early tomorrow morning by plane for the Belgian Congo."

"The Belgian Congo?" Bill said. "That is under Seraing's jurisdiction, of course. I'm sorry I won't see him. What about this fellow, Marat? Shouldn't you be hearing from him before they leave?"

"I should," Handley said. "I'm going to write my telephone number and address down on a piece of paper in case you want to reach me." He gave Bill a slip of paper. "I'm going to start checking on Marat because I'm getting worried. The moment I have any word from him I'll get in touch with you."

"Right," Bill said as they shook hands. "We need a little sleep, but we'll be ready to go any second. We . . . we've got to have some action pretty quick, Handley—"

"I know, Barnes. I know how you feel. I'll move heaven and earth to find out what you want to know tonight."

V—"BE READY TO GO!"

NORTHEAST of the capital of Belgium, north of a line drawn from Malines to Maestricht, is a continuation of the coastal plain, a huge, barren, sandy country which even Belgian industry has failed to make fertile. This is the Campine, or Kempenland, which stretches across the Dutch and German borders. On the surface of this wasteland grow nothing but fir and larch that moan under the high winds that blow in from the North Sea.

At one o'clock of that morning, while Bill Barnes and his men slept the sleep of exhaustion in their hotel in Brussels, strange things came to life on a tiny air field hidden deep within the recesses of that wasteland.

Half a dozen men with masks covering their faces climbed into the huge cabin of a cyclocopter that stood beside the small, darkened hangar. They were silent as the big man who was their leader kicked over the two motors that gave power to the revolving wings and the motor in the nose whose prop provided horizontal thrust.

A moment later the weird device that looked like some huge prehistoric animal rose into the air in an almost vertical climb. The incidence of the revolving wings was altered as the strange bird circled and the big man in the pilot's seat laid the nose on the ancient city of Brussels.

When the cyclocopter was a thousand feet in the air a tiny biplane from which the wings had been stripped to make it into an autogiro rose from the same field with a single masked man at the controls.

An hour later, with their motors idling, the two strange craft circled above the Hotel de Ville on the Grande Place in Brussels. Dropping lower and lower, their muffled exhaust pipes muted, they settled down side by side on the flat top of a huge Gothic building near the magnificent Grande Place.

The pilot of the cyclocopter gazed skyward and listened with his head cocked on one side as he killed his motors; then he stepped out on the flat roof of the building.

"Get on your gas masks," he said to his fellow passengers in French.

As the pilot of the autogiro joined them he said, "Lift him out of the cabin and put him on the roof."

Four of the men lifted the unconscious form of another man from the cabin of the cyclocopter and placed him on the roof. The big man took a hypodermic needle from a case in his pocket. Under the screened glow of a flashlight he lifted the loose skin on the forearm of the unconscious man and jabbed the needle into it with an expert hand. He pushed down the plunger, extracted the needle and put it back in its case.

"Put him in the pilot's seat of the autogiro," he said.

The four men carried out his orders with a crisp, methodical precision.

"Break out those tanks. Be sure your masks are adjusted," he growled.

Two of the men opened a panel in the side of the cyclocopter. Each of them

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extracted a long nickel cylinder. The flashlight blazed to life again, and they made their way toward the southeast corner of the building. The big man played the flashlight on a corner where a glass skylight met stone.

"Here," he ordered.

The men unlocked the plungers in the head of the cylinders.

"Get the nozzles well in and pump hard," he said. "Let it go!"

There was a sudden hissing pop as one of the cylinders was pushed into the hole that had been cut through the glass. As soon as it was pumped empty the second cylinder was inserted.

The big man was lying flat on his stomach now, one of his ears glued to the edge of the hole. A faint smile twisted his lips underneath his mask as a faint crash sounded below, followed by another and another. As the second cylinder was withdrawn the big man stuck his flashlight through the hole and played it around the interior. Then he ordered his men to a roof hatch which had already been burned open with acetylene torches.

The iron ladder they descended led to a wide balcony that overlooked all of the interior of the building. Two of the men carried explosives and acetylene torches. The gas masks they wore protected them from the deadly poison gas they had expelled into the building.

Before the big man cut the alarm wires to the steel vaults he checked the three guards who a short time before had been living men. Two of them had fallen from their chairs into grotesque positions, their arms and legs sprawled. The third sat upright in a swivel chair, his face a ghastly green.

The big man glanced at the watch on his wrist. "You have twenty minutes to cut through and clear the vaults!"

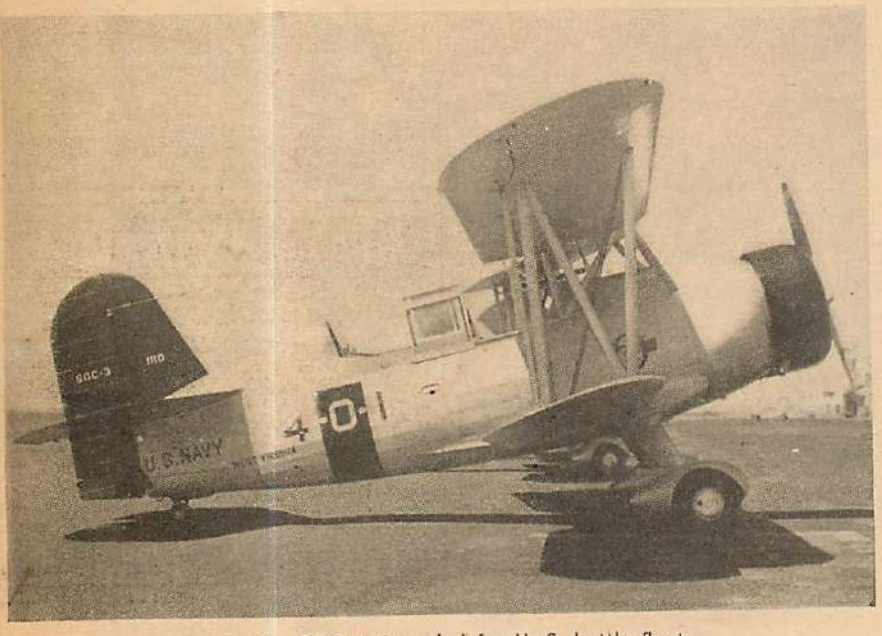
When the great steel door was thrown wide, fifteen minutes later, he played his flashlight inside the vault. He pointed to the half a dozen small wooden caskets that were carefully arranged on racks along the sides.

"One to a man," he said crisply. "I'll follow you up."

The five men each took one of the caskets under his arm. The big man took the last one under his left arm. In his right hand he carried a heavy automatic. He followed the five up the stairs to the roof.

He carefully stored the half dozen wooden caskets in the cabin of the fantastic-looking ship and ordered his men in behind him.

The revolving wings and the nose prop of the ship whined to life and bit into the cool night air. The ship rose again in an almost vertical climb above the ancient city as the big man poured in petrol.



Curtiss SOC-3, intended for U. S. battle fleet.

The autogiro with its unconscious pilot at the controls cast a strange shadow back there on the silent rooftop as the cyclocopter circled high overhead to return to its hidden base in the Kempenland.

Bill Barnes stirred uneasily as the telephone bell beside his bed disturbed his slumber. Almost automatically he picked up the instrument.

"Hello! Hello, Barnes," Handley's voice said in his ear.

"Go ahead, Handley!" Bill said. "This is Barnes! Do you have anything new? Have you located Sanders?"

There was a silence for an instant. Then Bill spoke Handley's name twice.

"Yes, yes!" Handley said. "I'm still on. But I can't talk to you now. We've located Sanders, but—"

"What the hell!" Bill roared.

"Wait a minute, Barnes!" Handley said. "Hold it. I'll be over there in a few minutes. While I'm getting there get your men up and dressed. Be ready to go! Do you get it? Be ready to go!"

VI—CONGO-BOUND

WHEN the thin-faced Handley came in the door of their living room ten minutes later the pupils of his eyes were large and round, and his face was the color of dirty plaster.

"Listen, Barnes. Young Sanders is down in the hoosegow. He's in jail! And by God, it looks as though he'll hang!"

"What the devil are you talking about?"

"A couple of hours ago," Handley went on, agitated, "the police got reports of two autogiros flying over the city. Just routine stuff they didn't pay attention to at first. A little later they had word that they had landed on the roof of the Union Minière de Haut Katanga. They made a routine check about that and found that the alarm wires to the steel vaults had been cut."

"What," Bill asked, "is the Union Minière de Haut Katanga?"

"Katanga," Handley said after he had stared at Bill for an instant, "is a district in the Belgian Congo. It supplies nearly sixty grams of radium to the world each year. That is, it supplies pitchblende, kasolite and torberite to the refineries in the Campine, or Kempenland, east of Antwerp. When the refineries get through with the minerals the refined radium is sent to the laboratories of the Union Minière de Haut Katanga, where it is placed in needles or plaques and distributed all over the world for therapeutic use."

"What the hell does all that have to do with Sandy?" Shorty wanted to know.

"Shut up!" Bill snapped. His mind was working like chain lightning now. "Go on," he said to Handley.

"When the police arrived at the laboratories they found that the vaults had been robbed of the Union's entire reserve of radium—nearly three hundred grams, worth in the neighborhood of seven million dollars. The place had been entered through the roof. Two autogiros had landed on it. When the police arrived one of them was still there and young Sanders was in the cockpit."

"Alive?" Bill whispered.

"Yes. He was sitting in the cockpit of his Eaglet. The wings had been taken off and it had been made into an autogiro. He was full of dope, babbling like a baby when they found him."

"Where is he?" Bill snapped.

"In the office of the prefect of police. But I don't know that you ought to see him! When the police questioned

him he told them he had come here with you to rob the Union of its radium!"

"He *what?*" Bill shouted.

"That was his story, and he is sticking to it," Handley said. "The only way I can figure it is that he has been doped for days and that story has been pounded into his head until he believes it himself. I talked to him. I told him I knew you and he told me the same story. The police are making desperate efforts to find out just where you are now. The newspapers have got the story and they're playing you up as an American gangster. Do you get the picture?"

Great beads of perspiration had oozed out on Bill's forehead. "Someone," he half whispered, "has framed us."

"You've got to think fast, Barnes," Handley said. "I know you didn't do it. You can prove it in time, but once you get inside a Belgian jail you'll have a hell of a time getting out to do your proving."

"Wait a minute," Bill said slowly. "Things are beginning to dovetail. I received a letter from Canada about a deposit of radium ore up near Coronation Gulf inside the Arctic Circle. I sent Sandy up to get the facts. That was when he was shot down and snatched. Radium. . . ."

"I know a little about the radium situation," Handley said. "I've been interested since I've been here because of the Union and the fact that the Belgian Congo produces more than half of all the ore. Alberta is producing a lot now, too. Since they found deposits there the price has dropped from seventy thousand dollars to twenty-five thousand dollars a gram. There are only about six hundred grams in the world."

"And if these thieves get away with the Union's reserve of three hundred grams the price will go above seventy thousand dollars," Bill said.

"I hadn't thought of that. That's what they're trying to do—get control of the market!"

"Wait a minute!" Bill snapped. "Have you heard anything more from this fellow, Marat, who gave you the report about Sanders?"

"No, nothing—"

"You probably won't! He was given that report to get me here. They worked the whole thing out nicely. Can you find out if this fellow Cassell and the minister of colonial affairs have started for the Belgian Congo yet? Things are *still hazy in my mind*, but they're beginning to click!"

"They'll leave from the same airdrome where you came in," Handley said. He reached for the telephone and called the airdrome. A minute later he reported: "They left a half hour ago in Cassell's plane!"

"Do you know what route they'll take?" Bill asked.

"Paris, Marseilles, Oran, Naimey to Leopoldville in the Congo. They'll follow the only established air route."

"Can you get two of our ships out of the airdrome with the tanks filled?" Bill asked.

"I can try," Handley said. "But look here, Barnes! I can't afford to be left here holding the bag. What about Sanders?"

"Red will have to go take the rap with him for the time being," Bill said. He turned to Red. "It's the only way, guy. I've got a hunch that this fellow Cassell and Seraing are mixed up in this thing. We don't have time to get in touch with Morton and go through a lot of red tape. You'll have to give yourself up to the police. Tell 'em I sent you and that I'll be back. See that Sandy is taken care of. I'll expect you to help with that, Handley."

"I'll do everything I can, Barnes. But if you expect to get your ships out we've got to work fast. The airdrome won't know about the robbery yet. If they do, there won't be a chance."

"All right!" Bill half snarled. "Let's go! Red, you go with us to the airdrome and then go back with Handley. You know we'll see you through. It may be tough for a few days. You just don't know what has happened to me!"

Twenty minutes later Bill climbed into the forward cockpit of the Charger while Shorty entered a Snorter. Their motors were warmed up and Bill was giving last-minute instructions to Red Gleason when Handley, standing by Red's side, shouted and pointed toward the administration building.

Bill saw a half dozen gendarmes rushing toward their planes. He stood up and waved an arm above his head to attract Shorty's attention and pointed.

The next instant the Snorter was racing down the center runway, with the Charger on its tail. They whipped the two ships into the air after an incredibly short run.

The grease monkeys, mechanics and officials at the Brussels airdrome are still talking about that take-off.

VII—BULLET-PROOF PLANES

AT fifteen thousand feet they leveled off and Bill threw the key of his radio and spoke to Shorty.

"Well, fella," he said, "we've stuck our chins out. Don't forget to duck!"

"What's up your sleeve, Bill?" Shorty asked anxiously.

"I'm playing a hunch. This fellow Cassell fits into this picture in some way. I'm not sure just how. I won't tell you just what my hunch is now because I may be wrong. We're heading for Leopoldville on the Congo. If Cassell has that radium, he'll be getting to Leopoldville as fast as he can."

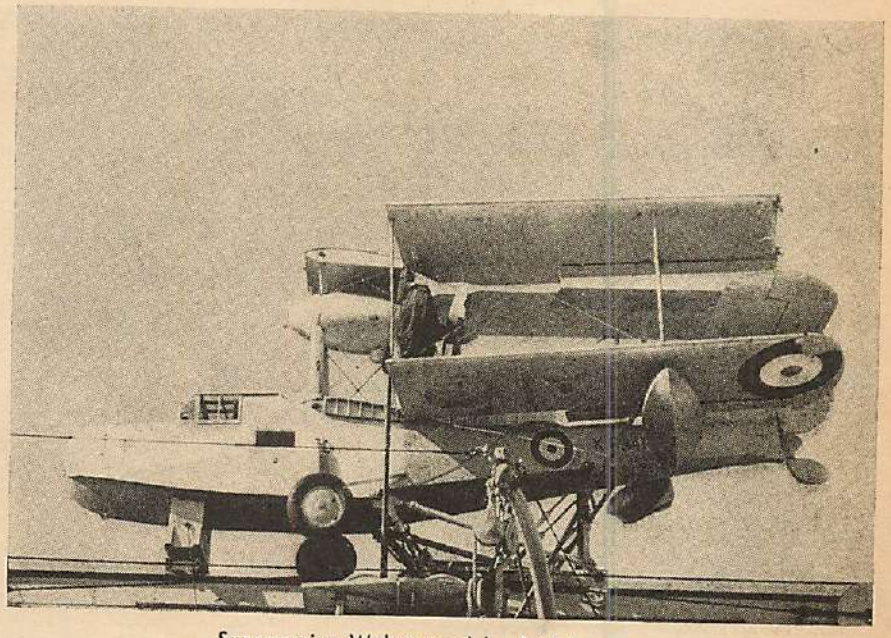
"You think Cassell engineered it?" Shorty asked quickly.

"I don't know. I'm signing off to contact Tony."

But he couldn't contact Tony Lamport on Barnes Field. Interference from storms over the Atlantic prevented him from getting through on their secret short wave length or their regular commercial assignments. He worked at it until after they had left the French port of Marseilles behind them and were nearing the Balearic Islands.

An hour later they fishtailed into the airport at Oran and held their breaths while Bill had his papers checked and they had their tanks refilled.

Leaving Oran, they nosed upward above the Atlas Mountains, vast stretches of lonely hills silhouetted



Supermarine Walrus used by British navy.

against the blue sky. Here and there were pale-green meadows over which trains of camels and turbaned Arabs made their way. But on the tops of the barren, desert mountains no life existed or ever had existed.

Then, that great desolate waste which is the Sahara stretched out before them as far as the eye could see. The sun and the ever-rising heat from the desert made their eyes burn. Over Tessalit, just beyond the Algerian border, Bill double-checked his instruments and double-checked with Shorty on their position and their course to Gao and Naimey.

At Naimey, where they stopped overnight, they learned that the single-motored ship carrying Chester Cassell and André Seraing to Leopoldville had refueled there and hopped on to Fort Lamy.

"Keep your eyes open, fella," Bill said briefly the next morning as they leveled off and plotted their course to Zinder and Fort Lamy. He was beginning to doubt the wisdom of the thing he had done now, and cursed in his mind.

The sweltering outposts of Zinder and Fort Lamy showed under their wings and were gone. The desert sands stretched away in a dead level, covered at times with a desolate gray bush, like sage. Skeletons of camels and an occasional gazelle were the only things that met their gaze, except the desert and the sky. Heat rolled in on them until it seemed they would smother.

When Ouanda Djalé was behind them Bill said into his microphone: "That's about half the distance to Leopoldville. Now comes the tough leg with the Equator coming in to meet us."

But at that moment it was not only the Equator that was coming in to meet them. There was death lurking in the wisps of cumulus clouds just above their heads, death that bared its fangs as three gleaming bullets that were three middle-wing monoplanes came plummeting out of nowhere, with their powerful chemically cooled engines bellowing and their machine guns vomiting steel.

"Take it away from 'em!" Bill screamed into his microphone as he dropped the nose of the Charger and opened his throttles.

The two single-blade props of the Charger whined in protest as a gale screamed along its sleek sides and the Snorter dropped its nose to keep pace with it. Down and down the two ships sped, until it seemed they must fly into a million flaming pieces and dissolve into thin air.

At five thousand feet, as the Charger reached terminal velocity, Bill coaxed the nose up with the touch of a master. The Snorter eased out of its power dive with him, and they came up in a great sweeping turn as the three enemy ships plunged beneath them.

"All right!" Bill shouted. "Let's take 'em!"

They eased the noses of their ships down again in a shallow dive to make their guns effective. As one of the gleaming ships nosed up and over in a fast Immelmann, Shorty pulled his Snorter up into a loop. At the top he centered his controls. The weight of his body sagged on his safety strap as he hung head downward and lined up the monoplane in his sights. His guns belched streams of death. The pilot of the middle-wing ship tried to skid away. But Shorty's aim was deadly, and his bullets played a tattoo on the crabbing ship from stem to stern before it could get out of range. Shorty rolled his Snorter right side up and waited for the enemy ship to yaw and whirl into a spin.

Then Shorty's eyes bugged as the monoplane's nose came up in a flashing chandelle and returned to the attack!

The pilot of the ship Bill had singled out tried to escape in a fast climbing turn as Bill fired his first tracer. He eased the wheel over and tapped his rudder as his guns began their song of death. His bullets wove a pattern along the cockpit of the enemy ship as it slipped off on one wing.

Again Bill tapped his rudder to correct his aim and poured round after round into the fleeing ship. He, too, waited for his enemy to plunge to his death in a spin. Consternation and amazement were written on his face as the ship leveled off and maneuvered to join the other two who were closing in on Shorty above him.

Then a picture of Dudley Mearson in his office on Barnes Field flashed through his mind, and the things Mearson had told him about Cassell. He reached for his radio switch.

"Hang your Snorter on her props and get upstairs!" he bellowed into the microphone. "Their wings and fuselage are covered with a metal alloy that sheds bullets the way a duck sheds water. The sliding hatch over the pilot's seat is bulletproof glass and the crash guard behind his head is armored. Don't let 'em get in close and gang you. Stay away from 'em!"

"How the hell am I going to stay away from 'em?" Shorty roared back. "They're as fast as my Snorter. They're going to make a sieve of me, Bill!"

"Hold it, guy," Bill said as he leveled the Charger off and laid the nose on a ship that was coming up under Shorty's tail. "I'll have to get 'em with my cannon."

He was moving at a terrific speed as his finger clamped down on the trip of his 23mm. Madsen. Five of his explosive shells drove into the long, sleek nose of the armored ship. As he pulled the nose of the Charger up the monoplane became one great ball of black smoke and orange flame. A moment later the

stricken ship disintegrated with a finality that was appalling.

Then Bill chandelled the Charger around with the speed of light and went after the second of the gleaming ships. But the pilot had seen him and skidded his ship out of range.

The two ships streaked and tumbled through the sky, filling the air with red-hot lead. Bill fired burst after burst from his cannon without telling effect.

Then a curse ripped from Bill's frenzied lips as he saw Shorty's Snorter tumbling over and over in the air above him, and he knew that the third armored ship had been too much for his companion.

He rolled the Charger level at the top of a loop to throw off the enemy ship that was on his own tail. Then he twisted up and back in another slashing chandelle. The two ships raced at each other again at terrific speed. But this time Bill anticipated the man's direction as he started to slip out of his line of fire.

His finger came down on his cannon as he corrected his aim. One instant Bill could see the man's head behind his windshield, and the next instant it dissolved into black smoke and saffron flame. Flames shot out in every direction as the gas tanks of the ship exploded.

Then he jammed the wheel of the Charger forward and dove on the tail of the plane that was trying to deal a death blow to Shorty as his Snorter plunged toward the earth half out of control.

He saw the white, twisted face of Shorty as he struggled to release himself from his safety strap, bullets zipping all around him. Rage such as Bill had never known before engulfed him. He laid the nose of the Charger on the third of the enemy ships and held it there until it seemed there was no way to escape a crash that would mean sure death.

Then his explosive bullets tore into the midwing monoplane as he yanked back on the wheel. The belly of the Charger almost scraped the tip of the dying prop of the ship beneath it as it went to pieces. Bill stuck the nose of the Charger down toward the whirling Snorter. He saw Shorty's white-clad figure struggle up out of the cockpit, fighting with all his strength to overcome the centrifugal force of the falling plane. He saw him get one leg over the coaming, saw him roll clear of the whirling wing and tail.

The pilot 'chute on his back opened up to drag the main 'chute after it. Bill dived and circled as close as he dared to see Shorty raise one hand with the thumb sticking upward to tell him that he had not been wounded.

Bill followed him to the ground as he gathered in his shrouds and collapsed his parachute.

"You're all right, fella?" Bill said anxiously a few moments later.

"I'm all right, except that I'm sore as hell," Shorty stormed. "Imagine letting that kiwi shoot my buttons off. We're out a Snorter because of my lousy work. I—"

"Those birds could shoot and they could fight," Bill said. "And you couldn't touch 'em with that armor on 'em. But don't worry about the Snorter. It will be worth it if my hunch turns out to be right, and I think it will be."

"What do you mean?" Shorty asked. "Who is this guy, Cassell?"

"He's—" Bill began, and stopped. "I'm not sure yet," he went on. "But I'm sure he sent out those three ships to stop us. He knows we're behind him. We've got to go like hell or we'll be too late."

VIII—THE MAN CALLED CASSELL

HUMID, enervating air rose from the dank jungles below them as they crossed the line from French Equatorial Africa into the Belgian Congo. Huge crocodiles and hippos sunned themselves along the banks of the Ubangi. A huge bull elephant threw up its trunk and trumpeted its defiance as Bill stuck the nose of the Charger down to skim above a roving herd that broke with flapping ears and gleaming tusks.

Where the Ubangi ran into that great sluggish sea of winding mud that was the Congo River, Bill altered his course to the southwest to lay the nose of the Charger on Leopoldville.

The airspeed indicator on his instrument panel read four hundred and fifty miles an hour as he poured soup into his pancaked Diesels. He knew now that his only chance was to catch up to Cassell before he reached the capital and had an opportunity, with the aid and connivance of Seraing, to place the little cargo of radium they carried in a safe place. He knew that unless he could catch them with the radium his own story and the reason for his flight to the Congo would sound ridiculous to the officials and to the world. He was certain that if Cassell saw him on his tail as he prepared to land at Leopoldville, Cassell would turn and try to destroy the one man in the world who had seen behind the mask that was a scarred face.

He was so immersed in his thoughts and his conjectures that he didn't hear that middle-wing monoplane as it screamed down on his tail. He heard it only when he felt the slashing drum of machine-gun bullets ripping through the metal skin of the Charger.

His blood turned to ice water as that sleek, stainless metal catapult went under him like something driven out of hell. He turned his head and saw that Shorty was frozen to the navigator's seat just behind him.

"Get back into the after cockpit and break out that gun!" he roared above the drum of his own engines. At the same instant he yanked the wheel of the Charger back into his stomach.

Shorty dove for the gangway that separated the forward cockpit from the gunner's pit in the tail. He crawled along the cantilever beam between the two main fuel tanks that formed the passage and dropped into the gunner's seat and snapped on the safety belt. Leaning forward he worked a control, and the low, transparent whale-back extending aft of the gun track turned smoothly on its longitudinal axis and disappeared into the fuselage. He unlocked the .50-caliber Browning nesting under it and pulled it into position.

As Bill hung the Charger on its props he disengaged the sliding seat. With a smooth motion the gun swung upward as Shorty slid almost out of sight under the rear deck. When the Browning's barrel was vertical, Shorty was lying almost flat on his back, with his eye glued to the ring sight above him, waiting for that instant when he could get the silver ship under his gun.

"Now," Bill said to himself as he roared upward, "I will learn. I must be right or he wouldn't have waited for me. He knows that I know!"

He looked over the side, saw the sleek monoplane pull out of its dive and begin to climb with a speed that was appalling. His face became a grim mask of determination as he said: "This time we will finish it!"

He clamped down on the rim of his 23mm. Madsen as his eyes flashed over his ammunition counters. He fired a short burst to be certain that it was not jammed, and then he and the Charger became as one.

The two silver ships leveled off at fifteen thousand feet, and they were over a thousand feet apart as they began those first feinting thrusts that would lock them in actual combat. Suddenly, so fast that a naked eye could not have followed their maneuvers, they were at each other's throats.

The silver monoplane zoomed up underneath the wings of the Charger with its guns spewing burst after burst of fire. Lead chewed through the leading edge of its port wing before Bill could slip the Charger out of range. It roared upward until it almost stalled, then flipped over and came down on Bill's tail as he started a sweeping turn to the left.

Shorty's finger clamped down on the trip of his machine gun just before Bill half-rolled to get out of that deadly hail of lead. He had the silver monoplane dead under his sights, and he knew that his bullets were pounding hard on into

its nose. But it seemed to shed them without an indication of distress.

The next instant they had leveled off again and were roaring at each other with terrific speed. Bill's finger clamped down on the trip of his cannon only to see the midwing monoplane slip out of his range of fire. He came up and around in a lightninglike chandelle and dived again with his cannon roaring. But the silver ship crabbed out from under his sights as though it was moved on threads by the fingers of the god of luck.

It was an aerial combat such as no one in "darkest Africa" had ever seen before. There was no quarter asked and none was given. It was a duel to the death, with the hands of two masters guiding the strokes. They both had that knack of seeming to fly on a straight course while actually they were drifting a little away from it to keep out of the sights of their opponent. They roared by each other so close that at times a cigarette paper could not have been inserted between their wing tips.

Then they were up and back, each in a flashing chandelle, with their guns screaming. And this time Bill saw the thing for which he had been waiting.

As the pilot of the silver monoplane came within range he was traveling at a terrific speed. Too fast, it seemed, for accurate shooting. As the two guns mounted along his engine housing began to spew forth lead and flame, and just before the two ships passed, the pilot of the silver ship swerved his in fast to the left, like a falcon about to strike its prey, for a death-dealing burst of fire.

Blood pounded in Bill's temples as he yanked the Charger out of its mad path to avoid the crash that seemed inevitable. Even in that moment, so close to death, he felt the warm glow of elation suffuse his body. Now he was certain. He threw the key of his intercockpit telephone and roared into the microphone.

"I was almost sure before," he shouted at Shorty, as he started climbing for the advantage of altitude, "but now I'm certain. Cassell is Mordecai Murphy, the Saver of Souls!"

"He died off the Isle of Wight!" Shorty's voice finally answered.

"He didn't die! In some way he saved himself. That's where he got the scars for a face. This is the fourth time I've fought him, and I know his tactics. It's Mordecai Murphy, and I want him alive."

It was almost impossible to believe, and he knew now that unless he took Mordecai Murphy back alive no one would ever believe him. He was as certain himself as a master of criminology would be if he had Mordecai Murphy's fingerprints before him. Because no one else in the world had ever developed that certain swerve in to the left as he was about to annihilate his enemy.

The silver ship was coming up beside him in a climbing turn. When it was above the Charger, Mordecai Murphy dropped the nose as Bill began a sharp turn to the right. He was ready to skid the Charger out of range as the monoplane nosed down within range. But no burst of fire came from the guns of the sleek ship until it had dived under the Charger to nose up with a terrific blast. Desperately Bill tried to get the silver ship under his sights. The other dropped into a dive that ended in a loop.

It was at that moment that Bill discarded the dive-and-zoom method for infighting. He knew that he must get in close where he could use his cannon or Murphy would kill them both.

He came up and over in a series of Immelmann turns until he got on the tail of the silver ship. He saw his tracers from his machine guns weave above the tail assembly of the silver ship and then ricochet off as Murphy rolled it out of range.

Again they came roaring at each other head-on, and this time Bill waited until Murphy made that quick swerve to the left with his guns yammering. Then he kicked his rudder with that touch that is just enough as his finger came down on his cannon trip. His finger kissed the trigger for an instant to send two explosive shells into the tail of the speeding monoplane as it passed.

He saw the tail assembly of the monoplane disappear in a great cloud of black smoke. As it came out of the cloud a third of the ship was gone into a thousand pieces, with only an engine and ailerons for Murphy to use for controls.

"You got him!" Shorty screamed as the tailless ship nosed down, too steeply, toward the side of a rolling hill that was partly clear of vegetation.

"Yes, but I want him alive!" Bill said. "And I want his cargo!"

He brought the Charger around in a great sweeping bank as he watched Mordecai Murphy fighting desperately, warping with all the skill at his command to bring the silver ship down safely.

"Get ready to get over the side fast if he gets down," Bill shouted at Shorty.

Bill was only a little behind the crippled ship as it nosed into the side of the hill, rolled along safely for a hundred feet and then went over on its back. Bill held his breath for one awful instant as he waited for the gas tanks in the ship to explode. Then he set the Charger down on the side of the hill and raced it toward the wreck that had been a sleek monoplane.

As his speed diminished he gently locked his wheel brakes and went over the side of the Charger in one great leap. At the same instant a single goggled-and-helmeted head appeared be-

neath the coaming of the wrecked monoplane. And even at that distance Bill could see the scars that were below the goggles on the man's face.

Mordecai Murphy's hand came up with an automatic in it; he took careful, deliberate aim as Bill raced toward him.

Bill could feel the breeze from two of the bullets as they passed his head. Then something struck the side of his left leg that whirled him half around and plunged him to the ground. He saw Shorty drop beside him as the helmeted figure by the plane ducked around it.

"Did he get you, fella?" Shorty gasped.

"Just a flesh wound," Bill said, and he was up and running again, his hand gripping an automatic he had taken from an overall pocket.

They saw Mordecai Murphy plunge into a rim of dense jungle growth at the bottom of the other side of the hill as they reached the top. For an instant the man turned and raised one hand to his forehead in salute. Then he was gone.

IX—SIGNED, THE SAVER OF SOULS

A WEEK later Bill Barnes sat in a large, overfurnished room with Shorty Hassfurther, Red Gleason and the pale-faced Sandy Sanders beside him.

In the room were high-ranking officials of the Belgian government and the officials of the Union Minière de Haut Katanga. An interpreter stepped to Bill's side as he rose to his feet and began to speak.

There was something of a smile on his lips as he first gazed at the solemn faces surrounding him. A smile that was one of both triumph and regret.

"Gentlemen," he said, "I am sorry that I caused you such consternation by my hasty flight to the Belgian Congo to recover the six boxes of radium that are now back in your vaults. What I want to say to you now is a word about that archcriminal Mordecai Murphy, who once called himself the Saver of Souls. I want to impress on you that it is imperative that you keep up a never-ending search for him. He will be a danger to civilization until he is dead.

"You all know the record he has behind him. Enormously wealthy, he was said to have had a finger in affairs in every part of the world. He was decorated by your own government for his feats during the World War. Many items appeared about him in the press. But never anything definite. He was truly a man of mystery.

"He traded in men, making them his tools in the nefarious enterprises he carried on, men he had saved from paying the penalty of their crimes. Men who had made him great promises in return for his seeming acts of charity and kindness. To them he had been the great emancipator. The Saver of Souls. It was so that he trapped Seraing when he was desperate and about to do away with his own life.

"He is a genius at knowing men and taking advantage of their weaknesses. It was so that he trapped me in this, his latest, and I hope last, enterprise. He hoped to place me in the position he was in after I had shot him down off the Isle of Wight and he managed to survive. How we don't know. But he had taken care of just such an emergency, we now know. He had transferred money and property and wealth to the name of Chester Cassell.

"The scars he received when I shot him down off the Isle of Wight helped him create a new personality. But underneath the surface he was the same. A man of cunning and intrigue, and with diabolical ideas always lurking in the back of his head.

"Who else but Mordecai Murphy would trade in human suffering as he intended to trade with the radium he stole? He believed that he could control the radium market and raise the price to exorbitant figures by controlling the amount of pitchblende that was brought out of the Belgian Congo, with the help of André Seraing.

"He knew human nature well enough to know that after he had kidnapped young Sanders and his plane, and I had had no word of Sandy in two weeks, I would jump at any clue. He knew that I was working with James Morton, the chief of the bureau of criminal investigation in the United States. He knew that I trusted Morton and his men. That is why he forced Marat, your own operative, to communicate the news to Morton's man, Handley, that he believed Sanders was in Belgium. He knew that I would come without hesitation. He had the whole thing clocked to perfection.

"It came to me the night I landed in Belgium that Chester Cassell might be the Saver of Souls. I had heard that Cassell hated me in a roundabout way that has nothing to do with my report to you. When Handley told me that he was traveling under a forged passport and that they were investigating him, Mordecai Murphy flashed through my mind. Because, as I have said, I knew that Mordecai Murphy was a most amazing man.

"When I heard of the precision and cleverness with which the robbery was performed, Mordecai Murphy came to my mind again because I knew how much he hated me. He wanted to place me in the same position he had been in. He wanted the world to loathe me. He very nearly succeeded. I played a hunch. Women, I believe, call it intuition.

"When Hassfurther and I were attacked by three of his armored planes over French West Africa, my suspicion became almost a certainty. I wanted more than anything else to get the radium I was sure they were carrying. Next to that I wanted to bring Mordecai Murphy back alive.

"I failed in the second undertaking. That is why I wish to impress on you that you must keep up an endless search for Murphy. He will hate the Belgian government and the Belgian people now as he hates me. Seraing is safe from his vengeance because he is dead. But your government is not and I am not. I pray that you will not stop until Mordecai Murphy is dead!"

After Bill had seated himself an official of the Belgian government got to his feet, and through the interpreter, thanked him and told him that the highest of their decorations had been awarded to him and to all of his men, along with a sizable reward in money.

Bill rose again and thanked them.

Before he sat down he pulled a cable blank from his pocket. "There is one thing I forgot to tell you," he said as he looked at the cable. "It is a message from Mordecai Murphy that was relayed to me from Barnes Field, Long Island. 'We shall meet again,' it reads. It is signed, 'the Saver of Souls!'"

THE AIR TRAILS SPORTSTER

(Continued from page 87)

indicated on Plate 2, between each rib with $^1/_{20}$" sheet balsa. The boxing forms a greater glue surface for our wing joiner, and also adds to the rigidity of the wing. The panels and center section can now be joined together. Cut the joiner notches adjacent to the front spar, and cement the butt ribs of the center section to the butt ribs of the panel. The panels should be blocked up at the tips to correct amount of dihedral. Be absolutely sure that both panels possess the same amount of dihedral. After this has been checked, the joiner of hard $^1/_8$" sheet balsa can be inserted onto the ribs and cemented in place against the boxing. The sheet leading edge and the sheet center section covering can next be applied. The sheeting should be finished with a light sanding with ten zero sandpaper. We complete the sanding of the entire structure of the ship with the rounding off of the longerons.

The entire ship is covered with a light grade of bamboo tissue, and three coats of dope are applied throughout.

TEST HOPPING

The model should balance at thirty percent from the leading edge after assembly. If the deviation is slight, a correction can be made with the tabs. If the model shows a great deviation from the thirty-percent point, a redistribution of weight will be required. Glide the model over tall weeds. The model should show no signs of any stall tendencies. The flight altitudes, while gliding, should not vary from the time it leaves your hand to the time it touches the ground. Progressive power increases with short motor runs are recommended. Gradually increase the power after making adjustments on each succeeding hop. Be sure to engage the timer before letting the ship hop.

BILL OF MATERIALS

(All lengths 36")

Fuselage

4 pcs. $^3/_{16} \times ^3/_{16}$", longerons
2 pcs. $^3/_{16} \times ^3/_{16}$", front diagonal bracing
2 pcs. $^1/_8 \times ^3/_{16}$", rear diagonal bracing
2 pcs. $^3/_{16} \times ^3/_{16}$", cross members
2 sheets $^3/_{32} \times 3$", bulkheads
1 pc. $^3/_{16} \times 1$" med., tail support and wing-mount longerons
1 pc. $^5/_{16} \times ^1/_2 \times 12$", motor bearers
1 pc. .0625 piano wire (36" long), landing gear
1 pc. $^1/_2 \times 2$" soft balsa, nose block

Tail Assembly

1 sheet $^1/_{16} \times 3$" med., ribs
1 sheet $^1/_8 \times 2$" med., outline
4 pcs. $^1/_4 \times ^3/_{32}$" hard, spars

Wing

1 sheet $^1/_8$" hard, spars
4 pcs. $^1/_8 \times ^1/_4$" hard, spars
3 sheets $^1/_{16} \times 3$" med., ribs
2 pcs. $^1/_4 \times ^3/_4$" med., trailing edge
2 pcs. $^1/_8 \times ^1/_8$" hard, leading edge
4 sheets $^1/_{20} \times 3$", sheet covering
1 pc. $^1/_8 \times 1$" hard, joiner
2 strips of $^1/_{16} \times ^1/_4 \times 15$" bamboo, tips

Miscellaneous

1 pc. $^3/_{32} \times 1$" hard, battery box
1 pr. 2⅝" airwheels
1 pint dope
4 ozs. cement
4 sheets 10 zero sandpaper
4 sheets light bamboo paper, 18 x 24"

Editor's Note—Cut-away drawing for this article was made by Frank Tinsley; model plans by the author.

C. A. V. U.

(Continued from page 8)

Trails is heartily in accord with this request. It seems to us that these aviation schools, who have been through the mill in learning how to instruct civilian fliers, kept actively alive the aëronautical education of the layman enthusiast and would-be pilot, and made envious reputations for their thoroughness and integrity, are the logical ones to participate in this great and timely program.

Naturally military training must be of a different order and discipline than the regular civilian training, but as the majority of the material to be included in this "back-log pilot" training comes from the collegian type of family circle, it is just possible that the usual aviation system of military training will have to be altered to make the program attractive and efficient. Be that as it may, we feel that the established schools are completely justified and entitled to request consideration in this allotment of government subsidy.

★ ★ ★

The Rolls-Royce Merlin 2M develops one thousand three hundred and twenty horsepower available for take-off. As commendable as this is, engineers recently made a startling announcement. The Merlin's potential output, yet unexploited, is eighteen hundred horsepower!

★ ★ ★

The world's air authorities have long panned the British super-super Hurricane and Spitfire. Criticism has centered

on the wooden propellers with which these capable ships are equipped. "Club" seems to have been the most commonly used descriptive adjective. It is significant that variable-pitch props are now to be utilized on both machines.

★ ★ ★

America is not going to enjoy a monopoly of the transatlantic airways, as she did with the Pacific. Newest contender for ocean air mail is the Italian Cant seaplane, which already holds eight world records. This design has already proven itself in transport service for the air line Ala Littoria and as a coastal defense bomber for the Italian Air Force. Three one-thousand-horsepower Fiats afford a top of two hundred and sixty miles per hour. The ship is novel in that conventional floats and bracing are used.

★ ★ ★

California Flyers School of Aviation has snagged our old friend, Lieutenant Commander G. O. Noville as director of training. When we ran into the commander on the west coast last spring he was all full of plans for the future, but either he's a good poker player or he hadn't been approached at that time by this famous school, for nary a word about anything except stories, plots, and flying with Dick Byrd at the south pole. Both parties of the new combine are to be congratulated.

Johnny Jones, no doubt known to you by this time as the lad who set a coast-to-coast record in an Aeronca, is an alumnus of California Flyers, having taken flight training there.

★ ★ ★

December 26th was a black day for the cross-Channel services. A blizzard succeeded in grounding all lines for the day—German, Belgian, Dutch, Swiss, French, and English, operating from Le Bourget to England and central and eastern Europe. Ordinarily there would be no news to this, but it is the first time in ten years that Channel service was grounded. There's a record for you.

★ ★ ★

We have had our Lindberghs and our Corrigans, as well as a few dozen other ocean-hopping airmen, both lucky and unlucky. But when a gas model sets out to fly the ocean that is news! The liner, *Nieuw Amsterdam*, en route to Rio de Janeiro from New York City, was struck by a gas model marked *Dawn Patrol* when four miles off Sandy Hook.

★ ★ ★

Considerable interest was aroused recently when Major George Fielding Eliot, formerly of the Military Intelligence Reserve and now an authority on defense policy, claimed Germany's air force to be but one third the size acceptable as a fact by the rest of the world. Not ten thousand planes, but three thousand, represents the awesome Reich air weapon, according to the major.

★ ★ ★

Aviation is a young man's business, yet to the thousands of young men who nearly despaired of ever getting a "break" it will be glad news to know that the apprentice system is at last getting under way. As yet few plants are experimenting with the system, and those that are are training men already employed toward a master craftsman's degree. Work in the plant is combined with adequate study in some institution or in some air school, both on salary. Probably the realization of inadequate trained personnel in time of national emergency lies behind the idea. It may be hoped that the current emphasis on armament preparedness will cause the apprentice system to be extended to include those who have no other hope of becoming a part of their favorite industry.

★ ★ ★

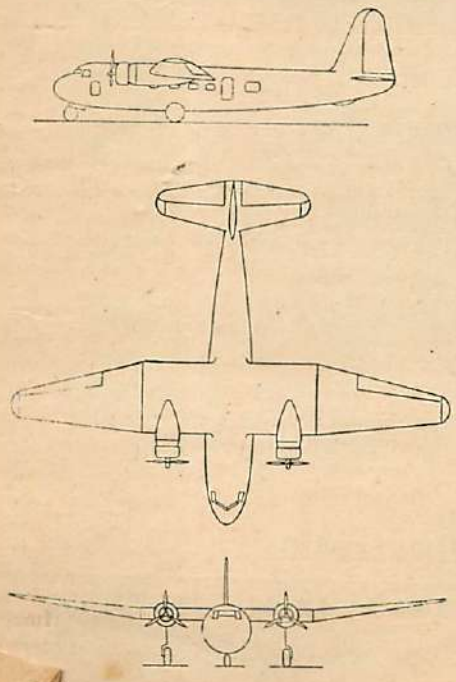
When Jane's "All the World's Aircraft" came out recently in its annual addition, observers were startled and some concerned to find reference to a secret fighting design that "will give all the world furiously to think." For a long time now the world has been subjected to a landslide of Spitfire and Hurricane propaganda. Despite previous ravings, the Spitfire was recently called "disappointing." Its speed is said to be three hundred and fifty-five miles per hour; the Hurricane's three hundred and thirty-five. What will England's secret new ship do?

★ ★ ★

The airplane has really become an essential in the American industrial system. Its manufacture is now a big-time business. Some idea of the influence that aircraft wields over allied and sundry smaller industries can be gleaned from the fact that the Los Angeles district alone produced last year forty-six million two hundred thirty-seven thousand one hundred and twelve dollars' worth of equipment. Four companies, North American, Lockheed, Douglas, and Vultee, have a current back-log of seventy-seven million dollars. Current deliveries from the section are at the rate of four million dollars a month.

★ ★ ★

Six robot radio-controlled planes have been ordered by the government from the Reginald Denny Industries. They will be used for antiaircraft gunnery practice. The twelve-foot ships are capable of seventy-five miles per hour.



DOUGLAS DC 5

SPECIFICATIONS

Dimensions:	Length	60′ 2″
	Height (tail down)	16′ 0″
	Wing Span	78′ 0″
	Wing Area	825 sq. ft.
	Tread	22′ 0″
Weights:	Empty	11,500
	Useful Load	6,750
	Gross	18,250
Power Plant:	Wright or Pratt & Whitney	Cyclones Hornets Wasps
	Total Horsepower (sea-level, take-off)	1,750 to 2,100
Performance:	Maximum Speed	215 to 248 m.p.h.
	Cruising Speed	182 to 221 m.p.h.
	Landing Speed	64 m.p.h.
	Take-off Run (at S. L.)	750 to 875 ft.
	Service Ceiling	21,700 to 23,400 ft.
	Wing Loading	22.1 lbs./sq. ft.

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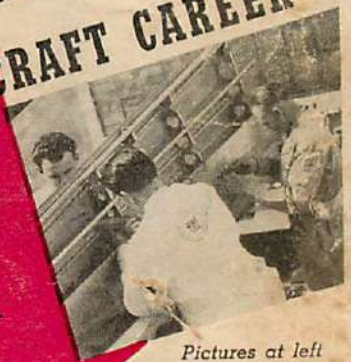

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