

AIR TRAILS

COMPLETE

UNDER THE MIDNIGHT SUN

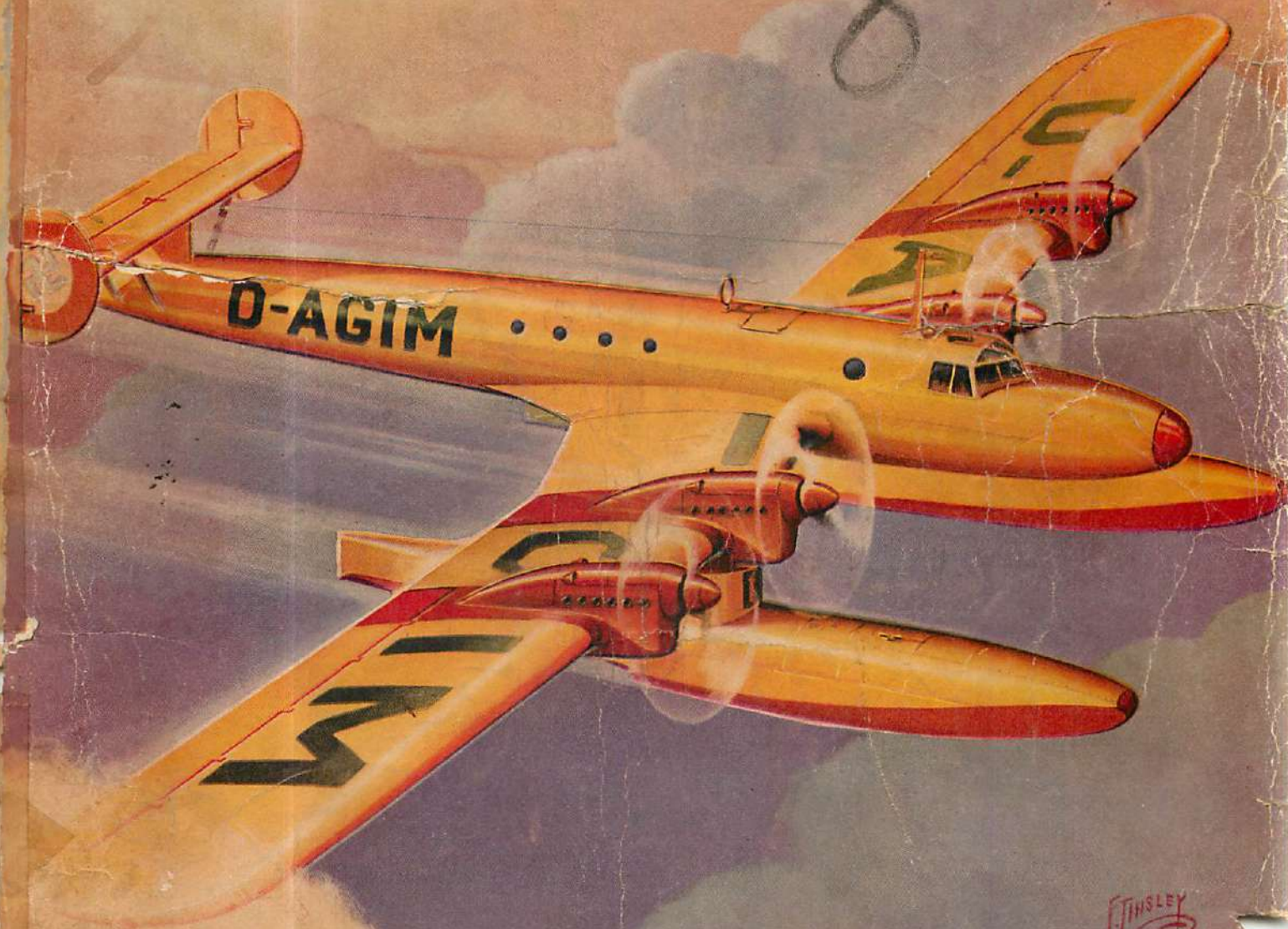
BILL BARNES

by George L. Eaton

AIR NOVEL



JUNE
1937



SOARING

THE GREATEST SPORT IN THE WORLD—

What Do You Know About Sailplanes?

About Gliding? About Cloud-hopping?

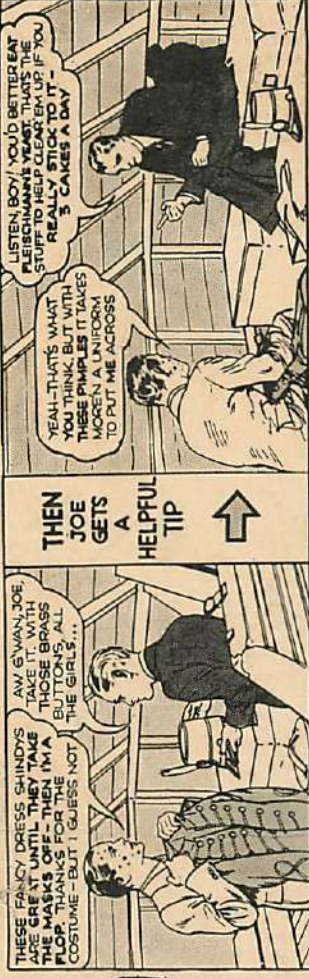
YOU WANT TO BE A GLIDER PILOT?—**SEE PAGE 8**

SWELL NEWS!

Start Now to Clear up Your Skin!
Learn the New Steps! **BE POPULAR**

ARTHUR MURRAY
World's Greatest
Dance Instructor—
Tells you how to do
the very Newest
DANCE STEPS
FREE!

IT COSTS \$5 EACH PRIVATE LESSON
TO LEARN THESE STEPS IN
MR. MURRAY'S NEW YORK STUDIO



ASK YOUR GROCER FOR THIS FREE
FLEISCHMANN DANCE CARD...

Don't slip up on this big chance, boys and girls! Begin today to save yeast labels for Arthur Murray's exciting book of 20 dance lessons! You CAN'T BUY this book anywhere! The only way to get one is with Fleischmann Yeast labels. Eat 3 cakes of Fleischmann's Yeast daily for 27 days. Save the label from each cake. Paste these on the free Fleischmann Dance Card, your grocer will give you.

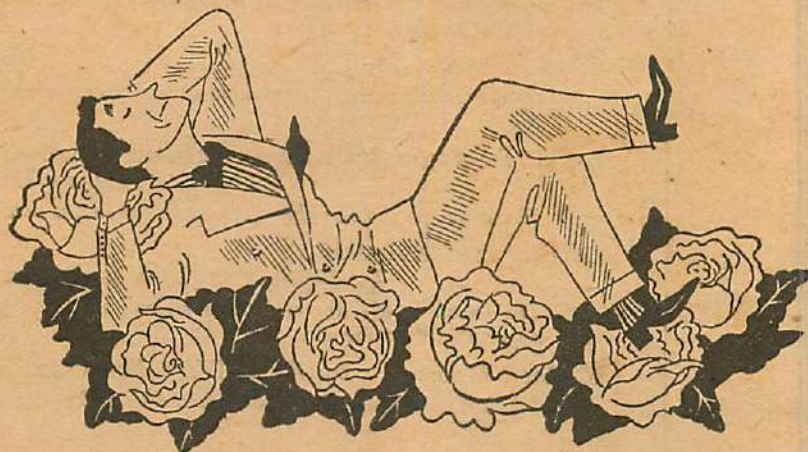


"Keep eating it regularly," says Dr. R. E. Lee, well-known physician, "and FLEISCHMANN'S YEAST will help clear up ADOLESCENT PIMPLES."

● After the start of adolescence important glands develop, causing disturbances throughout the system. The skin gets oversensitive. Waste poisons in the blood irritate this sensitive skin. Pimples break through. Fleischmann's Yeast helps to overcome adolescent pimples by clearing these skin irritants out of the blood. Eat 3 cakes daily—one about 1/2 hour before meals—plain, or in water.

Copyright, 1937, Standard Brands Incorporated

NOT WANTED



MEN CONTENT WITH THEIR PRESENT INCOMES

IF YOU'RE satisfied with what you're making—If you're content to just hold onto your present job—If you see no advantage in modernizing your training—Then—This coupon doesn't interest you!

• But—If you'd like to follow the path to more money, already blazed by thousands of ambitious men, then this coupon may be the turning point in your earning career! Mail it for free information.

INTERNATIONAL CORRESPONDENCE SCHOOLS

BOX 4934-B, SCRANTON, PENNA.

★ Without cost or obligation, please send me a copy of your booklet, "Who Wins and Why," and full particulars about the subject *before* which I have marked X: ★

- | | | |
|---|---|--|
| TECHNICAL AND INDUSTRIAL COURSES | | |
| <input type="checkbox"/> Architect
<input type="checkbox"/> Architectural Draftsman
<input type="checkbox"/> Building Estimating
<input type="checkbox"/> Contractor and Builder
<input type="checkbox"/> Structural Draftsman
<input type="checkbox"/> Structural Engineer
<input type="checkbox"/> Management of Inventions
<input type="checkbox"/> Electrical Engineer
<input type="checkbox"/> Electric Lighting | <input type="checkbox"/> Telegraph Engineer
<input type="checkbox"/> Telephone Work
<input type="checkbox"/> Mechanical Engineer
<input type="checkbox"/> Mechanical Draftsman
<input type="checkbox"/> Machinist
<input type="checkbox"/> Toolmaker
<input type="checkbox"/> Patternmaker
<input type="checkbox"/> Foundry Practice
<input type="checkbox"/> Heat Treatment of Metals
<input type="checkbox"/> Reading Shop Blueprints
<input type="checkbox"/> Sheet Metal Worker
<input type="checkbox"/> Boilermaker | <input type="checkbox"/> Radio
<input type="checkbox"/> Welding, Electric and Gas
<input type="checkbox"/> Diesel Engines
<input type="checkbox"/> Aviation Engines
<input type="checkbox"/> Plumbing
<input type="checkbox"/> Heating
<input type="checkbox"/> Air Conditioning
<input type="checkbox"/> Steam Engineer
<input type="checkbox"/> Steam Electric Engineer
<input type="checkbox"/> Marine Engineer
<input type="checkbox"/> Bridge Engineer
<input type="checkbox"/> Bridge and Building Foreman
<input type="checkbox"/> Highway Engineer
<input type="checkbox"/> Civil Engineer
<input type="checkbox"/> Surveying and Mapping
<input type="checkbox"/> Refrigeration
<input type="checkbox"/> R. R. Locomotives
<input type="checkbox"/> R. R. Section Foreman
<input type="checkbox"/> Air Brakes
<input type="checkbox"/> R. R. Signalmen |
| BUSINESS TRAINING COURSES | | |
| <input type="checkbox"/> Business Management
<input type="checkbox"/> Industrial Management
<input type="checkbox"/> Traffic Management
<input type="checkbox"/> Accountancy
<input type="checkbox"/> Cost Accountant | <input type="checkbox"/> C. P. Accountant
<input type="checkbox"/> Bookkeeping
<input type="checkbox"/> Secretarial Work
<input type="checkbox"/> Spanish
<input type="checkbox"/> French | <input type="checkbox"/> Advertising
<input type="checkbox"/> Salesmanship
<input type="checkbox"/> Service Station Salesmanship
<input type="checkbox"/> Business Correspondence
<input type="checkbox"/> Stenography and Typing
<input type="checkbox"/> Civil Service
<input type="checkbox"/> Mail Carrier
<input type="checkbox"/> Railway Mail Clerk
<input type="checkbox"/> Grade School Subjects
<input type="checkbox"/> High School Subjects |
| DOMESTIC SCIENCE COURSES | | |
| <input type="checkbox"/> Professional Dressmaking and Designing
<input type="checkbox"/> Home Dressmaking | <input type="checkbox"/> Advanced Dressmaking
<input type="checkbox"/> Tea Room and Cafeteria Management, Catering
<input type="checkbox"/> Millinery
<input type="checkbox"/> Foods and Cookery | <input type="checkbox"/> Chemistry
<input type="checkbox"/> Pharmacy
<input type="checkbox"/> Automobile Mechanic
<input type="checkbox"/> Coal Mining
<input type="checkbox"/> Navigation
<input type="checkbox"/> Cotton Manufacturing
<input type="checkbox"/> Woolen Manufacturing
<input type="checkbox"/> Fruit Growing
<input type="checkbox"/> Agriculture
<input type="checkbox"/> Poultry Farming |

Name.....Age.....Address.....

City.....State.....Present Position.....

If you reside in Canada, send this coupon to the International Correspondence Schools Canadian, Limited, Montreal, Canada

A
STREET & SMITH
PUBLICATION

AIR TRAILS

Reg. U. S. Pat. Off.

Volume VIII No. 3
June, 1937

Editor
F. Orlin Tremaine

Associate Editor
Clyde Pangborn

Model Editor
Gordon S. Light

Art Editor
W. L. Lawlor

Technical Editor
Arch Whitehouse

Department Editor
William Winter

Advertising Director
Harry Brown

Ass't. Adv. Director
Ralph Whittaker

Model Board
Gordon S. Light
Frank Tinsley
William Winter

Single Copy, 15 Cents
Yearly Subscription, \$1.50



The entire contents of this magazine are protected by copyright, and must not be reprinted without the publishers' permission.

Monthly publication issued by Street & Smith Publications, Inc., 79-89 Seventh Avenue, New York, N. Y. George C. Smith, Jr., President; Ormond V. Gould, Vice President and Treasurer; Artemas Holmes, Vice President and Secretary. Copyright, 1937, by Street & Smith Publications, Inc., New York. Copyright, 1937, by Street & Smith Publications, Inc., Great Britain. Entered as Second-class Matter, January 11, 1937, at the Post Office at New York, N. Y., under Act of Congress of March 3, 1879. Subscriptions to Cuba, Dom. Republic, Haiti, Spain, Central and South American Countries except The Guianas and British Honduras, \$1.75 per year. To all other Foreign Countries, including The Guianas and British Honduras, \$2.25 per year.

We do not accept responsibility for the return of unsolicited manuscripts. To facilitate handling, the author should include a self-addressed envelope with the requisite postage attached.

**STREET & SMITH
PUBLICATIONS, INC.**
79 Seventh Avenue
New York, N. Y.

CONTENTS

5 Articles:

- Soaring and Gliding by John DuBarry 8
Introducing a new Air Trails Department in an article valuable to all air-minded readers.
- Fritz Flies the Mail by Frank Tinsley 20
German challenge for transatlantic air-line supremacy—the plane on the cover.
- Aerial Photography with a Miniature Camera
by Hubert W. Meyer 22
The amateur photographer goes aloft for instruction.
- Getting into Aviation
by Clyde Pangborn and Lieut. W. M. Wood 26
The fourth in a series of articles which answer all your questions about opportunities in the air.
- Modern Motors by Arch Whitehouse and A. N. Troshkin 32
The last in a series of valuable technical articles—the supercharged engine.

8 Features:

- This Winged World 4
News photos of airplanes, air events, airmen.
- Air Progress 7
The current news review of aviation.
- The Flier's Dictionary by C. B. Colby 11
The twenty-first lesson in the technical terminology of the air.
- Development of Vertical Flight 19
A pictorial lesson in basic principles.
- Split-second Action by Jon L. Blummer 23
Aerial adventures that come only once in a lifetime.
- Pictorial History of Man in the Air 31
The early days of powered flight.
- Air Trails Gallery 35
Photographic studies of new planes.
- Cross Winds 38
The Air Trails Aviation Crossword Puzzle page.

3 Stories:

- Under the Midnight Sun (Bill Barnes Air Novel)
by George L. Eaton 12
Bill eased the throttles of the Lancer open another notch and took it through the air with the speed and fury of a flaming meteor—
- Fire Dive by Leonard Long 24
Across the mile-high sky, they weaved designs—beautiful, eccentric, bizarre—
- "Dear Harry—" by George Swift 30
Letters of an Air Student to his friend.

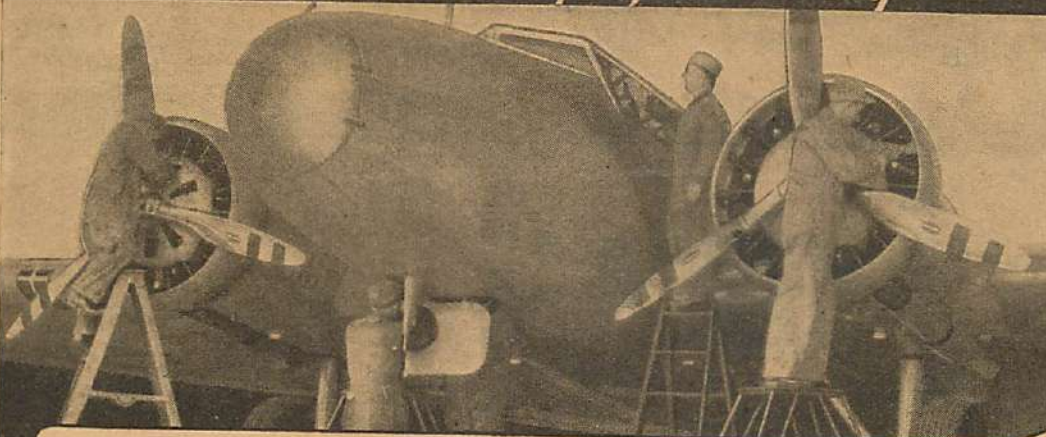
2 Departments:

- What's Your Question? Conducted by Clyde Pangborn 34
A page of expert information on technical questions for Air Trails readers.
- Air Adventurers Club Conducted by Albert J. Carlson 36
An association for the advancement of aviation.

12 Model Building Items:

- The Model Shop
Model contents are listed on a separate contents page—Page 39.

GET INTO AVIATION for Fascinating Good Pay Jobs



WALTER HINTON: Aviation Pioneer, Explorer, AVIATOR, the first man to pilot a plane across the Atlantic Ocean (the NC-4 in 1919), the first man to fly from North to South America. During the War, as a Lieutenant in the Navy, he helped train hundreds of men for the Naval Air Force. Today he offers you the benefits of his long years of experience in practical Aviation to help you find your place in this thrilling, fascinating, good-pay industry—to help you benefit from Aviation's wonderful future.

MY FAMOUS COURSE TRAINS YOU AT HOME IN SPARE TIME ... MAIL COUPON FREE BOOK TELLS HOW

GET MY BIG FREE BOOK Why put up any longer with a dull, tiresome, uninteresting job? Why sit back and envy the men already in the midst of the adventure and romance of Aviation? If you've got ambition and average intelligence—**YOU DON'T HAVE TO!** "What," you say, "I can't give up my job and go to Aviation School at some distant airport. I'd like to, but I just can't do it!" All right—you're the man I want to talk to—you're just the fellow I developed my famous home-study training for many years ago. You're just like many other young men I have trained. Furthermore, you don't need previous experience and you don't have to know anything about planes or engines.

YES—MY SCHOOL OFFERS YOU THE OPPORTUNITY TO LEARN AVIATION RIGHT IN YOUR OWN HOME IN YOUR SPARE TIME. I give you knowledge you must have to enter this thrilling industry. I'll train you for many of Aviation's good pay opportunities—and I'll do it in a way that you can afford. Read all about it in my big book. Send for your copy now!

MANY TYPES OF JOBS TO CHOOSE FROM

You have over forty (40) types of Aviation jobs to choose from once you get the necessary training. You get information you need to pass the Government's written examinations for mechanic's license in a few short months. Then, if you wish to take up flying, I save you money on the cost of flight instructions at good airports all over the country. My Big Book tells you how.

MY TRAINING IS THOROUGH, PRACTICAL, UP-TO-DATE

I've put my eighteen years of experience—backed by over 400,000 miles of flying—five years of instructing officers and men in the Navy—into my thorough, quick training. And I've made it all so clear that almost anybody can understand it. My Aviation friends know that Hinton-trained men are well qualified to work for them.

GET MY BIG BOOK—NOW!

Now is the time to act! Now is the time for you to get into Aviation! Now is the time to prepare yourself to cash in on Aviation's tremendous growth during the next few years! Get all the facts! Learn how I train you quickly! Read actual letters from my graduates who are already in Aviation. You will find all this, and much more in my BIG FREE BOOK. SEND FOR IT NOW!

A few of the Good-pay Jobs in this Fast-growing Industry.

ON THE GROUND
Superintendent
Instrument Specialist

Electrician
Shop Foreman
Hangar Crew Chief
Traffic Manager
Purchasing Agent
Aerial Mail Clerk
Motor Expert
Radio Operator
Airplane Mechanic
Field Work

IN THE AIR
Air Express Agent
Air Mail Pilot
Aerial Photography
Airport Manager
Test Pilot
Private Piloting
Weather Observer
Flight Instructor
Commercial Pilot
Field Manager
Transport Pilot

AIRPLANE FLIGHT INCLUDED WITH TRAINING

"Give her the gun!" You're off! Yes sirree, as soon as you complete my Course I arrange an airplane flight for you at an accredited air field, near your home. It doesn't cost you a penny extra. It's my graduation present to you.

Rush Coupon to Washington NOW

AVIATION JOBS PAY \$40, \$60, \$75 A WEEK AND UP TO MANY

Aviation is no "cheap-skate" game. It can't be. It is absolutely necessary to have high type, well-trained men. For only in that way can the Airlines build and maintain the remarkable record for speed, economy and more important, SAFETY, that they have today. To get high type, trained men, Aviation must, and does pay good salaries. Read in my Big Free Book about the many different types of jobs I train you for—and the salaries which go with these jobs. Mail coupon for my Book NOW.

AVIATION IS GROWING FAST—GET INTO IT NOW!

Aviation is a young industry for young, ambitious men. Aviation is a profession in which a young man like yourself can make good money quickly, with opportunities ahead for bigger and better jobs. Aviation's growing fast. It was practically the only industry to forge ahead during the depression. Millions of dollars are being spent yearly on improvements of airways, apparatus, equipment, and planes. The Government's program for expanding Army and Navy Aviation units; Government contracts for planes and equipment; for the Army and Navy Coast Guard; Air Mail Contracts, etc., etc., are pouring more millions into Aviation. What does this mean to you? Opportunity NOW! Opportunity for you to get into a prosperous, fast-moving industry, in which work crammed with thrills and romance replaces tiresome, "nose on the grindstone" drudgery. Opportunity for you to get into aviation on the ground floor—while it is still young—when you do not have to replace a lot of older men. My big book tells you much more about the opportunities which exist in Aviation today—MAIL COUPON FOR IT NOW.

These Men Made Good With My Training

Course Helped Pass Government Examination

"I am a holder of an aeroplane and engine mechanic's license and a private pilot's license. Your Course helped me a great deal to pass the examinations."
JOHN HALENDA, 329 S. Ballet St., Frackville, Pa.

Recommends Course To All

"I can honestly recommend your Course to all who are interested in Aviation as worth the time and money spent on it, and much more. I am proud to have been a student of your Institute."
A. J. W. SLABBER, Darling Road, Malmesburg, Cape Province, South Africa.

Mail for my big FREE BOOK on AVIATION NOW!

**Mr. Walter Hinton, President
Aviation Institute of America, Inc.,
1115 Connecticut Avenue, Washington, D. C.**

A3H

Please send Free copy of your book, "Wings of Opportunity," telling about my opportunities in Aviation and how you will train me at home for them.

Name
(Print clearly)

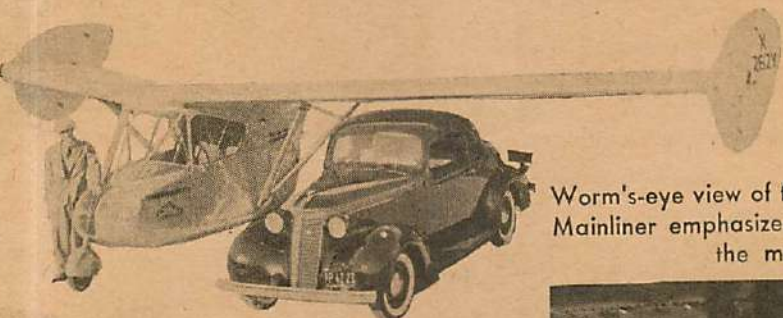
Address Age.....

City State.....



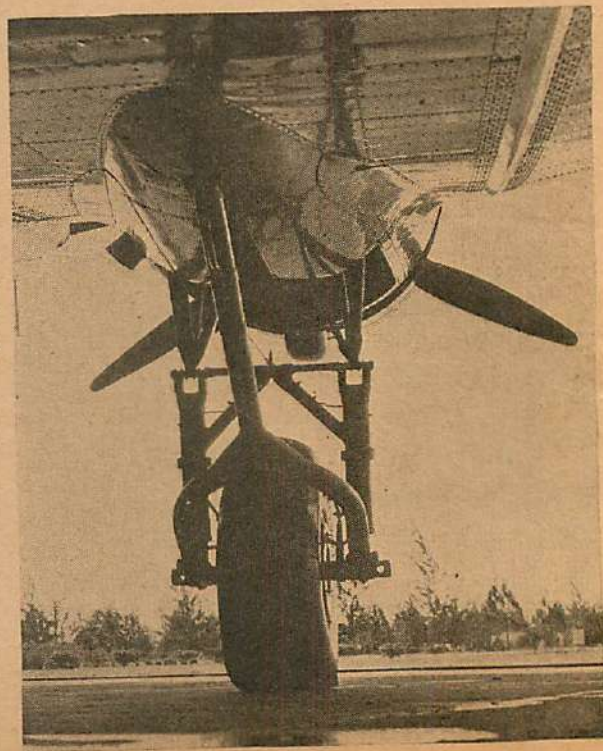


Right: Waterman tailless plane, posed alongside car for comparison, hits 55 m.p.h. on the ground and 125 m.p.h. in the air, using a 6-cylinder Studebaker motor. Easily detached wings permit its use as a combination car and plane.

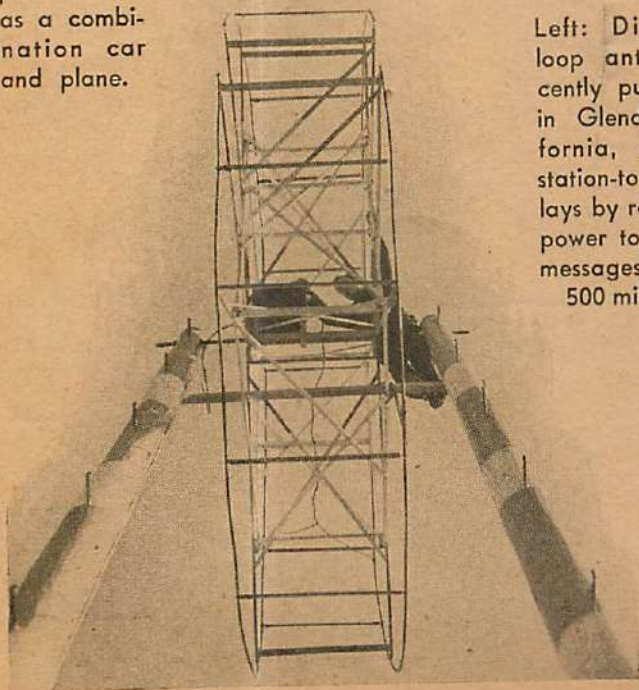


The China Clipper, in early dawn, prepares to hop from Dinner Key, Pan American base in Florida.

Worm's-eye view of the undercarriage of a Douglas Mainliner emphasizes the mechanical perfection of the modern transport.



Left: Directional loop antenna, recently put into use in Glendale, California, eliminates station-to-station relays by reason of its power to broadcast messages to planes 500 miles away.





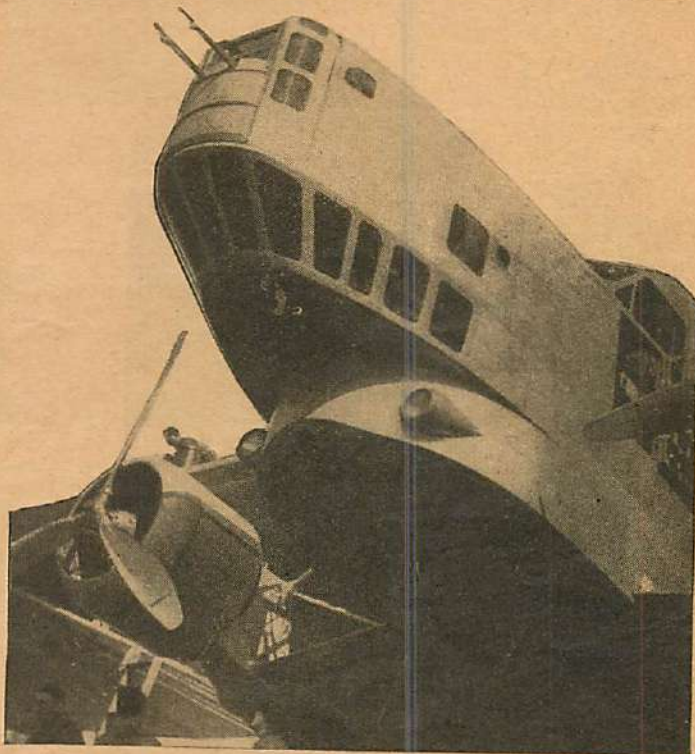
Fred D. Fagg, Jr., on the left, World War pilot, founder of the Air Law Institute and recently named to succeed Eugene L. Vidal as director of the bureau of air commerce, takes over his new duties. Mr. Vidal intends to reënter commercial aviation.



Waco cabin plane demonstrates practicability of newly developed Edo amphibian gear.

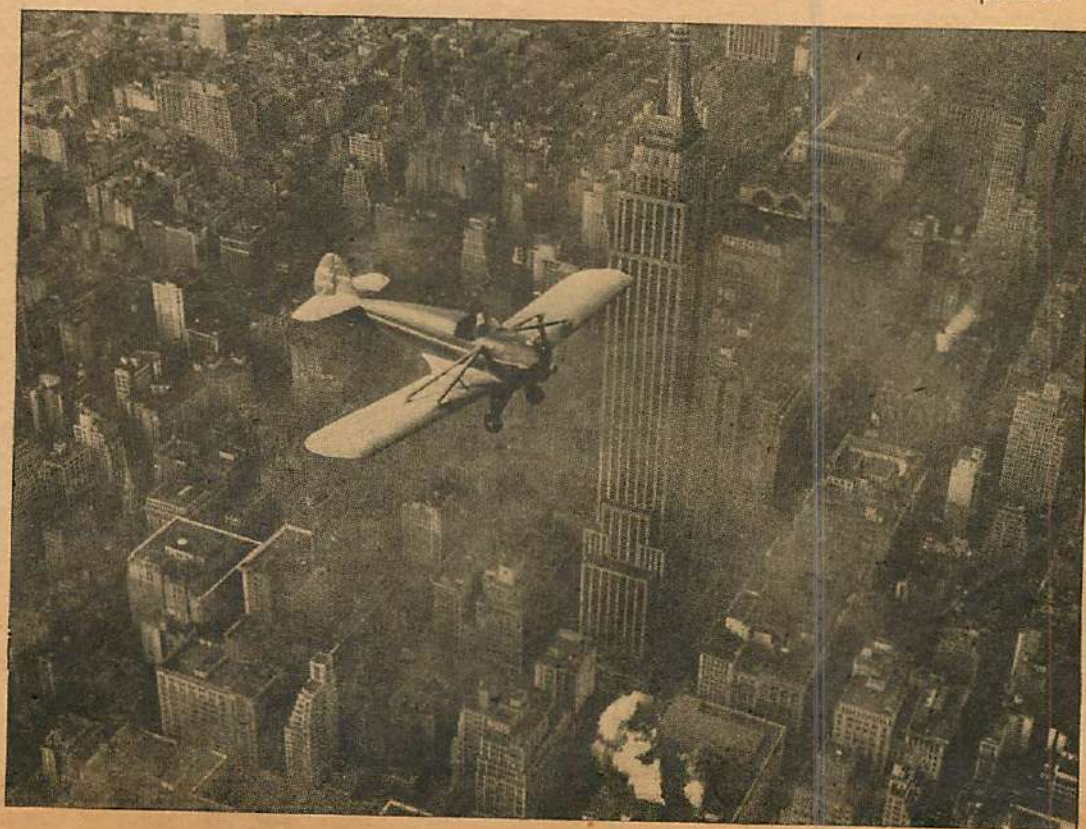


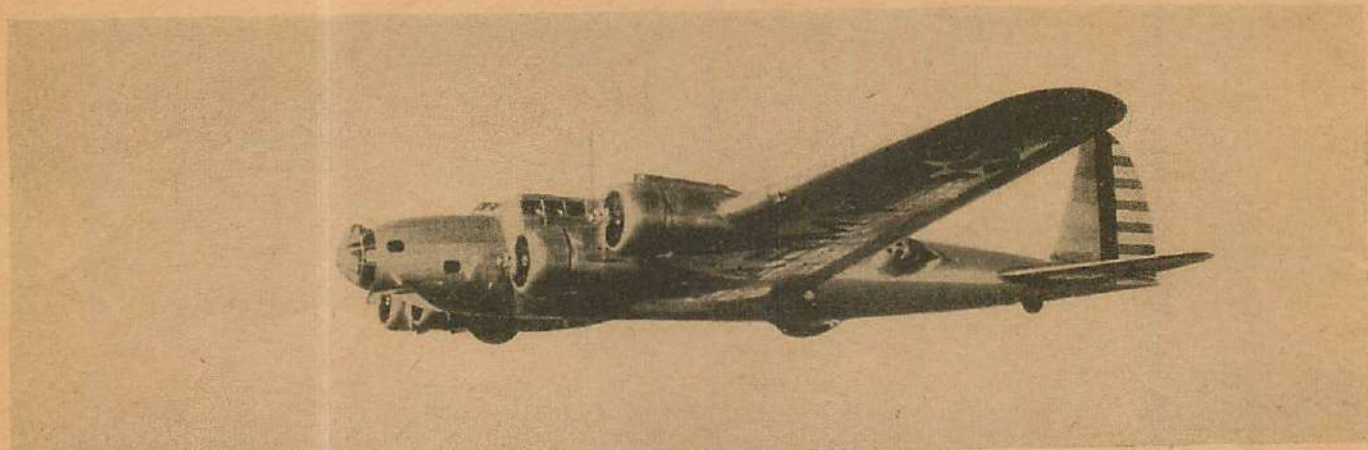
Short "Cavalier" taxiing for take-off. Assembled in Bermuda for transoceanic service, it suggests brute power.



Nose-turret guns and bombers' windows of 4-engined French Farman bomber, make an awesome picture.

Arrow Sport, powered by Ford V-8 auto motor, drifts over the skyscrapers and canyons of New York, unhampered by traffic and undaunted by city din.

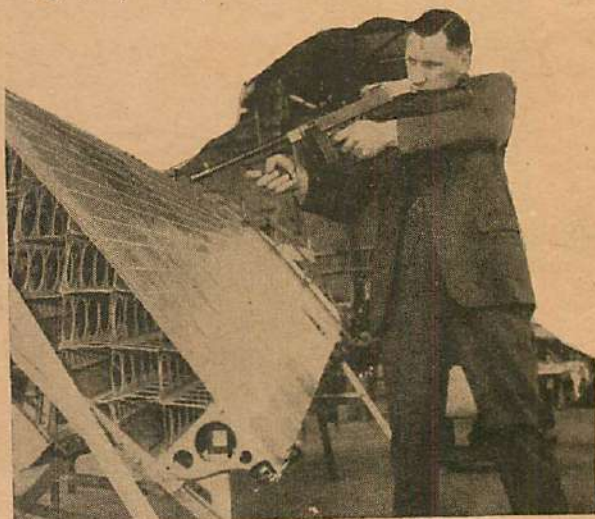




Boeing "Flying Fortress" in aerial close-up during army acceptance tests at Langley Field.



One-bladed prop recently developed has met severe service tests and claims greatly increased efficiency. Cylindrical counterweight eliminates vibration.



Multispar, cellular wing developed by Barkley-Grow for the government, actually withstands sub-machine gunfire.



New French 35 h.p. diminutive seaplane adds zest to already popular continental light-planing.



Glimpsed between the twin rudders of a Sikorsky is the China Clipper, dotted with the figures of the maintenance crew.

Progress

A Summary of AVIATION NEWS

a new big Consolidated flying boat which is being constructed at San Diego for their particular use.

Marcel Farman, who taught Dick Depew, noted Fairchild salesman to fly, back in 1911, called on his former pupil at Roosevelt Field and disclosed that he still pilots his own plane between his country estate and his factory in Paris.

The new British Short flying boat *Caledonia* recently flew from Southampton to Alexandria in 13 hrs. 35 min., at an average speed of 184 miles per hour.

AIR FORCES

By 1939 the War Department hopes to have 2,320 military planes in its air services, none of which will be over 5 years old. Speed and efficiency in movement, rather than numbers, will be the goal. Six Kellett Autogiros have been purchased at a cost of \$39,747.03 apiece, which includes certain spare parts. They will be used for reconnaissance, observation of fire, message carrying, and command missions. The new Kellett has a top speed of 125 m.p.h.

The first of the 13 Boeing Bombers actually turned over to the army arrived at Langley Field on March 1st. It was flown across the continent from Seattle in easy stages.

Fifteen army planes recently left Albrook Field, Canal Zone, on a 4,000-mile flight to Lima, Peru, and return. The squadron, commanded by Major George H. Beverly, was composed of 3 observation and 12 pursuit planes.

A number of new navy aviation cadets recently reported to Scouting Squadron 1. Four flew aboard the Aircraft Carrier *Ranger* and stepped out of their planes as though nothing unusual had taken place. Of the four, three were on board a ship for the first time in their lives!

Eighteen American fighting planes, purchased by loyal Nationals abroad, were recently dedicated at Nanking, China, by daughters of Nanking officials. Rare old Shaoshing wine was spattered over the engine cowls while 5,000 army students looked on.

Britain plans another balloon barrage to protect London from future air raids. The new balloons will be raised to such a height that airplane pilots hoping to fly over them will have to use oxygen helmets. This will prevent them from carrying but a small supply of bombs and from that height accuracy will be very difficult. It is believed that the balloon apron device will reach 30,000 feet.

The new Henschel fighter, Germany's newest air service single-seater, is said to do 221 m.p.h. It can also be used as a dive bomber. Britain's (Turn to page 93)

THAT the aviation industry is on the upgrade and heading for prosperous times again is indicated in the report that during the month of January plane deliveries showed an increase of 62 per cent over January of 1936. A total of 106 airplanes were delivered, valued at \$1,109,397.

Roger Q. Williams of transatlantic fame is now representing the Porterfield firm and recently reported that 40 Porterfield ships were sold to the firm of Erickson and Rommert, a sales agency at Floyd Bennett Field.

Howard Hughes was recently awarded the Harmon Air Trophy by President Roosevelt for his record-breaking flight from Los Angeles to New York. Other Americans who have been awarded this trophy are Colonel Charles A. Lindbergh and the late Wiley Post. Miss Jean Batten, the New Zealand girl, was awarded the woman's trophy.

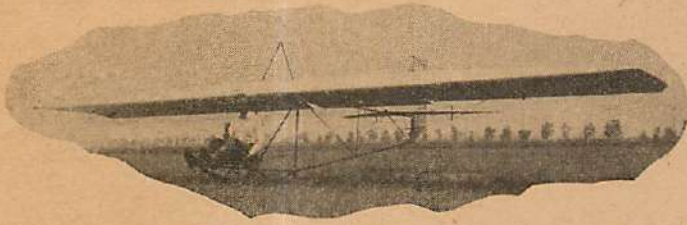
Canadian readers will be interested to learn that Matt Berry of Edmonton, Alberta, has been awarded the Trans-Canada Trophy for his service to Canadian aviation in 1936. Berry, a former R. A. F. pilot, has been flying with the Northern Aerial Minerals Exploration Co., the Mackenzie Air Service and Canadian Airways. He has made many rescues in the North.

Richard Archbold, research associate in mammalogy at the American Museum of Natural History, and his pilot, Russell Rogers, are preparing for a second flying expedition into New Guinea in the fall. They will use

The Greatest Sport in the World!

SOARING

An Important Article



The Pacific Primary is the type of glider on which the fledgling tries his wings.

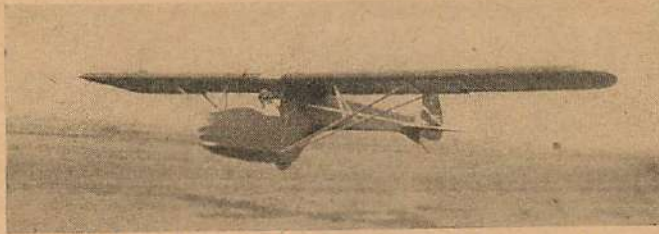
available to every one. Some of us may get into the air through the efforts of the bureau of air commerce to develop small, "safe," low-priced airplanes for the private

pilot, and the success of inexpensive light planes such as the Taylor Cub. But for those who find the cost of instruction and the rental or ownership of a plane too expensive, powerless flight offers opportunity.

Powerless flight may be defined as motion through the air, in other

than a vertical direction, by a heavier-than-air craft without engine power. It is the result of a lifting force generated on the wing by movement through the air in response to the pull of gravity. The same lifting force produces ordinary airplane flight in response to the pull of the engine-driven propeller.

• Gliding and soaring are two classifications into which powerless flight is divided to-day. Gliding is all downhill; that is, the flight path descends to a landing place lower than the take-off point. Soaring is at least part uphill, in which the flight path rises above the take-off



The Briegleb utility glider represents the secondary stage of the birdman's training.

THE AIR is free; so is the force of gravity. To these two things we need to add only a fundamentally simple man-made device in order to soar like the hawk—not so well as he does, perhaps, but well enough to stay aloft for hours, to climb thousands of feet, and to travel hundreds of miles.

Those are some of the achievements of human, powerless flight: a kind of flying that has its own unique sensations. And because of its cheapness and simplicity it offers a fine, safe way for air-minded Americans, young and old, rich and poor, to actually get into the air.

There's a thrill in powerless flying that's found in no other form of flight. To the motion and controllability of the airplane is added the silence of the drifting balloon. The glider pilot, coasting across the sky, hears only the murmur of the wind against his wings and faint, clear sounds reflected upward from the earth. He feels only the surge of the air currents. Experience of gliding has lessened the pleasure of engined airplane flying for more than one pilot. Its thrills and the scope it affords for individual skill make it the most exhilarating of all sports.

Of its practical use in aviation, it is sufficient to say that students first trained in gliding almost invariably make better airplane pilots than those who start behind an engine. The glider-taught student knows the "feel" of the air and handles his plane well if the engine fails; the power student is apt to rely too much on his motor.

The pleasure and value of powerless flight are

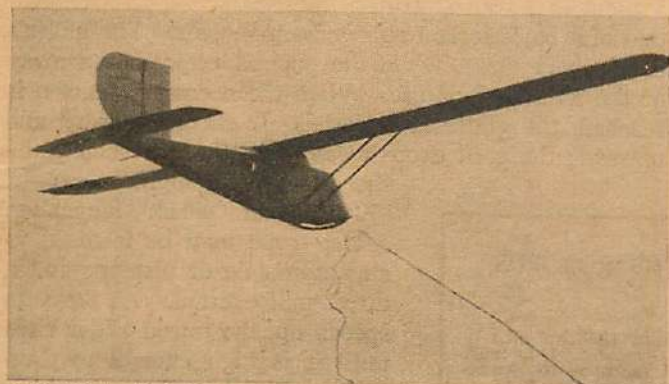


Soaring, the privilege of the veteran, affords brilliant sport for the enthusiast.

Introducing a New Air Trails Department

and GLIDING

by John DuBarry



Official Photo, U. S. Navy

Darmstadt glider on the instant of take-off—shock cord still in the air indicates the method of starting.

level. But soaring is really gliding under special air conditions, inasmuch as the aircraft, although rising, remains pointed slightly downward, as if making a simple downhill glide. Therefore the word gliding is usually used as synonymous with powerless flight in general.

Gliding is one of the oldest developments and newest sports of man flight. From available records, Besnier, a French locksmith, accidentally made a short glide two centuries ago while trying a set of artificial wings he had hoped to flap. In the first half of the last century Sir George Cayley of England devised a contraption which is supposed to have carried one of his servants across a small valley. In the latter half of the century, experimenters began studying gliders in earnest. Flights in man-sized machines, they thought, might show the way to the ultimate goal—engine-powered airplanes.

These men were the pioneers of heavier-than-air flight. Among the first were two Frenchmen, Mouillard and Le Bris, whose inventions, as preserved in sketches, would hardly inspire confidence, although the boat-shaped body and gull wings of Captain Le Bris' craft—he was a sailor—made the first significant glider flights.

Extensive and scientific experimentation began with the German, Otto Lilienthal. What might be called the first successful man-carrying

The glider was the forerunner of the airplane. Sailplanes preceded powered flight as sailing ships preceded modern ocean liners. But nothing can steal the romance from yachting, or stop men from dreaming of "—sails in the sunset." Nor will the sport of sailplaning ever fail to intrigue us so long as we have any imagination.

There is a new, spontaneous movement to popularize soaring and gliding. AIR TRAILS will be the nerve center of this movement—in so far as we can make it so—reaching out to the largest air-minded audience in America.

Did you know that you can become a licensed glider pilot when you are fourteen—without cost, and without a physical examination?

Did you know there are eighty gliding clubs in America now?

You can organize a club with as few as six members. The new department in AIR TRAILS will tell you how.

We will be glad to answer your questions about equipment, costs, methods, etc.

If you have learned aero-dynamics through flying models—you are prepared for the next step.

Write to me if you are interested. Let's make this sport universal.

—The Editor.

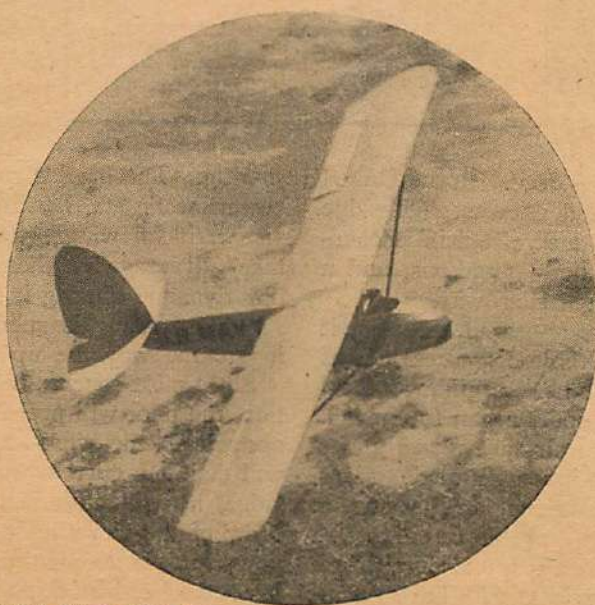
glider was Lilienthal's apparatus of 1891, a fabric-covered framework of willow rods, in which the pilot hung with legs and body free. Control was gained by shifting the weight and angle of the body. It was a precarious system. Although Lilienthal made over two thousand glides from low hills, he crashed fatally in a biplane glider in 1896.

Control remained a problem, most gliders of that period being "hang" gliders, depending to some extent on the shifting of the pilot's weight. In England, Percy Pilcher added a horizontal tail to Lilienthal's monoplane, but Pilcher also lost his life in an accident.

Meanwhile, Americans were active. Professor John James Montgomery, the American pioneer, built a series of successful gliders notable for their tandem wings, a departure from the Lilienthal design. They performed some remarkable feats, including several long, stunting glides from considerable heights, to which they were lifted by big hot-air balloons. The last model incorporated a complete control system of elevator, rudder, and warped wings.

Montgomery's work extended from about 1884 to 1905. During that period, gliding was also progressing under other American hands, culminating in 1903 in the long-sought triumph: the Wrights' successful flight in an engine-powered airplane.

Octave Chanute, importing Lilienthal's ideas, built up an



Official Photo, U. S. Navy

Naval glider has been used successfully in tests made from the dirigible Los Angeles.

impressive record of glides in well-designed hang gliders, despite his sixty-four years when he made his first flight in 1896. He tried a quintuplane, a triplane and a biplane, the last proving particularly efficient. All his hops were without accident.

It was a historic moment when, in 1900, two immortal bicycle mechanics started their experiments. To the Wright brothers, Orville and Wilbur, gliding was only a step to powered flight, but they devised important improvements: skids as landing gear instead of the pilot's dangling legs, and effective controls. First they tried their boxlike biplane as a kite, then they began to glide with it. By 1902, with a front horizontal rudder, rear vertical rudder and warping wings, they were gliding over the wind-swept North Carolina dunes for distances of six hundred feet and flights of a minute. In the following year they added an engine and propeller and made history.

Probably gliding would have progressed further but for that engine. Powered flight seized attention. In 1911—the year of Cal Rodgers' first transcontinental air trip—Orville returned to Kitty Hawk to experiment with stability devices and soared on a stiff wind for nine minutes forty-five seconds—a world record for eleven years, and an American record for seventeen. In 1912-14, gliding was tried in the Rhön district in Germany, and some hang gliders were produced in the United States, but nothing more was done anywhere until after the World War.

Deprived of airplanes by the peace treaty, Germans turned to powerless flight. Gliding meets, begun in 1920, developed aerodynamic design, pilot skill, and knowledge of air currents so rapidly that within a few years flights were being measured in hours and miles. German advance has been steady, and today still accounts for the official international records. In other countries gliding is becoming widespread. In the United States, progress has been slow and uneven, chiefly due to the popularity of airplanes and lack of official encouragement; but inquiries are becoming numerous, and a spontaneous movement is getting under way.

During the 1920s a few gliders appeared here, but it was not until 1928, when the Rhön organization was invited to send three pilots to establish a gliding school on the Cape Cod dunes, that the sport began to expand.

In 1930, Frank Hawks rode an airplane-towed glider from coast to coast. Colonel Lindbergh made glider flights. Piloted by Lieutenant Commander Barnaby, a glider was launched from the navy dirigible *Los Angeles*. Then the economic crisis made itself felt, and despite the efforts of a small group of enthusiasts who have maintained the annual meet at Elmira, interest waned, and has only recently begun to revive.

Modern powerless flight is largely soaring. Gliding

is what the student does while under instruction. When he cuts loose on his own, he goes hunting for "up-currents." But, in either case, his launching is the same.

To the nose of his craft is attached a hook, and from that hook stretches a cord by which the glider is pulled into the air. The pulling force may be supplied in a variety of ways.

The cord may be an elastic one, hooked to the glider at mid-length, with a crew of men at each end, or with a single end pulled by a crew, or a winch, or some other mechanical device. With the elastic cord—commonly known as a "shock cord"—the action is identical with that of a boy's forked rubber bean-shooter. The glider's tail is held down while the ground crew moves away or the winch winds up. When the necessary tension is reached, the glider is released. It shoots forward and upward; the cord drops away from the nose hook, and the glider is in flight.

Instead of "shock" launching, a long rope may be fastened to an automobile or airplane and a direct pull exerted. As the auto speeds up, the towed glider rises until it is high enough to drop the rope and float free. With an airplane, the glider is pulled right on up, like the tail of a kite, to any height desired. Airplane towing requires a strongly built glider and a steady-handed glider pilot.

Once in flight, the glider pilot noses down toward his approaching landing place, if he is a student, or is riding a simple glider; or he coasts around seeking up-currents if he's bent on soaring.

Soaring is of two major types: "static" soaring, which depends on the up-currents mentioned; and "dynamic" soaring, which utilizes the changing velocities and directions of horizontal air currents. Horizontal gusts, and flight up and down across the border line between one moving layer of air and another should, theoretically, permit dynamic

soaring. The hawk's success is credited to this type of powerless flight. But man has not yet been able to devise artificial wings efficient and responsive enough to take advantage of these elusive horizontal forces; for him dynamic soaring is still only a mathematical theory.

Static soaring is subdivided into four kinds, according to the way the up-currents originate.

Since most soaring flights are launched from an elevation, the pilot will probably first try slope soaring. Any obstacle in the wind—a hill, a tall forest, a building—will deflect a current upward. Launched from a hill or ridge, he will glide into the area above the windward brow of the elevation where the deflected wind is most powerful. If the air there is rising faster than the "sinking speed" of his craft—the rate at which it loses altitude when gliding, usually measured in feet per second—he will be carried upward. But always he keeps gliding, cruising back and forth in figure -

(Turn to page 66)

OFFICIAL GLIDING RECORDS

Distance, Airline

International Record

504.200 kms. (313.295 mi.)
Rudolf Oeltzschner, Germany, "D-Leuna"
glider, from the Wasserkuppe to Brunn
Airport, Czechoslovakia, July 29, 1935.

National (U. S.) Record

254.759 kms. (158.299 mi.)
Richard C. du Pont, du Pont-Bowlus sail-
plane Albatross II, from Elmira, N. Y.,
to Basking Ridge, N. J., June 25, 1934.

Distance With Return To Point Of Departure

Neither International nor National
(U. S.) Record has been established.

Duration With Return To Point Of Departure

International Record 36 hours 35 minutes
Kurt Schmidt, Germany, Grunau Baby
glider "D-Loerzer," at Korseheuruhi,
Prusse Orientale, Aug. 3-4, 1933.

National (U. S.) Record

21 hours 34 minutes
Lt. William A. Cooke, Jr., Cooke Night-
hawk glider, Honolulu, Hawaii, Dec.
17-18, 1931.

Altitude Above Starting Point

International Record

4,325 meters (14,189.590 ft.)
Heinrich Dittmar, Germany, "D-Condor"
glider, at Campo dos Afonsos, Brazil,
Feb. 17, 1934.

National (U. S.) Record

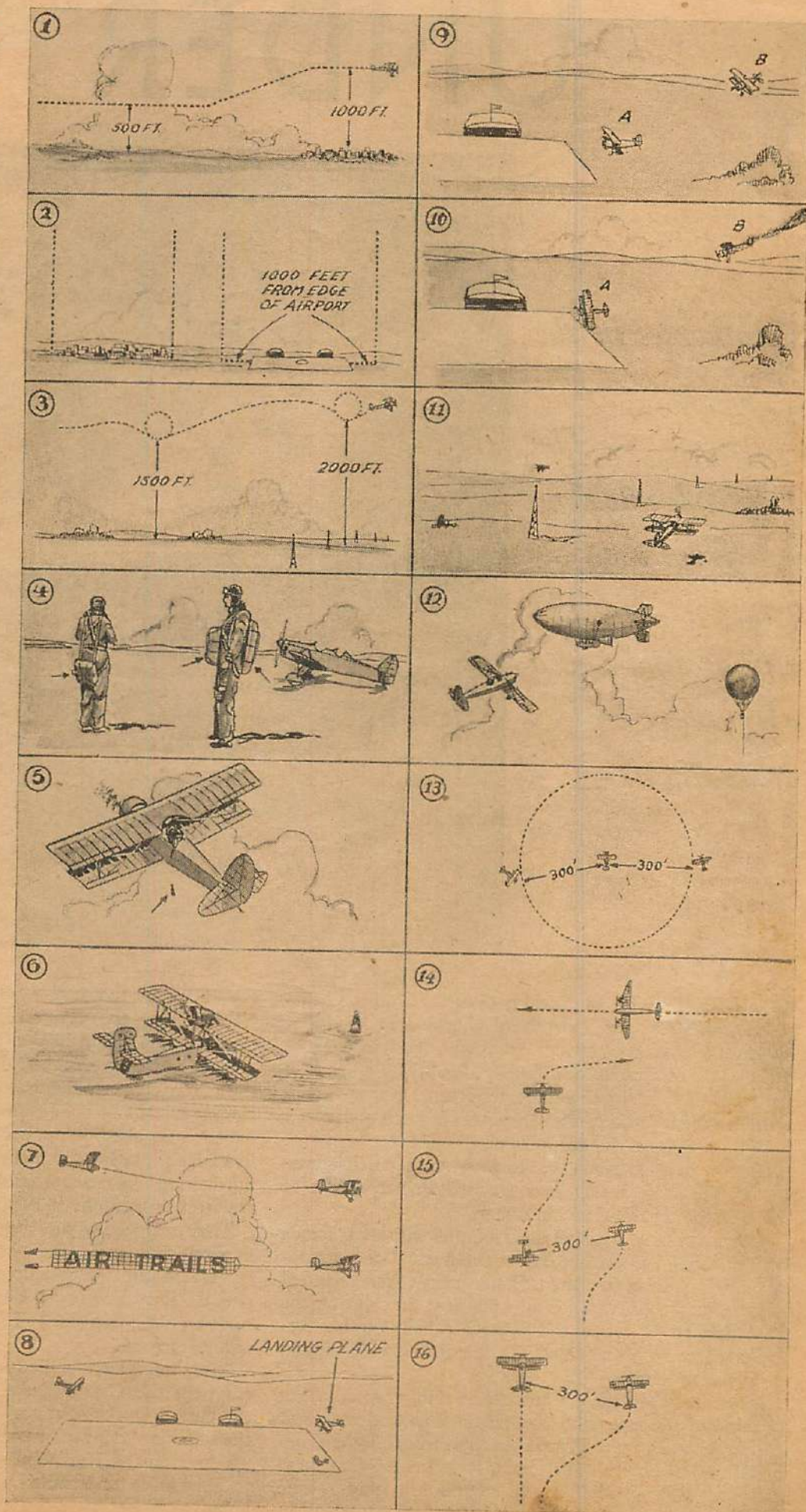
1,397 meters (4,583.334 ft.)
Richard C. du Pont, du Pont-Bowlus sail-
plane Albatross I, at Elmira, N. Y.,
June 30, 1934.

THE FLIER'S DICTIONARY

The twenty-first lesson in the technical terminology of the air. Save your files!

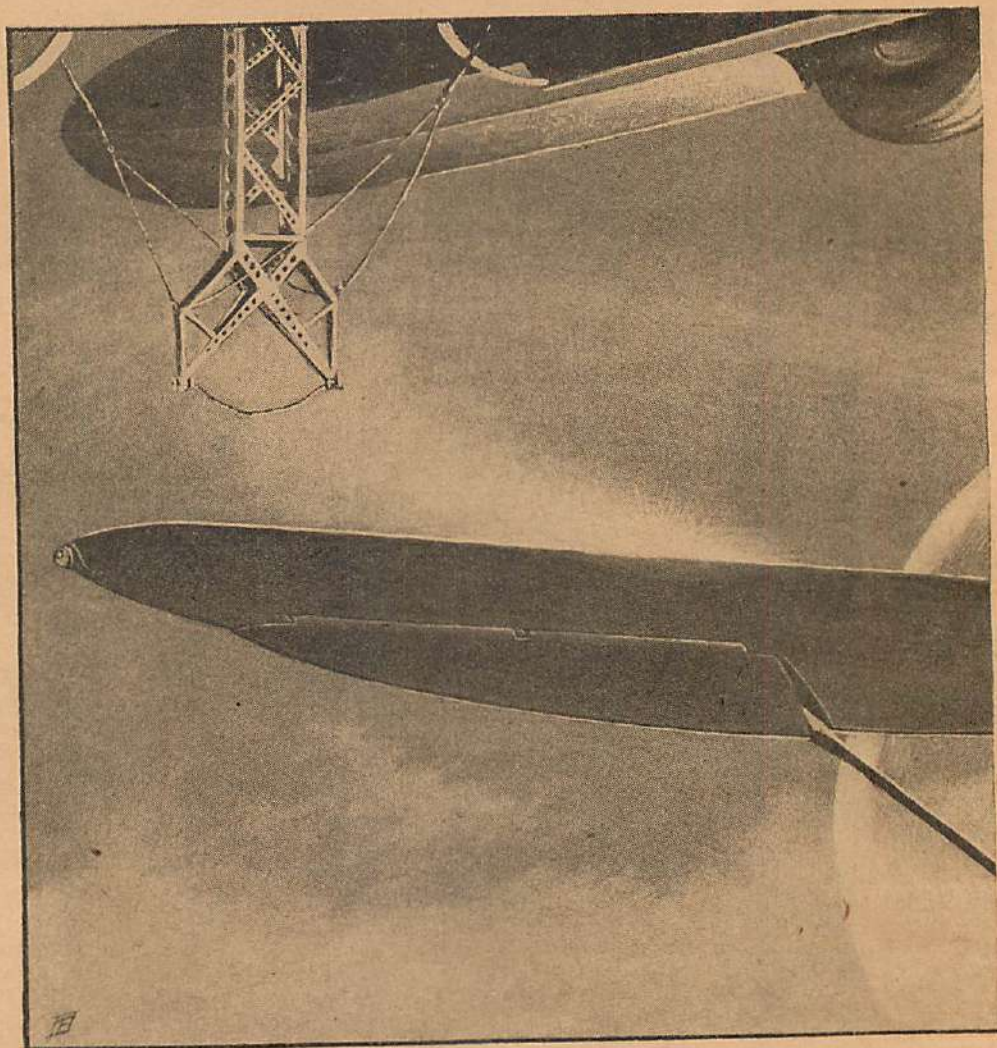
AVIATION LAW

- 1 Planes must fly at 500 feet altitude, except when crop-dusting or engaging in similar work. Planes flying over congested areas must fly at 1,000 feet. This also applies to gatherings.
- 2 Planes are not allowed to stunt over a congested area.
- 3 No stunting may be done below 1,500 feet over unrestricted land or below 2,000 feet over a civil airway.
- 4 A pilot of a stunting plane must wear a parachute.
- 5 No object may be dropped, thrown, or allowed to be dropped or thrown from a plane except with the permission of the secretary of commerce, or when necessary to the personal safety of the passengers or crew.
- 6 When a seaplane is resting upon the water it is at once under the rules and regulations of water craft.
- 7 No plane may tow another plane, glider, or object, except with the special permission of the secretary of commerce.
- 8 A landing plane has the right of way.
- 9 If two planes are landing the one at the lower altitude "A" has the right of way over "B."
- 10 If two planes are landing at the same time and one of them is in distress, the ship in distress has the right of way over all other planes.
- 11 In flying along a civil airway, planes keep to the right.
- 12 A plane must give way to an airship and free balloon, and an airship must give way to a free balloon.
- 13 No plane may approach within 300 feet of another.
- 14 Of two planes approaching each other at right angles, the one who is being approached from the right by another plane must give way.
- 15 If two planes are approaching head on each must give way to the right.
- 16 If a plane approaches another ship from the rear or from an angle of seventy degrees to either side or directly behind, he must alter his course so that he will pass to the right of the overtaken ship. The overtaking pilot must alter his course in a horizontal plane and not in a vertical. These last four rules, of course, do not apply to military planes.



UNDER THE

*Slow horses in the
darkness—a
treasure— The
Eaglet launching
from the
transport— The
sun at night and
under it
searchlights—*



THOSE THREE mythical goddesses, Clotho, Lachesis, and Atropos, must have chuckled in high glee on the day the young czar, who was to become Nicholas II of Russia, was cruelly slashed by a saber in the hands of a Japanese fanatic at Kyoto. For if we are to believe the legends of the Greek and Roman mythology those three control the destinies of all men.

They must have smiled a knowing smile on that fateful day the same young czar wedded Princess Alix of Hesse at the deathbed of his father.

They must have covered their mouths with their hands to hide their laughter that day at the festival of his coronation when three thousand of his people were crushed to death at the distribution of bounties; and during the coronation itself, when the imperial chain on his festooned chest was torn away by an invisible hand and fell to the ground.

They must have known how those things would affect the mind of the man who was destined to lead the great sleeping bear that was Russia through troublesome times abroad and at home. They must have known that these and other things would instill within him that mystic resignation that was with him until the night, when, in

the cellar of the house where he was held prisoner, Yourkovsky, the Ekaterinburg Commissar, drew his pistol and shot him in the head!

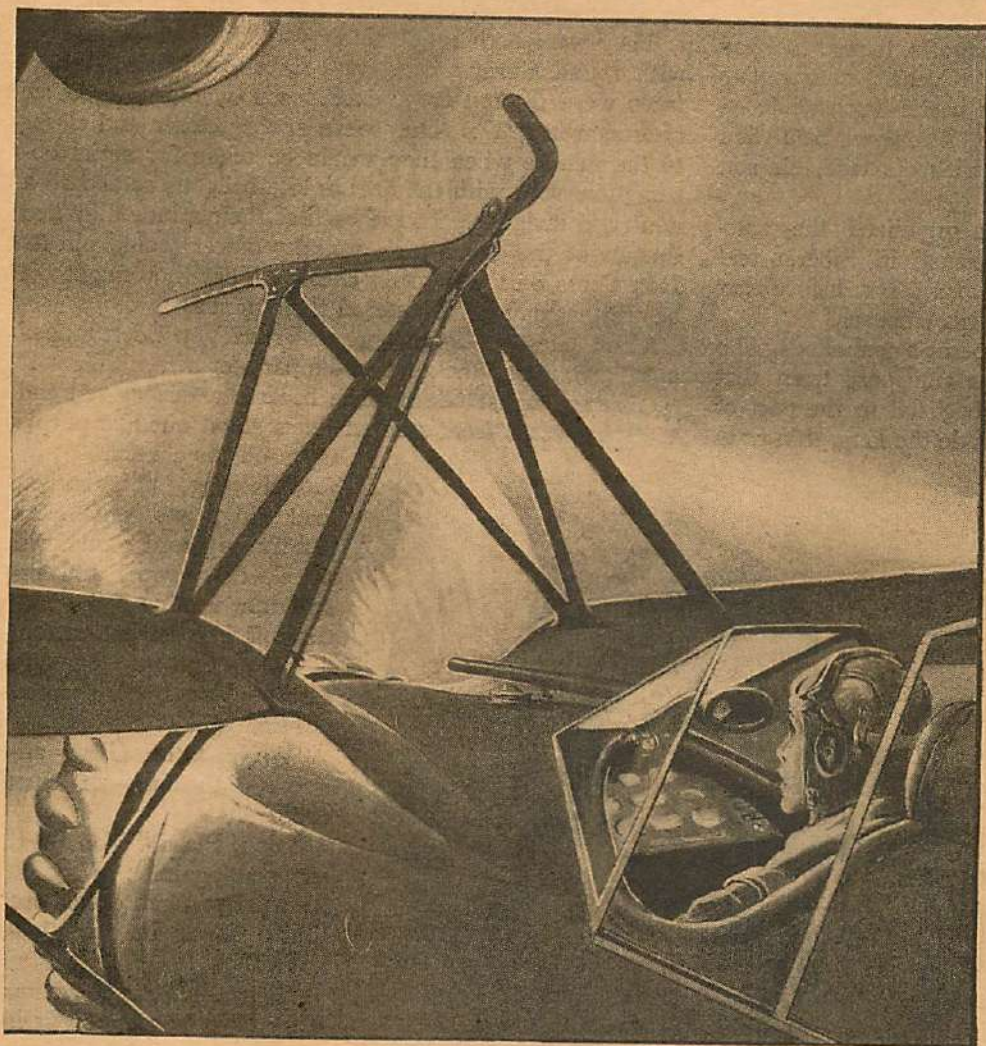
They must have rubbed their hands in high glee when the czar's consort, the Empress Alexandra Feodorovna became the most dangerous of their mystic representatives. For Alexandra Feodorovna, highly strung and hysterical, sought providential guidance in the midst of unbalanced women and false prophets from such men as the French medium Phillippe and the peasant Rasputin.

They watched while the crafty peasant exercised his hypnotic influence over her son, the czar Alexis, while he treated him for that dread disease, hereditary hemophilia. They watched the treacherous Rasputin gain his mystic power until he had his say in the most important affairs of state.

They must have smiled in triumph while the dowager empress, the Grand Duke Nicholas Mikhailovich, and the Grand Duchess Victoria warned the empress against the imminent danger of her fleeting régime of ministerial shadows in the war office, and which she did not heed.

They must have smiled while all these things and more led up to that historic day when the head of the Romanoff

MIDNIGHT SUN



A
New
Complete
BILL BARNES
Air Novel

by
George
L.
Eaton

dynasty was severed with one blow from the bloody body of Russia.

But this is not the tale of Nicholas II, czar of Russia, or his fate, but the strange destiny of the men who followed the frozen trail of the gold that had been touched by the mystic wand of Clotho, Lachesis, and Atropos.

Nicholas II knew that day in March, 1917, when he received a telegram from the president of the Duma, that the end had come. The people standing in the snowy streets in front of the Cathedral of the Virgin of Kazan knew it, too, when they saw a *sotnia* of Don Cossacks come cantering down the street.

They knew it because the Cossacks were laughing!

Never before had they seen these men, who took a sadistic delight in cutting open the faces of the people with their *naigaikas*—those wicked little steel-tipped whips—laughing. Usually, they rode their short-legged horses from the steppes into crowds, trampling, maiming, killing. Now they were fraternizing with the milling mobs in the streets.

Shopkeepers began to pull down the steel shutters over their windows, as the crowds increased and gained confidence. The Nevsky was black with people when a

detachment of loyal uhlans came down the Letaney Prospekt at a full gallop, their lances pointed straight ahead. They struck that great mass of milling men and women with terrific momentum and drove through it. As they cleared the other side they left a twisting, screaming, agonized path of humanity lying in the snow.

A roar such as no man can know who has never heard it went up from the crowd. They drove at the uhlans with only their hands and feet for weapons.

The things that happened then, and from then on, can only be compared to those horrible days that were known as The Terror after the French Revolution. Everywhere about the city of Petrograd there were little reddish-black patches in the snow that were part of what had been a mounted policeman.

In eight days there were no policemen. Some of them froze to death at their machine guns along the rooftops of the Nevsky, where Protopopoff had placed them to nip the revolution in the bud. But his efforts were in vain. As each regiment mutinied they murdered their officers. The Kerensky Revolution was an actuality. Armed bands of plunderers roamed and terrorized the streets of Petrograd.

The faces of the workers, who had been forced to live like swine under the czar, became the faces of men with a lust for blood and spoils. Workers, *moujiks*, soldiers, and sailors listened with upturned faces to the haranguing of a thousand orators.

"Dictatorship of the proletariat!" the people cried. "Take the land! *Deloie boorjoie!*"

Nicholas II, the last of the Romanoffs, turned to Rear Admiral Alexander Vassilievitch Kolchak, commander of the Black Sea Fleet in his last hectic days, while he was transferred from Pskov to Tsarskoe Selo and Tobolsk, where he was interned with his wife, his son and his four daughters.

After the revolution Kolchak organized the anti-Bolshevik force of "White Russians" in Siberia and established his headquarters at Omsk. But before that he carried out his last mission for his emperor.

It was Kolchak, obeying his emperor's commands, who organized that long, horse-drawn transport train that crept northeast over treacherous bog soil to the port of Onega on the Gulf of Onega. Beside the long, thin train rode a regiment of loyal Cossacks. Within the high-piled wagons rode over three hundred million dollars in gold and precious stones.

A destroyer waited at Onega with secret orders known only to the emperor, his family, Kolchak, and the commander of the destroyer.

For two long, horrible months Kolchak fought his way north while men died and were left to become a part of the bog soil. When it seemed that they must abandon their cargo or perish they came within sight of Onega. Kolchak lashed his men onward and saw them die while they loaded the precious cargo into the holds of the destroyer. Then his work was done. He went back to fight the Bolsheviks until he was captured and shot at Irkutsk in 1920—another victim of the curse of the gold of Nicholas II.

The destroyer *Komaroff* crept out of the Bay of Onega and into the White Sea and the Arctic Ocean. It held close to the Murman Coast as the skipper plotted his course around the North Cape of Norway.

Then, those three mythical goddesses, Clotho, Lachesis, and Atropos waved their mystic wands again.

The *Komaroff* and the gold that rode in its belly never reached its destination. The *Komaroff* disappeared as if it had been swallowed up by the great Arctic wastes.

And Nicholas II, last czar of Russia, died as a fusillade of bullets drove into the bodies of his family and destroyed them.

II—ALOFT

FRANZ VON BOETT, flight sergeant, glanced at the nineteen-thousand-cubic-foot spherical balloon tugging at its moorings and then lifted his eyes to the gray,

wintery sky. A half dozen large, wet flakes of snow flattened themselves against his face and he rubbed them away irritably. He barked an order, in German, to the two cadet fliers who had just finished their ground training for service in the lighter-than-air division of the Imperial German navy and were preparing a free balloon for their first training flight.

They were both solidly built youngsters of seventeen, with round German faces and light-blond hair. Their faces were flushed from excitement on that November afternoon in 1917. They were getting closer and closer to the minute when they would be ready for aerial observation work with the fleet in kite balloons or aboard a non-rigid dirigible. In the back of their minds they had dreams of the day a high ranking officer would pin an Iron Cross on their manly chests. That they might die before that day never entered their minds.

"You, Giest," Flight Sergeant Franz Von Boett rapped out, "give me a quick list of the parts of a free balloon!"

Young August Giest's face became a deeper red and the saber scars from student duels stood out like purple welts on his cheeks.

"Gas bag, net, basket, load ring, gas valve, appendix, rip-cord gland, rip panel, drag rope, and inspection window," he rattled off like an automaton.

"Inspection window and *what?*" Von Boett shouted at him.

"And, *sir!*" Giest answered, flushing an even deeper red.

"You, Plass!" Von Boett snapped again. "Why do we use hydrogen gas as our lifting force in free balloons?"

"Because, *sir,*" young Karl Plass answered, "it is very active. It has great lifting force and is not dangerous when pure, is odorless and very nearly combustible. It is a natural gas and is extremely cheap and

easy to make. It has no original volume, *sir.*"

"How do you use a drag rope, Giest?"

"It is used for recoverable ballast or automatic ballast. It is used to check descent when the balloon nears the ground, *sir,*" Giest answered promptly.

"How would you describe the weather to-day in your log book, Plass?"

"A small 'o' for overcast, *sir,*" Plass answered, "and perhaps a small 'g' for gloomy and dark, *sir.*"

"Right!" Von Boett snapped. "Giest, what equipment have you prepared for this flight?"

"A compass, maps, a watch, a valve case, balloon packing case, basket cover, ball of twine, barometer, statorope, recording barograph, ballast, empty bags and a knife," Giest said without breathing.

"A knife and *what?*" Von Boett roared, his face purple.

"And, *sir!*" Giest roared back.

"Right!" Von Boett said. "Get aboard. Plass, you will be acting pilot in charge of gas and ballast. Giest,



Nels Larsen

keep the flight record in the log book."

The young cadets climbed over the side of the wicker basket and waited for Von Boett. Plass grinned at young Giest and whispered, "How does your stomach feel?"

"O. K.," Giest answered. "Watch this Von Boett. They all say he's a tough instructor. I don't like the way the snow is coming down."

"We won't have much lift if it doesn't stop," Plass answered. "Not so much danger of being blown out over the North Sea."

"Let go your lines!" Von Boett shouted at the ground crew who held the straining bag. "Let out your drag rope, Plass, and watch your statoscope. Easy on your ballast."

The nineteen thousand cubic feet of hydrogen gas inside the tugging bag bounced into the heavy air which it displaced. For three hundred feet it went upward at a speed that would have put an express elevator to shame. A slight northerly wind caught it as the voices of the men on the ground floated upward.

During that first three-hundred-foot rise the faces of young Plass and Giest registered a mixture of alarm and curiosity. As the balloon continued its rise and swung easily in the slight breeze the alarm disappeared. The great green and brown and heather fields of Germany floated below them. No sound broke the faint sighing of the wind around the basket. Above them black storm clouds scudded off to the north. All was peace and quiet and serenity. It seemed as though the noise and motion and turmoil of the world had ceased. Flight Sergeant Franz Von Boett broke the calm peace.

"You'd never know millions of men were trying to murder one another down there when you get up here," he said as though he was speaking to himself.

The two young cadets looked at him and then looked away without answering. They knew that his brusqueness was caused, in part, by the two silver plates he wore in his head to keep his brains from oozing out. He had worn them since the battle of Jutland in May, 1916.

At three thousand feet it became noticeably colder and they drew their flying coats more tightly about them.



Once the basket skimmed the licking waves; frantically, Von Boett dumped sand over the side—

"Ease out a little more ballast," Von Boett said. "I think there is a southerly wind at about four thousand feet."

The big bag leaped upward again like a race horse given its head, as Plass let sand trickle through his fingers. He held the bag of ballast on the edge of the basket while he dribbled it out.

"Take——" Von Boett began, pointing at the bag. Plass, startled, looked around. The heavy bag of sand slipped off the edge and disappeared below the rim as Von Boett finished, "—that bag off there!"

The huge balloon raced upward at terrific speed as it was lightened of some of its load. The clouds overhead seemed to be racing down to meet them as Von Boett cursed until his face was purple.

"If we catch a northerly wind above those clouds, Heaven help us!" he shouted. "You dunderhead! Look at that barometer!"

The cold, clammy, dripping clouds engulfed them. They raced through one layer into a space that was like nothing they had ever seen. Below them was a blanket of clouds and above them another.

They were in a vault that was as still as death itself. The silence was so complete it was like the roar of one long, continuous clap of thunder. It frightened them as they had never been frightened before. They were insensate, awed by the silent storm that swirled around them.

Ahead they could see a great white wall of snow marching to meet them. Then, they were in the midst of it, as a fifty-mile gale picked up the huge bag and swirled it north by east.

"If you live through this you'll have something to tell your grandchildren about," Von Boett growled. His words were snatched out of his mouth by the wind, as the two cadets looked at him.

"Won't this snow on the bag bring us down?" Plass asked.

"In the North Sea!" Von Boett snarled. "We want to stay up now until we get a more easterly wind. Then we'll have something under us besides water when we land."

That night was a thing of terror to them. They huddled together for warmth, crouching below the rim of the basket to cut off the biting wind. At times they wanted to die.

Three times they valved gas from the bag to bring it to earth. Each time they found nothing below them but the waves of an angry winter sea and had to use precious ballast to get aloft again. Once the basket skimmed the licking waves and they knew that if it once settled on the surface they would not have enough ballast to set them free. Frantically, Von Boett dumped sand over the side, while he cursed the sea and the storm and the clumsiness of Plass.

As the night went on and on and on hunger and thirst and the intense cold drove them half mad.

Once Giest screamed above the wail of the wind and pointed. "We're going into a mountain!" he said, and covered his face with his hands.

But the mountain was only an illusion. The wind drove

them on without mercy into zero and subzero weather. Their hands and feet became almost useless from the cold. The night wind shrieked and wailed and screamed at them like the notes from a symphony by Sebelius. Strange phantom forms, that trailed away into ghostly shapes, danced at them and passed them by. They became three men without hope, three men who hoped only that they might die.

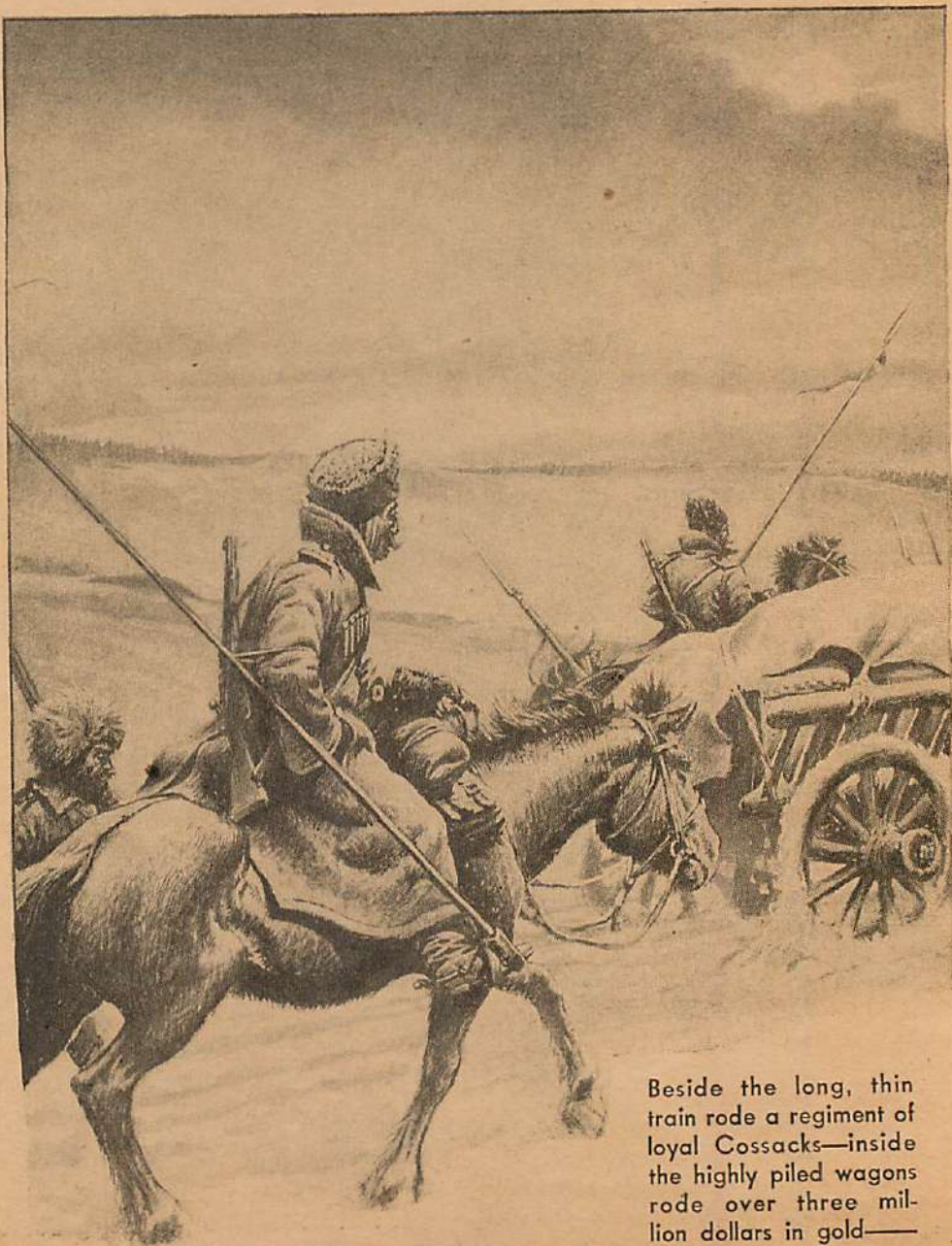
Plass and Giest were crumpled together in the bottom of the basket when Von Boett half brought them to their senses with his kicks and shouts.

"There is land below!" he bellowed at them as he valved the bag. "Plass, you yellow dog, get up and let out the drag rope for a landing!"

Both Plass and Giest pushed themselves upward like men with wooden hands and feet. They stared stupidly into the blackness of the night.

"We're above the Arctic Circle!" Von Boett screamed at them. "We've been in the air twenty-four hours and are over one of the Scandinavian countries. Try to act like men!"

"It's still dark," Plass said through swollen lips.



Beside the long, thin train rode a regiment of loyal Cossacks—inside the highly piled wagons rode over three million dollars in gold—

"There is no sun here for two months at this time of year, you fool!" Von Boett shouted. "Let out that drag rope!"

The huge balloon sagged lower and lower, as Von Boett continued to valve. Great snow-capped mountains loomed up on all sides of them as the wind carried them above an ice-choked fiord.

"Get on your toes!" Von Boett screamed, as he reached for the rip cord and tore the panel out of the side of the bag. The basket struck, bounced twenty feet and struck again, as the bag collapsed across what had once been a part of the hull of the Russian destroyer *Komaroff*.

III—PRACTICE—AND DEATH!

BILL BARNES' blue-gray eyes smiled as he blasted the two fifteen-hundred horse power, supercharged Diesel engines in the nose of his huge carrier-transport "BT-4." The two million-candle-power landing lights cut a path through the black of the night, as Bill flipped a switch. An instant later the transverse bands of yellow-and-black pigment painted across the runways became vis-

up a telephone in his living quarters and had spoken to Tony Lamport, chief radio operator and communications superintendent on the field.

"Tell Scotty to have the carrier transport jacked up out on the apron and ready to go in fifteen minutes," Bill snapped at Tony. "Rout Sandy out and tell him I want him ready to take the Eaglet out of the carrier when we get in the air. None of the crew, except Miles, to work the take-off and landing mechanism."

"O. K., Bill," Tony said. "Anything else?"

"No," Bill said. "We'll be back in an hour. It's only a practice flight. Sandy's getting careless. I saw him bring in a Snorter this afternoon and he did it as though he had nothing but thumbs."

"I'll tell him," Tony chuckled.

"Don't tell him anything but to be ready to go in fifteen minutes," Bill snapped. "I'll tell him!"

Bill checked the watch strapped to his wrist with the chronometer on the instrument panel. The kid still had two minutes left.

Above and behind Bill's head was a circular platform in which was mounted a rapid-firing one-pounder that could throw over one hundred one-inch shells in the space of a minute.

In the midships section of the big bomber was the hangar of the Eaglet, "Sandy" Sanders' fast little fighter. Suspended by its landing hook from an overhead girder, the Eaglet was locked rigidly in place on the girders, and hung with its cockpit just above the level of the deck.

Behind the Eaglet's hangar was a retractable machine-gun turret that could be lowered below the bottom of the fuselage. Farther back were showers, lavatories, and Bill's private cabin—also a dining saloon, with seats that could be converted into berths for the crew. In the tail was the galley, with an electric stove, ice box and a machine-gun turret where old Charlie, the cook, held forth.

On the bridge of the monster were dual controls and instruments, a Sperry automatic pilot under the commander's seat, wireless equipment, a new Kreusi radio compass

"homing device" and every modern appliance known.

From the bridge and pilot's compartment steps led downward to a machine gunner's cockpit in the nose, mounted with a .50-caliber Browning. Beneath the gunner's feet were bomb sights and releases. In each of the wings, abaft the engines, were inclosed machine gunners' pits similar to the one in the nose. A runway connected these two cockpits with the main fuselage. The big ship was a carrier, a bomber, a flying fortress all in one. It was the kind of ship commanders of air forces the world over have been looking for.



ible, as the huge floodlights were turned on in the traffic tower.

In fifteen minutes Barnes Field, Long Island, had been converted from a drowsing airport to a place of feverish activity. It had been Bill's practice from the time he first founded his famous little squadron to snap his men out of their lethargy when he thought they were getting stale. Only fifteen minutes before he had picked

Bill Barnes looked up into the long, dour face of "Scotty" MacCloskey, head technician and major domo of Barnes Field, and winked as he heard Sandy come scurrying up the steps to the bridge.

"You're ten seconds late!" he bellowed at Sandy, as the kid ace of his outfit stumbled onto the bridge.

Young Sandy tried to swallow the mouthful of food on which he was chewing, as he closed zippers on his white flying overall and pushed his helmet and goggles out of his eyes.

"Good gosh, Bill!" Sandy said as he gulped. "What do you expect when you get a fella out at this time of night?"

"I expect you to be ready to go at any time, day or night," Bill said, but the gleam in his eyes belied the tone of his voice.

"You'd think I was a fire horse or something," Sandy grumbled. "Where we going?"

"We're going up where you can practice night landings with the Eaglet," Bill snapped. "If you ever try to hook the Eaglet onto the carrier the way you made that sloppy landing with a Snorter this afternoon I'll be minus a couple of ships."

"What about me?" Sandy asked. "I——"

"You'll be dead!" Bill said. "O. K., Scotty. Is Miles aboard?"

"He's aboard, boy," old Scotty said. "He has his ear phones on waiting for orders."

Bill slipped his boots into the rudder stirrups and gunned the engines again, as Scotty went out the port door. Then, he flipped a switch on the intercockpit telephone and spoke to Miles on the landing and loading trapeze. "Stand by, Miles," he said.

"Yes, sir," Miles answered.

Bill released his brakes, blasted the big ship around into the wind and poured soup into the twin, supercharged Diesels. The monster transport rolled down the runway like some huge, prehistoric animal gathering speed. Two hundred yards from the electrically wired fence surrounding the field Bill eased back on his stick and took it into the air in a long, low climb.

Far off to the right the spires and turrets of New York's lighted skyscrapers gleamed above the city. Sandy stood gazing at them while he finished his dressing, until Bill brought him out of his reverie.

"Take the controls, kid," Bill said. "I want to make a check before you take off."

"O. K., Bill," Sandy said. He sat down in the port pilot's seat and took the wheel.

"Level off at five thousand," Bill said shortly.

As Bill went down the steps from the pilot house and squeezed by the perpendicular propeller of the tiny Eaglet, Sandy dived a hand into a pocket of his flying overalls and extracted a piece of chocolate. With an adeptness born of experience he wedged the huge piece of candy into one cheek while he held the ship steady.

A few minutes later Bill came back and dropped into the commander's seat. The big ship was plowing through

the night air with the steadiness of an ocean liner on a smooth sea.

Barely perceptible lines of worry creased Bill's forehead and wrinkled his eyes as he spoke to Sandy.

"You haven't taken the Eaglet out in a long time, kid," he said. "You're sure you can manage it all right?"

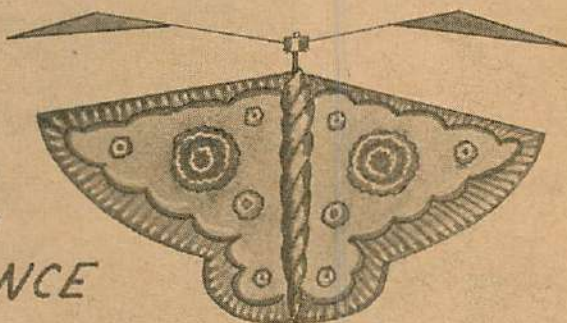
Sandy looked at Bill disdainfully. (Turn to page 72)



Bill never finished that sentence— Two big, twin-motored mono-planes came roaring out of a solid mass of cumulus clouds—

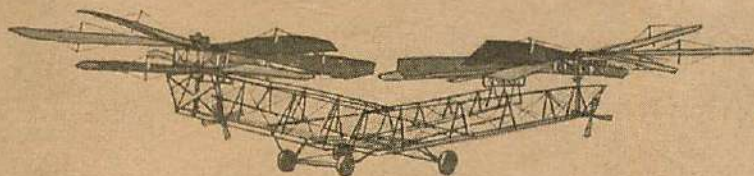
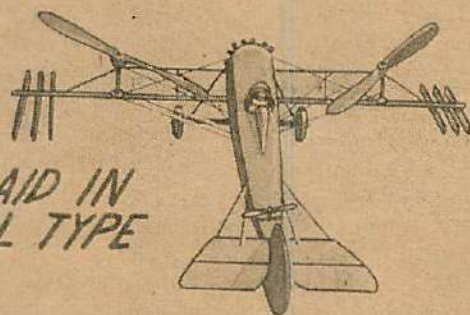
Development of VERTICAL FLIGHT

AN EARLY "HELICOPTER" THAT REALLY FLEW WAS A RUBBER BAND DRIVEN TOY BROUGHT OUT IN 1879 BY DANDRIEAUX OF FRANCE



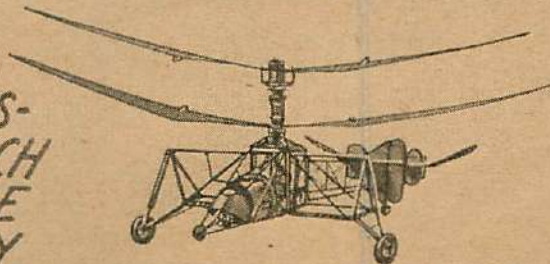
IN 1880, THOMAS A. EDISON PERFORMS EXPERIMENTS TO PROVE HORIZONTAL PROPELLERS WILL LIFT AND SUPPORT A WEIGHT.

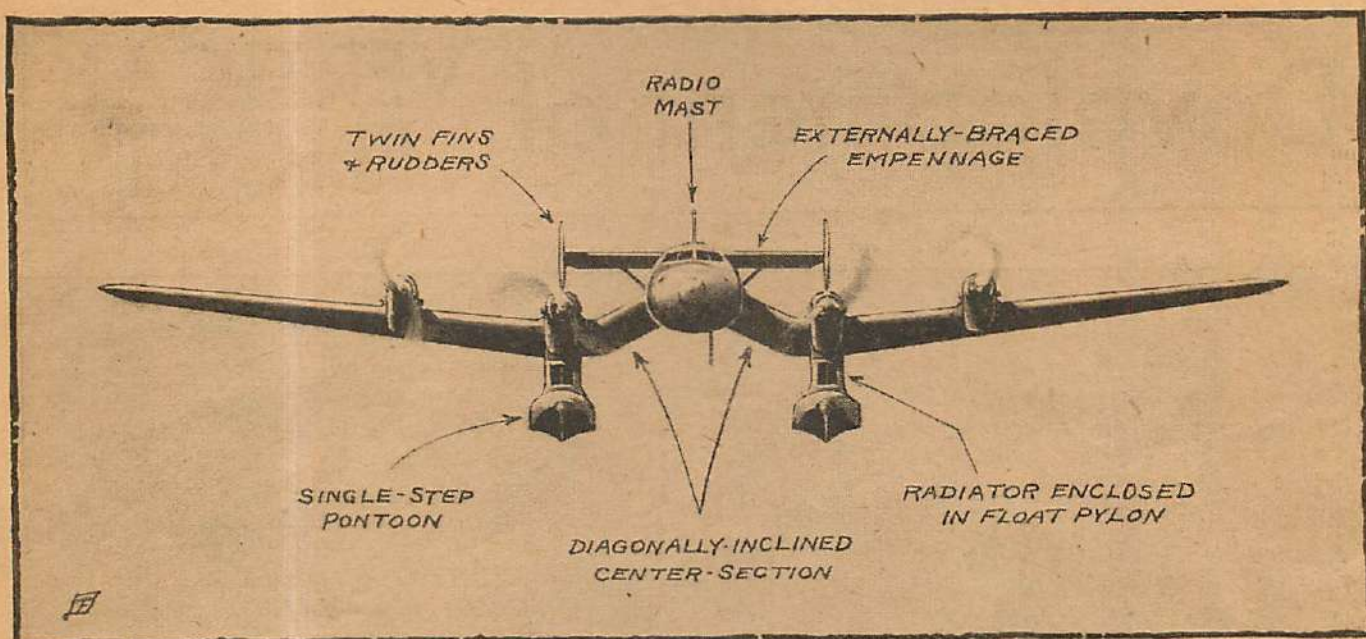
ABOUT 1925 APPEARED A BERLINER HELICOPTER WITH TWO LARGE PROPELLERS TO LIFT IT AND A SMALL ONE AFT TO AID IN STEERING. NOT A VERY SUCCESSFUL TYPE



A YEAR OR SO LATER DE BOTHEZAT BUILT A HELICOPTER OF NEW DESIGN THAT CARRIED FOUR PASSENGERS ON SHORT HOPS

THE LATEST AND MOST SUCCESSFUL HELICOPTER IS THE FRENCH BREGUET-DORAND GYROPLANE THAT RECENTLY FLEW NEARLY A MILE AT A SPEED OF OVER A MILE A MINUTE!





Head-on view of the Ha.139 reveals the striking arrangement that reduces frontal area to a minimum.

FRITZ FLIES THE MAIL

*Newest German contribution to the race
for transatlantic airline supremacy
—the plane on the cover.*

By FRANK TINSLEY

THOSE of you who are old enough to have faced the German soldier over sandbag parapets or through the windshield of a fighting plane will testify that Fritz-boy was quite a guy.

No experienced veteran has ever questioned the individual bravery of the men in field gray, and most observers willingly admit that, taken collectively, Le Boche were probably better "soldiers" than we were. Well they might be. Four deadly years of fighting under varied conditions had weeded out most of the old, stiff-necked, stick-in-the-mud regulars of pre-War days and left a residue of tough, highly adaptable officers and men. Constant changes in tactics and innovations in armament tended to keep the front-line soldier well up on his toes mentally as well as physically. He had to be alert—or die!

Mistakes were made and opportunities lost on both sides—naturally. In justice to the lads on the fire step, however, it must be admitted that the biggest bungles were bungled back in higher headquarters. For instance, there was the military genius who, convinced of the efficiency of chlorine vapor as an offensive weapon, used it so sparingly that the attack failed and the tremendous surprise value of poison gas was lost. Whoever was responsible for that boner can be fairly charged with losing the War for the Kaiser. Then, as if anxious to prove themselves fully the equal of their foes in stupidity, the British powers promptly repeated the blunder with tanks, and another chance to end the carnage was thrown away.

In the air, however, things went differently. There seemed to be something about the new element that quickened man's perception and spurred on his imagination. Lacking the traditions that shackled the older branches with ancient precedents and prejudices, the air service forged steadily ahead, improvising new tactics and creating new equipment as it went. The mad race for better and still better planes reached far back of the battle front and touched every one connected with the flying arm.

Unhampered by military red tape, the civilian technicians and designers vied with one another in meeting the demands of the fighting pilots. Aviation is said to have advanced twenty years during the four years of the War, and there is no doubt that it bred the most progressive and enterprising group of officers in the military service.

The sudden collapse of the Teutonic "home front," in 1918, defeated an exhausted but still defiant army. The retreat of the Kaiser's forces to German soil was embittered by the soldier's belief that his leaders and people had betrayed him. Following closely on his heels, allied armies of occupation set up headquarters across the Rhine, and the French, English and American victors went to work demolishing what was left of the self-exiled Kaiser's military machine.

Small arms and equipment were destroyed in enormous quantities. Artillery, both heavy and light, was smashed beyond further usefulness or, more galling still, shipped abroad as trophies of an Allied victory. The proud

and dashing imperial air service suffered the greatest degradation of all. By the terms of the Versailles Treaty, its very existence was abolished and its once-proud wings piled up airplane upon airplane, to form the most expensive bonfire in history.

Before the ashes of the War had cooled, thoughtful Teutons realized that the avenging Allies had been unable to destroy the most important of all the elements that had made her Wartime air force great. The brains and courage of her airmen were still Germany's, and the new republic had work a-plenty for them to do. Even the destruction of her aerial equipment was soon recognized as a distinct advantage. While the aviation industries of the victor nations were being almost completely wiped out by the tremendous surplus of War-time planes, German airplane designers and manufacturers, unhampered by large stocks of obsolete military machines, quietly went to work developing the commercial side of aviation.

Companies like Junkers and Dornier adapted their big all-metal bombers and flying boats to transport use just in time to provide ships for the newly formed, government-subsidized air lines. Under the name Deutsche Lufthansa, Fritz soon spread a network of civil airways over all Europe.

Profiting by this commercial experience, new and better types of passenger-carrying craft were gradually evolved. Typical of these was the tri-motored, all-metal Junkers G-23, which first appeared in 1924 and can be fairly called the granddaddy of all modern low-wing, cantilever-monoplane transports. It had a wingspan of just over 95 feet, carried 10 passengers, and had a crew of two pilots and a page boy. This ship, along with the Dornier "Delphin," a flying boat produced about the same time, established the Lufthansa lines in the popular mind as the premier air service in the world.

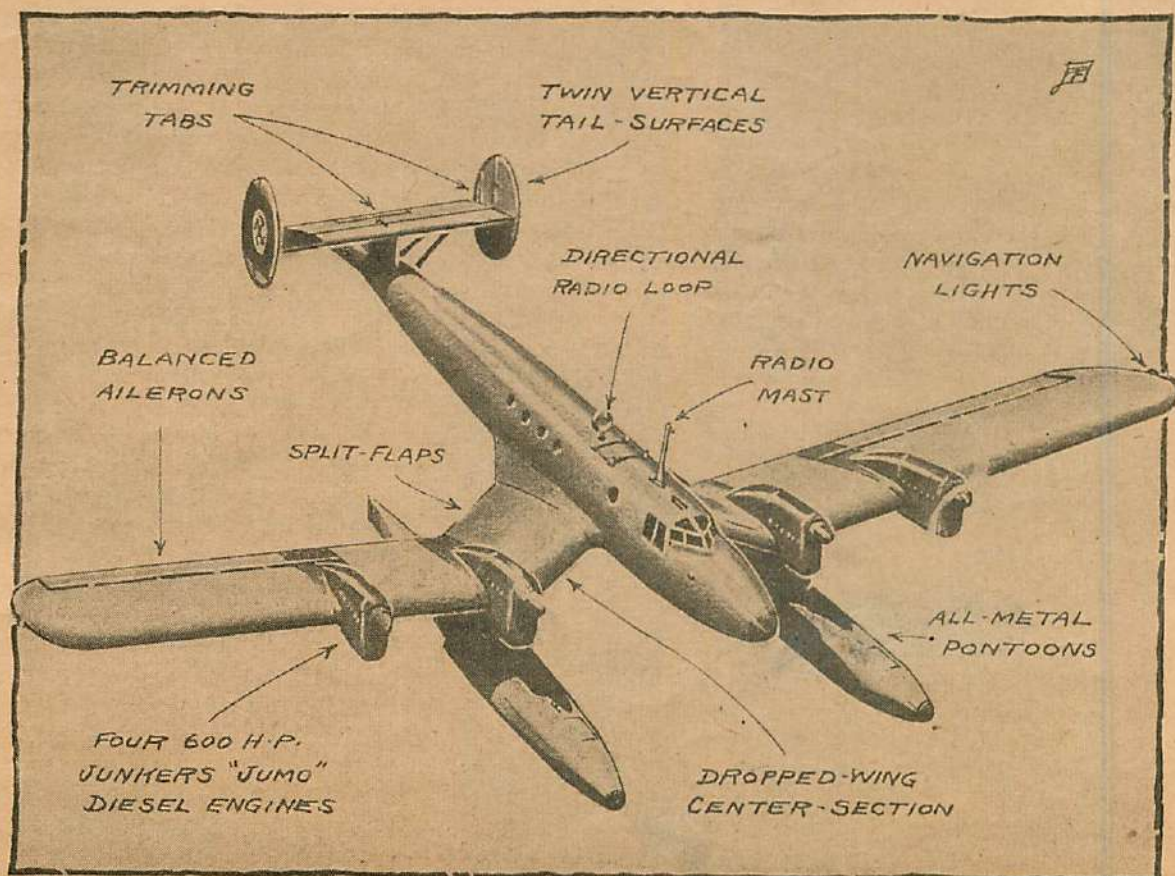
The rapid development of flying equipment and transport technique since 1924 indicates that German designers, pilots and air-line executives are still very much on the job. German airships have provided the first real transoceanic passenger service, both on the North and South Atlantic runs. Intensely receptive to new devices and methods, Lufthansa developed the catapult ship and launched a fast flying-boat mail service to South America, using Dornier "Wals"—the descendant of the original "Delphins."

Last year, while British and American interests talked about a United States-European heavier-than-air line, Fritz-boy quietly went ahead and established one. It is true that it was more or less of a stunt—that only mail was carried and that just a couple of flights were completed—nevertheless, Teutonic initiative has fairly earned the palm. The first commercial airplane service across the dreaded North Atlantic will go down in history as having been pioneered by Germans, using German ships, German planes and German engines.

During 1937 we can expect a further development of this oversea service. In addition to the twin Diesel-powered Do.18 flying boats used last year, a newly developed 4-motored seaplane will be used. This unusual ship, carrying the designation, Ha.139 is a product of the Hamburger Flugzeugbau, a comparatively new firm organized in 1933 by the great German ship-building firm of Blohm & Voss. The Ha.139 is an all-metal, cantilever monoplane designed expressly for transatlantic mail carriage. It is equipped for water landings with twin pontoons, which have been specially strengthened to stand the stress of catapult launchings and the shock of heavy seas.

An ingenious departure from conventional design combines the advantages of keeping the fuselage high above the water and at the same time

(Turn to page 68)



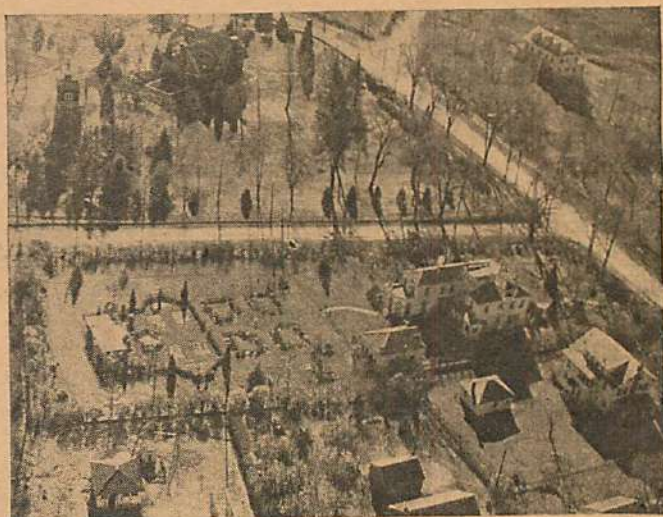
The torpedo-like fuselage, the filleted, angled wing roots, the neatly cowed Diesels and the general blending outlines all contribute to the efficiency of the ocean mail carrier.

AERIAL PHOTOGRAPHY

with a Miniature Camera

by Hubert W. Meyer

IF you have never taken photographs from an airplane you have missed some of the greatest fun and satisfaction that can come to an amateur photographer. I can assure you your friends will envy your results, even if you produce no great works of art in the process. The unusualness of the point of view from which the pictures are taken will result, even in the least successful of the prints, in unusual and interesting compositions, provided, of course, that your ability to recognize composition is instantaneous enough to accord with the speed of your motion in the air.



The clever photograph captures every landscape detail.

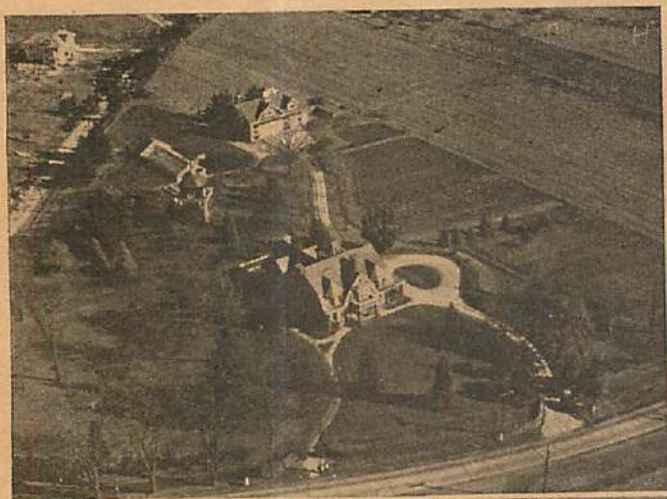
Having experienced the fun and excitement of dabbling in aerial photography several times, I am happy to give my observations, gleaned from much failure and a modest success, to any kindred amateurs who might wish to pioneer in the same direction.

The first consideration is the choice of a camera. The Leica, Contax, Exakta and similar cameras are to be preferred, since they use a lens barrel instead of a bellows. A bellows camera may be used, but some means must be devised to prevent the bellows from collapsing if it is to be used in the slipstream of the plane. Of course, if it is to be used inside the cabin such a precaution will not be necessary, but it will be advisable to hold the camera closely to the glass to prevent reflections.

In the case of the bellows camera, a metal shield should be securely fastened to the camera and extend the length of the bellows. A neck cord should also be used to prevent the accidental dropping of the camera if it is necessary to hold it over the side of the plane.

The miniature camera is especially adaptable to oblique aerial photography because of the large aperture lenses and high shutter speeds usually associated with such cameras. The ease of operation and economy are also tremendous advantages. The great depth of focus obtainable with the short, focal-length lenses permits the inclusion of parts of the plane and ground in the picture, resulting, at times, in very unusual compositions.

Now we come to the question of filters and film. For near objects and scenes, the Wratten K 2 or a like filter will be found satisfactory. For photographs from high altitudes or over long distances, the Wratten G or a filter should be used. (Turn to page 94)



Above: Aerial photos of your home are unequaled in preserving its charm.

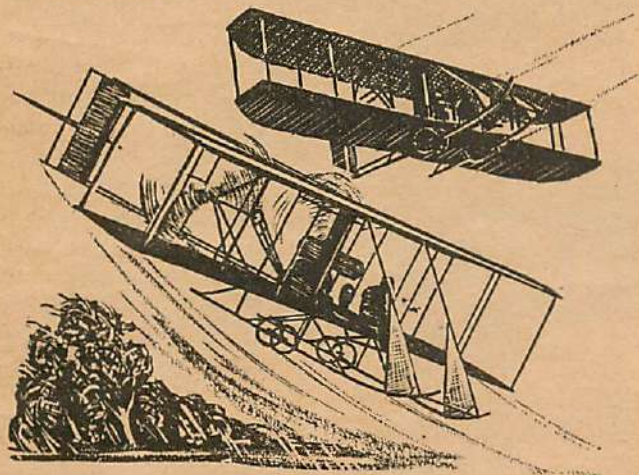
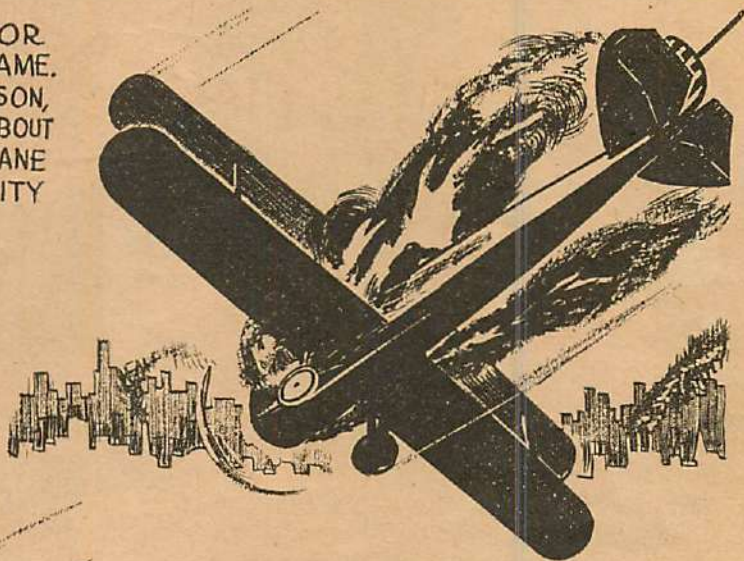
Right: A snap from the air proves what a stranger you are in your community.



SPLIT-SECOND ACTION

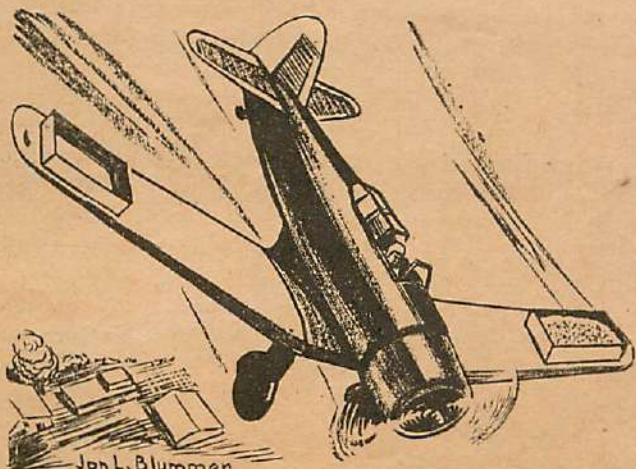
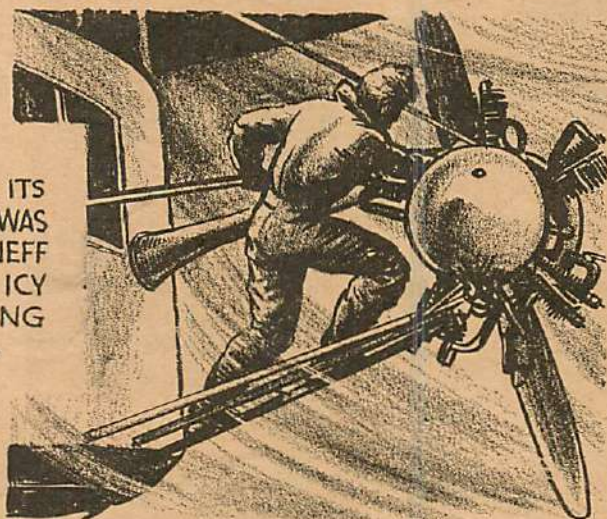
Hair-breadth escapes, hair-trigger decisions, dangerous moments that come once in a lifetime.

A VIOLENT EXPLOSION IN THE MOTOR AND SOON THE COCKPIT WAS AFLAME. THE OBSERVER BAILED OUT. LT. HUTCHINSON, THE PILOT OF THE BIG BOMBER, WAS ABOUT TO LEAP WHEN HE REALIZED THAT THE PLANE WAS HEADED DIRECTLY TOWARD THE CITY WHERE THE LOAD OF HIGH EXPLOSIVES MIGHT CAUSE A MAJOR DISASTER—SO, DISREGARDING HIS OWN SAFETY, HE REACHED THROUGH THE FLAMES AND RETARDED THE THROTTLE. FOR A TIME, AS THE PILOT 'CHUTED DOWN, THE FLAMING BOMBER SPIRALED AROUND AND AROUND HIM BUT FINALLY FELL AWAY.



IN 1910 TWO INTREPID FLIERS EACH BENT ON ALTITUDE RECORDS TOOK OFF IN AN 80 MILE GALE. THE MOTORS OF EACH WRIGHT PUSHER AT FULL THROTTLE—NEVERTHELESS THE TWO SHIPS, SPUTTERING PROTESTS, WERE PUSHED BACK NEARLY 25 MILES.

WHEN AN ARMY BLIMP BROKE AWAY FROM ITS MOORING MAST IN A WINTER STORM AND WAS IN DANGER OF CRASHING, SERGEANT FRANK NEFF CLIMBED OUT ON LURCHING, SLENDER AND ICY STRUTS AND SUCCEEDED IN FIXING AND STARTING THE MOTOR THUS SAVING BLIMP AND CREW.



CAPTAIN T.H. CARROLL, TESTING THE EFFECT OF HEAVY LOADS ON AIRPLANE WINGS, WENT UP WITH 500 POUNDS OF SAND BOXED ON EACH WING. AFTER NOTING THE VARIOUS RECORDINGS ON INSTRUMENTS CAPT. CARROLL PULLED THE STRINGS TO RELEASE THE SAND. ONE BOX EMPTIED READILY BUT THE STRING ON THE OTHER BOX BROKE—AND CARROLL LANDED THE UNBALANCED PLANE SAFELY.

Jon L. Blummer



The flames—
They had reached his
cockpit—were blazing
over him—

Fire Dive

by Leonard Long

*Fear enveloped him—
destroyed his sanity—
left him raving—*

THE boy seemed to appear out of nowhere. Dave Rainier lifted his head from an inspection of a landing gear strut to see him approaching. The late-afternoon sun, he noticed, reflected on the boy's odd-colored hair and produced a sort of glow.

"Are you Mr. Rainier?"

"Yes, sir," Dave replied, and added jokingly, "you see before you, Dave Rainier of the Air Aces, finest flying-exhibition team in the country."

The boy smiled—not a broad smile, but one that fairly radiated warmth.

"I saw your exhibition this morning. It was wonderful the way you trailed those smoke designs across the sky."

Dave found himself smiling in return. He had been complimented before, but somehow this lad's words were different. They were so sincere, so filled with fervor.

"And what can I do for you?"

"I understand you're looking for a mechanic. I'd like to apply for the job."

The pilot looked down and tried to check the half-ironic grin he felt coming on. It seemed inevitable that

wherever the Air Aces performed, scores of youths found themselves vowing to get into aviation, to fly like the pilots they saw weaving rainbow smoke trails across the sky. There was something in the spectacular exhibitions that heated young blood to fever heights.

And more often than not that led to an interview with the Air Aces, either Dave Rainier or his partner, Bert Dayton, in the hope of obtaining a job with the stunt men.

"Yes, we need a mechanic," Dave said kindly. He was one who remembered very well his own early efforts to break into the flying game. "But I'm afraid we can use only a man with an aircraft and engine license."

"I have an A and E license—also a private pilot's ticket."

Dave showed his surprise.

"That's different. You look pretty young—but—perhaps we can give you the job. First, let's have your name."

"Art Weldon."

"And your experience?"

The boy's manner changed almost imperceptibly. His speech slowed the merest trifle.

"After graduating from mechanic's school I worked at Sharon Airport."

"And you left there——"

The boy visibly hesitated.

"They let me go."

Dave noted the hesitation. But that open, honest face was not one to promote uncertainty.

"Well, Art, I take it you're not overburdened with practical experience. But I think you can prepare to tender your resignation to the army of the unemployed. I'll get my partner's O. K. on it right after the show. Stick around."

The program announcer's voice was already booming over the field. The crowd stirred in anticipation.

"Ladies and gentlemen, I give you the Air Aces in their original and unique exhibition. You will be thrilled! You will be awed! You will see glorious sights to long remember."

Both planes had been idling in readiness. Now the engines boomed out. The biplanes rolled heavily down the runway. They seemed awkward as they traversed the ground.

They lifted, became fleet and graceful as birds.

Deep exhaust roar filled the air as the planes climbed swiftly. These ships carried heavy engines, necessary because of the extreme nature of their maneuvers.

Then they were at their desired height, seeming to poise there.

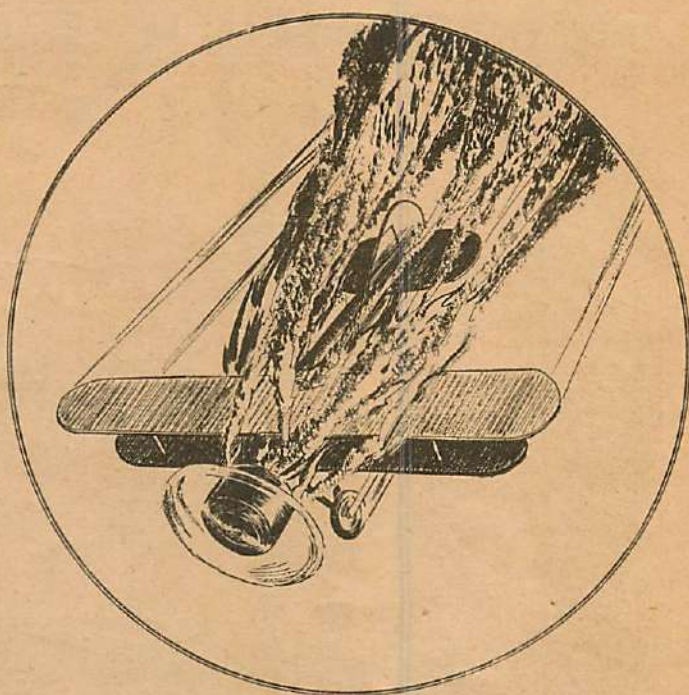
They dived.

A murmur rose from the crowd as the ships plummeted down, a trail of smoke appearing from each. As the engine thunder grew louder the trails expanded, their color a dazzling white.

A tortured drone from both planes. They leveled out at terrific speed—and zoomed. At the top of the zoom they crossed their own smoke trails, stalled and spun down in a whirling climax, leaving the smoke design drawn across the sky.

That was only the beginning. They separated, climbed and dived again. Engines running wide open, the ships zoomed, circled and looped. From them came smoke streams of gorgeous hues, all the colors of the rainbow. Across that mile-high sky, against a background of mountainously piled clouds, they weaved designs, beautiful, eccentric, bizarre.

While one plane dropped down slowly, the other bored higher in climbing turns. Gaining the top of a lone cloud, it flipped over on its back and flew down one side, leaving behind a smoke trail of brilliant yellow. Faster and faster it dived, then eased out of the dive following the outline of the fleecy mass. Now it was flying underneath, now climbing the other side. It was at the top.



The entire mass of spectators rose. Then the ship was enveloped—a blazing comet diving to destruction!

And the crowd's awed murmur swelled out, for they saw the cloud encircled with a perfect smoke ring.

The second ship was at a low altitude. The spectators tore their gaze from the high heavens as this low flier suddenly spouted vapor of a vivid green.

Engine roar reverberating from the ground, the plane flew back and forth above the field, sewing its designs just over the heads of the crowd. Color succeeded color, until all the streams merged in blended beauty.

Invisible above the smoke screen, the plane climbed to join its mate.

As the tinted vapors faded, the crowd looked up, sensing that the main event of the exhibition was at hand.

"Whew!" A red-faced spectator wiped his brow. "Those fellows up there can't put on anything more spectacular."

"That's right," his neighbor agreed. "But say—what's that!"

One plane was falling—falling in uncontrolled maneuvers. And from its engine came clouds of dirty, black smoke; evil-looking smoke, far different from the former gayly colored streamers.

The crowd fell silent, half incredulous.

"Aw, it's just another stunt," some one said.

The black smoke became mixed with fiery red! Then the ship was enveloped—a blazing comet diving to destruction!

The entire mass of spectators rose. Cries rang out.

"It's no fake! He's burning!"

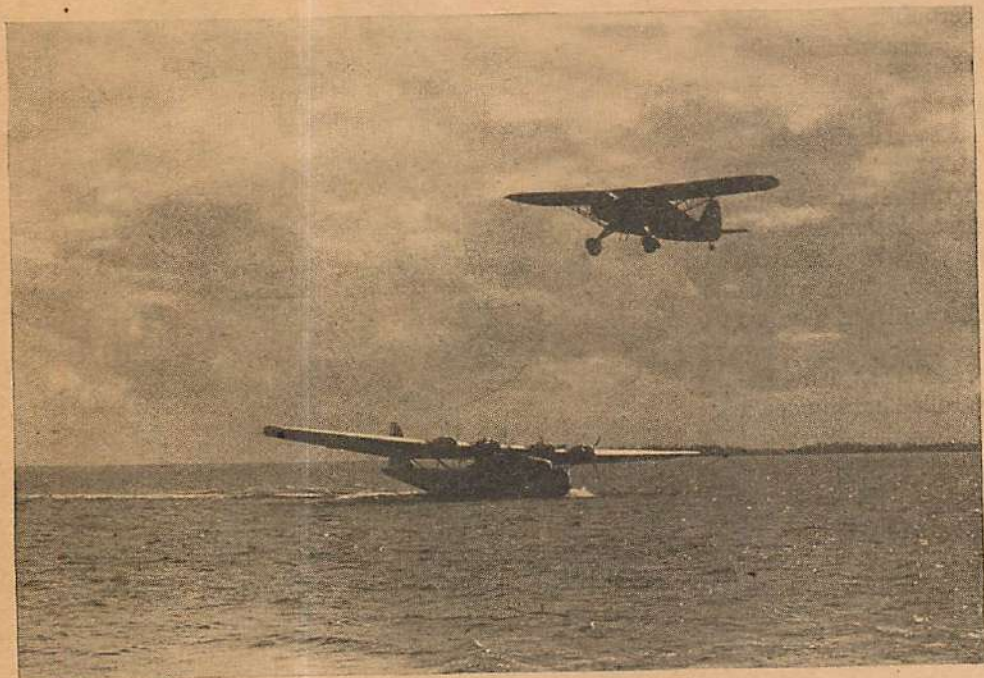
"What a death!"

With every eye on the sky, no one noticed Art Weldon. The boy stared at the falling plane as one in the grip of utter terror. His face worked. He moaned aloud.

"Fire!" he shouted hoarsely, voice vibrating with emotion.

His shout was drowned by the tremendous thunder of the diving plane as it suddenly (Turn to page 95)

GETTING INTO



*The Most
Important
Series
of the Year.*

Stinson Reliant greeting the China Clipper by air. Although handling seaplanes and flying boats on the water appears simple, actually the operation is a difficult one, calling for experienced personnel.

THE aircraft industry in the United States is in the midst of the most rapid expansion since the Lindbergh boom of 1928 and 1929. Many factories, with orders on their books far in advance of production, are operating at full capacity, and some of them are enlarging their plants as fast as possible. New factories are being opened and new makes of planes are being introduced.

The air lines are growing and call for more planes. Sales of private planes, especially of the lighter makes, rose sharply in 1936 and are still rising. At the recent National Aviation Show, light-plane exhibitors were amazed at the size and interest of the crowds and at the unprecedented sales made. It looks like 1937 is an even bigger year than 1936 for private flying.

Last year Congress handed the aircraft industry the job of building a 2,320-plane air corps—on top of the 1930 plane “treaty strength” navy program. Money was appropriated for 565 of the authorized army planes this fiscal year, and Congress would have ordered more if the industry had been able to build them. So it looks like the government will be feeding orders to the manufacturers as fast as they can take them for some time to come.

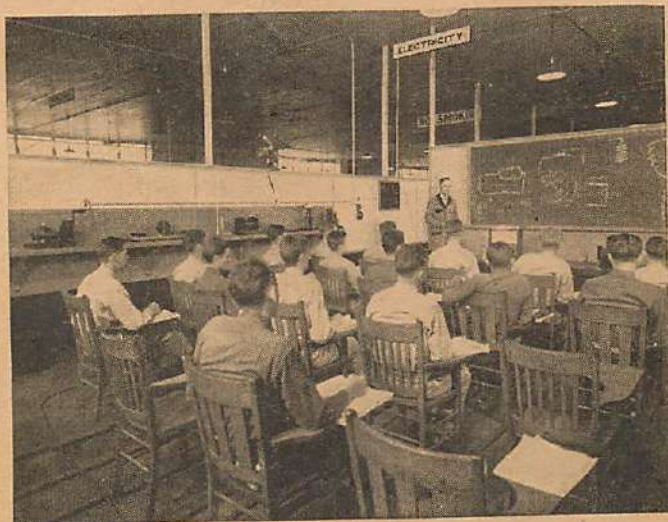
In addition, while air-

plane factories in Europe work feverishly on military planes for their own governments, the American industry is being called on to build commercial planes for export. For instance, almost a million dollars’ worth of planes will be ordered in the United States for the new trans-Canada air line. England is too busy to handle the job.

More skilled workers, mechanics, and engineers are needed to build these airplanes, and more mechanics and maintenance executives are needed to keep them in flying condition. Just how fast and how big this expansion in the use of airplanes and in the demand for trained personnel will be there is no way of telling. At present, however, there is a need for more properly trained men in almost all lines.

Major General Oscar Westover, chief of the army air corps, recently complained that the mechanical forces of the air corps are being depleted by the demands of the civil industry, and said it would be a service to national defense if more men were trained in civilian schools. Officials of the civil service commission tell the same story of trained personnel flocking out of government service to private employment.

At the same time, the aircraft manufacturers on the West coast, with government and commercial orders piling up,



Official Photo U. S. Army

Class in electricity and basic instruction at the army's Chanute Field.

AVIATION

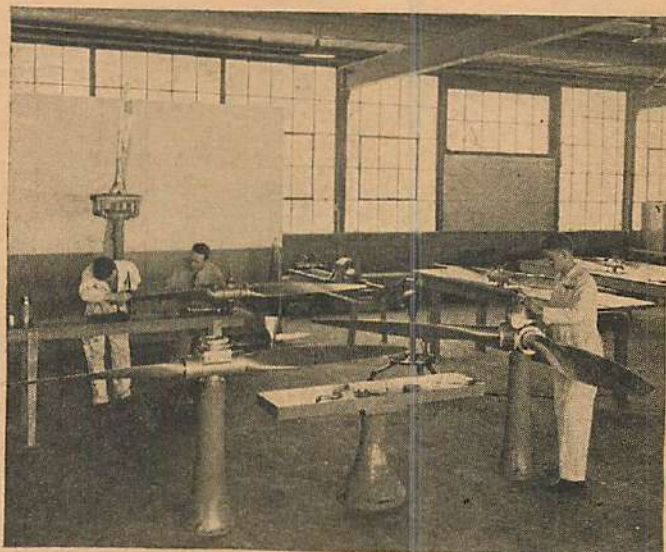
PART FOUR

by Clyde Pangborn
and
Lieut. W. M. Wood

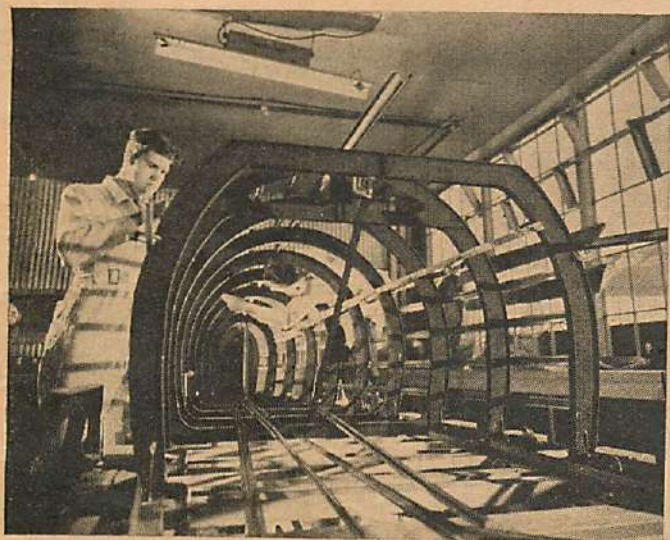
need more skilled men of certain kinds, and have even advertised by newspaper and radio for high-speed tool and die makers, sheet-metal workers, electrical welders and aircraft riggers, and offered to pay their fares from the East. They are also complaining of a lack of aeronautical engineers.

But all this doesn't mean that all the people who are rushing to get a smattering of knowledge and experience in an aeronautical trade will be sure of landing good jobs at high pay immediately. There are certain things to remember.

One of them is that in spite of the expansion and the



Mechanics students at Parks Air College are trained in the servicing and repairing of propellers.



Boeing School of Aeronautics, offering special advanced courses in metal working, is typical of the approved schools supplying the industry's labor demand.

opinions from high places that aviation is going to be the next giant industry, the building and maintenance of airplanes is still comparatively a small business. The bureau of air commerce estimates that about 19,000 people are employed in aircraft manufacturing, and about 8,500 in engine, propeller and accessory manufacturing. The department-of-labor tables indicate that late in 1936 about 14,000 wage earners (not salaried men) were employed in manufacturing aircraft. Estimates by the same method show that in the manufacture of automobiles there were in 1936 about 400,000; in blast furnaces, steel works and rolling mills, about 435,000; in petroleum refining about 79,000; in newspaper and magazine printing and publishing about 121,000; in radio and phonograph manufacturing about 64,000 wage earners.

THE bureau of air commerce estimates that there are about 8,000 people engaged in miscellaneous flying activities in the United States, including pilots. The number of airport employees, a large number of whom do mechanical work, is put at about 5,000. The air lines in 1936 were employing about 2,700 mechanics and riggers, and about 1,500 other hangar and field personnel. In the air depots which overhaul army air corps planes about 4,000 civilians were employed, and the bureau of aeronautics of the navy was using about 4,000 civilian mechanical workers during the last fiscal year (probably more this year).

The navy refuses to tell how many enlisted men it has in aviation, but the army air corps right now is in the midst of an expansion calculated to put the total of enlisted men at 17,784 by July 1, 1937. Only part of these, of course, are airplane maintenance men.

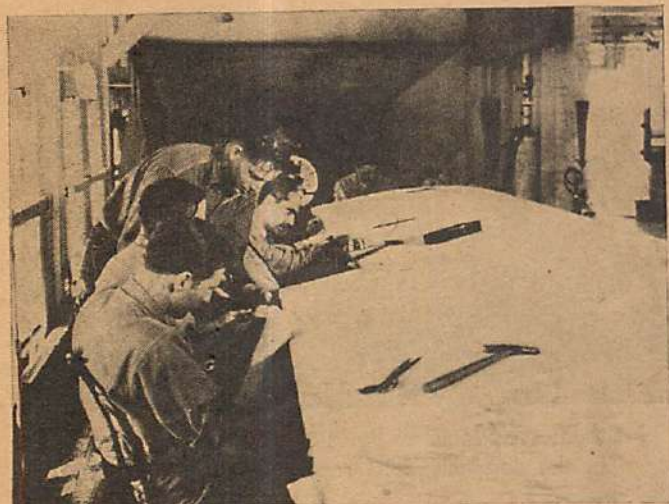
Even if one counts all these maintenance men, and counts some who aren't maintenance men, the business of airplane maintenance is seen to be relatively small compared to keeping up railroad equipment. Close to 300,000 are employed in railroad repair shops.

Another thing to remember, if you are thinking of getting into the building or maintenance of airplanes, is that the present expansion and bright hopes for the future are causing a rush to the aviation schools; new schools are opening and new courses are being added at old ones; classes are being enlarged. It is possible that the supply of qualified workers, short in most lines at present, may catch up with and pass the demand. If you can afford training for only one kind of work, you should have the advice of some one in touch with the industry and the employment situation and able to give you an idea of what the special needs of the industry will be when you plan to finish your course of study.

We will tell you something of the current situation, but conditions change very rapidly in the aviation industry. If you don't get around to taking

aviation training for some months, it may be that by that time there will be an oversupply of qualified aircraft workers in general (though this is not believed likely). In that case it might be better for you to go into some other line of work and count on having a plane of your own and aviation merely as a hobby.

A good person to guide you in a matter of this kind would be the head of a responsible aviation school which is known to maintain close contacts with the industry. The heads of the aviation departments of universities



Official U. S. Navy Photo

Naval students at Pensacola, undergoing rigging instruction, shown applying fabric to the wing structure.

may also give you advice, as well as officials of the few vocational high schools whose courses are good enough to hold the attention and respect of the aviation industry. The personnel managers of the air lines and manufacturing companies may, in some cases, answer queries by mail. But it's a good idea to talk to them if you can.

Though the one-job man, in the right specialty, can easily get a job under present conditions, it is well to know several jobs, and the more broad and thorough your training is, provided you are not "jack of all and good at none," the better your chances for steady employment and promotion. In slack times the one-job man is often dropped first. Volume of production varies widely from time to time, especially in factories producing commercial ships. A skill useful in producing one kind of ship might not be needed on another type, and in that case you'd have trouble changing from one factory to another unless you knew different kinds of work.

Technical developments may also ruin the one-job man. For instance, the wide adoption of metal construction has greatly increased the demand for metal workers and decreased the demand for woodworkers. One big manufacturer says "welding is going out." Another needs more welders at present. The need for welders varies according to the type of ship being built. The welded tubular steel fuselage is still with us. Sales of small planes using it are increasing. But the trend is marked toward the stressed skin *monocoque* type.

Here is a situation which illustrates how broader training may be very valuable, and also how demand for men with certain skills varies between areas. We were informed recently by the personnel manager of the Douglas factory that there has been an excess in the southern California manufacturing area of army, navy

and commercially trained maintenance and service men. They have gone there looking for jobs in the factories, the famous weather, and perhaps movie stars. Now the Douglas factory and others have been looking for installation assemblers and metal fabricators, but many of these maintenance men cannot be used because of their inability to work from blue prints. They can be used only in the final assembly department.

At the same time, one of the biggest air lines tells us that engine mechanics under present conditions have good chances for jobs in maintenance bases. Apparently the lure of the famous weather and movie stars has caused a bad distribution of mechanics, and unless those California mechanics learn to use blue prints they'll have to forsake the Western glamour for more humdrum cities farther East.

The failure of many of the aviation schools to include preparation for production work on modern metal ships in their courses is a common complaint just at present. Some schools are taking steps to remedy the matter. Another big factory says that aviation trade schools in general are "good, but not thorough," and makes a careful distinction between good ones and bad ones. Incidentally, this factory says that, in spite of the demand for more trained workers, boys who have had aircraft trades courses in high schools have an "only fair" chance of getting a job.

WITH these words of general caution in the backs of our heads, let us hold on to our confidence in the future greatness of opportunity in aviation and take a look at the matter of training to enter the manufacturing and maintenance end. We are considering manufacturing and maintenance together because the same preparation enables one to perform some jobs in both, and because, in general, the schools training for one train for the other.

In both maintenance and manufacturing the jobs may be roughly divided into hand work and brain work. It is not a very exact division, for hand workers and machine operators must have plenty of intelligence and a great deal of skill. They must use their heads constantly. And head workers—the engineers who plan new procedures, design and test new and better airplanes, and correlate the various activities with each other, must also know how to use their hands.

Directing and correlating the work of all are many varieties of supervisors—from foremen to chief engineers, department heads and general managers. There are also various kinds of inspectors.

The ambitious young man expecting to make a career of this side of aviation will, of course, consider the possibility of getting a thorough education as an engineer. The best jobs go to well-prepared engineers, though the wages paid less thoroughly educated workers compare favorably with those in other highly skilled trades and the supervisory posts open to a limited number of non-engineers are quite attractive.

Many young men cannot afford four- or five-year university- or technical-school courses, and not everybody has the special kind of mathematical talent necessary in a high degree for aeronautical engineering. So we will consider training for nonengineering jobs first.

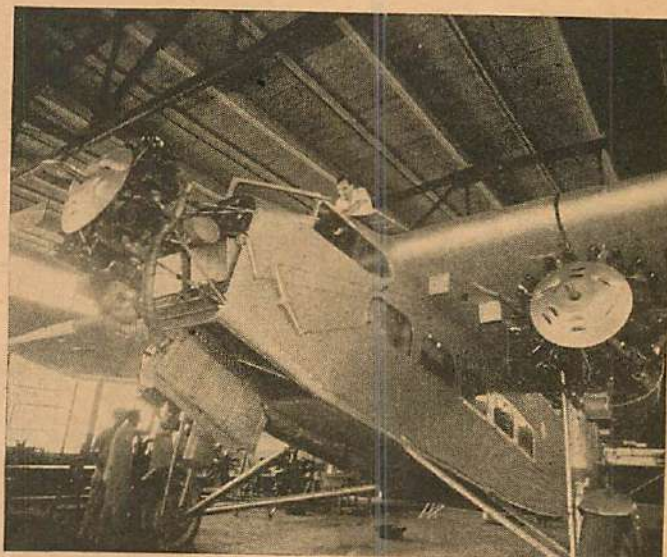
What are the general qualifications for a man who

expects to enter training for aircraft mechanical work? Most important of all, he must have mechanical aptitude. He must like to make things and fix things that run—model airplanes, for instance. Educational authorities recognize that a boy may be a poor academic student in school and still have in him the makings of a fine mechanic. However, a boy who has mechanical aptitude and is also smart in books has a better chance to advance. Because the safety of lives depends on the mechanical worker, responsible schools and employers alike generally steer clear of all except those who have intelligence plus mechanical aptitude.

Do you have to graduate from high school? Generally speaking, it is very advisable. Some aviation trade schools have no specific requirements for entrance. Others have fairly low requirements, but the best commercial schools, and the army and navy schools (in practice if not by regulation) require high-school graduation for entrance to their mechanical courses.

What should you study in school? If you expect to go on, eventually, into engineering, you will naturally get as much mathematics as possible. But if you have no intention of becoming an engineer you will have little need for far-advanced mathematics in your work in maintenance or in most factory jobs. However, it would be a very good idea to learn as much as possible about mechanical drawing, as a good many factory jobs require ability to work from blue prints.

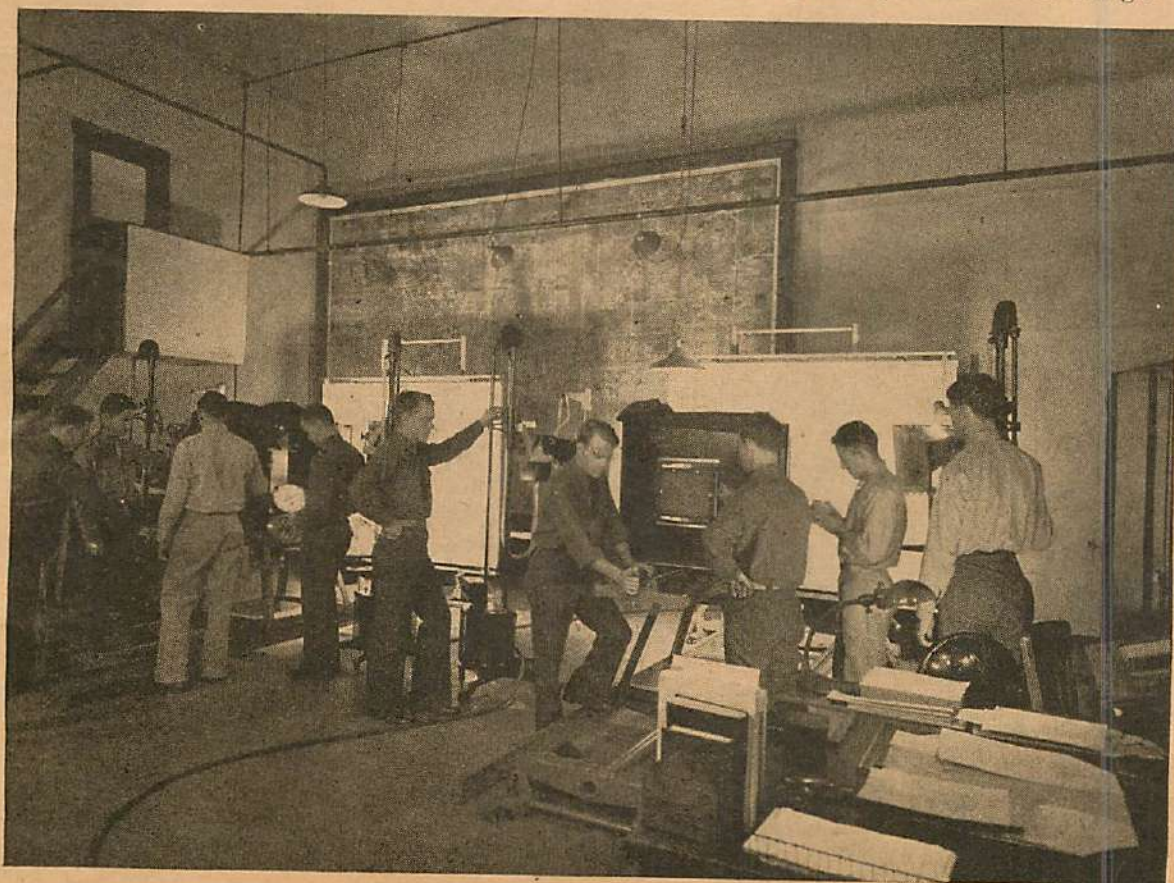
Many maintenance supervisors consider training in automobile mechanics worthless and even harmful as preparation for aviation mechanics. This is because one frequently develops habits in auto work which are very bad for aircraft work and have to be unlearned. But machine-shop practice, largely because it develops habits of accuracy and precision, is considered the best of all preparation for aircraft-engine work.



Students at Parks Air College gain practical experience by the actual rebuilding of planes, such as the Ford trimotor shown.

NOW we come to the matter of specific preparation. Must a job seeker always have special training? Generally speaking, yes, for all jobs worth having. In maintenance, men who work under licensed mechanics are not required by department-of-commerce regulations to hold licenses, but they are of relatively little value without some organized prejob training. Though some air lines do hire inexperienced and untrained apprentice mechanics, it is expensive to train them on the job, and the air-line bases ordinarily want well-trained men.

However, we are informed that men with only a little training in engine mechanics can get (Turn to page 88)



This army class in copying department of photography is typical of the unlimited aeronautically related technical subjects in which specialization is possible.

Official Photo
U. S. Army



From—STEVE STERLING,
Skyways Air School,
Greenvale, Calif.

"Dear
Harry—"

To—HARRY REED,
Burton, Pa.

DEAR HARRY,

Can you picture me flying a one-thousand-horse-power racing plane; one of the fastest ships in the entire United States, with a top speed of way over three hundred miles per hour! No? Well, I don't blame you. Such planes are usually flown only by pilots of experience.

But read on, read on.

A few days ago "Speed" Spaulding, who, as you know, is one of the best racing pilots in the country, came into the field with his new *Sunstreak* racer.

What a ship that is! Huge one-thousand-horse-power, supercharged motor. Superstreamlined design with absolutely everything, even the heads of bolts, shaped to decrease resistance. Completely enclosed cockpit. And—oh, yes—a stalling speed of approximately one hundred miles an hour.

Well, sir, I am giving this racer the double-o when Norwood appears on the scene.

"Think you could fly that airplane?" he asks jokingly. (He should have known better.)

"Why, that might be possible," I reply seriously. "Landing it at around one hundred miles an hour wouldn't be easy, but with luck I could do it."

Norwood looks at me incredulously.

"I believe you *would* try it," he says. "And that being the case I'd better make certain that you do not have an opportunity to do so."

He calls over Speed Spaulding, who is an old friend of his.

"Speed, you'll be wise to maintain a guard over your racing ship," he warns. "Otherwise this young man might try to fly it."

And with that speech Norwood walks away, leaving me talking to Spaulding.

We will now proceed with the story from Norwood's point of view. That gentleman is standing in front of a hangar when he sees mechanics roll the *Sunstreak* racer out on the field and warm the motor.

Spaulding is going up in his ship, thinks Norwood.

The racer's mighty motor is roaring; the little ship is quivering, ready to go—when—across the field runs

Letters of an Air Student to His Friend

by George Swift

Steve Sterling, easily recognized because of his distinctive flying clothes, Sterling leaps into the cockpit, pulls down the transparent cover and motions to the mechanics to take away the chocks. Before Norwood can race, shouting, to the spot, the *Sunstreak* is thundering down the field!

"Why did you let him get away?" Norwood demands of the mechanics.

"We couldn't hear you on account of the motor," one of them answers. "And we thought Sterling was only going to taxi around the field."

Norwood turns and watches the racer. If only Sterling does confine his efforts to taxiing. But it is a forlorn hope.

The *Sunstreak* is turning at the extreme end of the airport. Now the one-thousand-horse-power motor bellows out at full throttle. The little racer leaps ahead with incredible swiftness, roars down the field.

Halfway across the 'port Sterling lifts the ship into the air.

"Too soon," Norwood groans. "He should have taxied farther. He can't possibly stay in the air."

The speed plane is faltering as Sterling strives frantically for control. It drops to the ground—rolls five hundred feet—rises again—soars into the sky!

"He made it," Norwood wipes perspiration from his brow. "But he can't land that ship and live. And he has no 'chute."

Mechanics and pilots are streaming from the hangars and shops. The news has spread like wildfire that a student pilot has taken off in the *Sunstreak* racer.

"Run out the ambulance. Assemble the crash detail," Norwood orders.

Within a few minutes the ambulance is standing in front of the hangars with motor running, ready for a quick dash to the hospital. Lined up near by are the members of the crash detail, carrying axes, metal cutters and fire extinguishers.

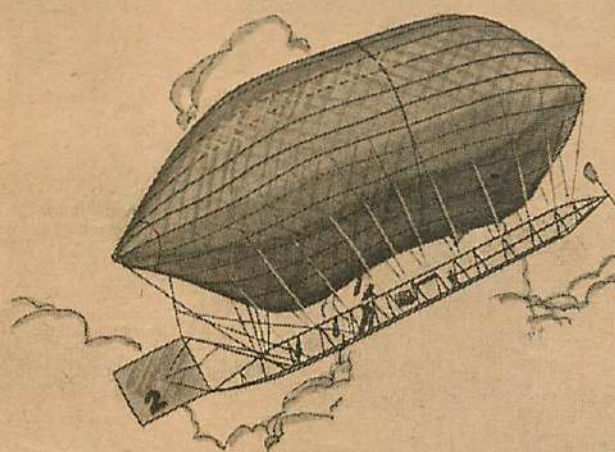
A tremendous roar comes from above. Steve Sterling is diving the racer at the field. He levels out and streaks by at blinding speed.

Most of the flying instructors are now standing with Norwood.

"That kid Sterling can fly," one of them breaks the strained silence. "I wouldn't have believed he could handle the ship at all."

(Turn to page 93)

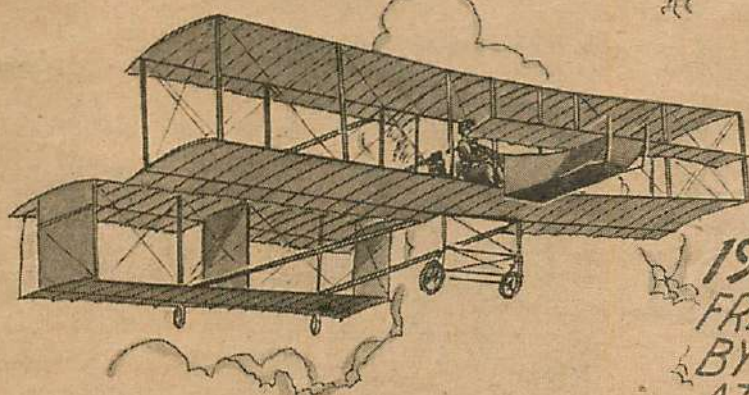
Pictorial History of Man in the Air



1907 BALDWIN'S AIRSHIPS NOW TAKE THE LEAD IN AMERICA. THE PILOTS WHO FLEW THEM HAD TO WALK BACK AND FORTH ON THE FRAMEWORK BENEATH THE BAG TO CONTROL THEM ALOFT.

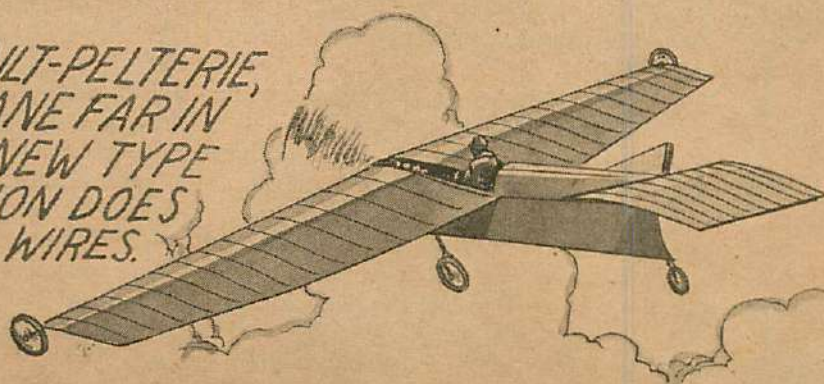


1907 THE FIRST AMERICAN AIR MEET IS HELD AT ST. LOUIS. CHANDLER AND McCOY WIN TROPHY BY FLYING 475 MILES IN ARMY BALLOON, "SIGNAL CORPS NO. 10."



1907 HENRI FARMAN OF FRANCE BREAKS RECORD BY FLYING 770 METERS AT MORE THAN 50 M.P.H.

1907 ROBERT ESNAULT-PELTERIE, PRODUCES MONOPLANE FAR IN ADVANCE OF TIMES. NEW TYPE OF WING CONSTRUCTION DOES AWAY WITH BRACING WIRES.



MODERN MOTORS

Article Five—

Today's SUPER-POWERED AIRCRAFT ENGINES

by Arch Whitehouse
and
Alexander N. Troshkin

*Guggenheim School of Aeronautics
New York University*

OVER a period of 4 months we have probed into the mysteries of various types of aircraft motors. We have studied the various cycles of operation, the radial and the rotary. We have delved into the wonders of the Diesel engine and, in general, we have learned what makes them tick.

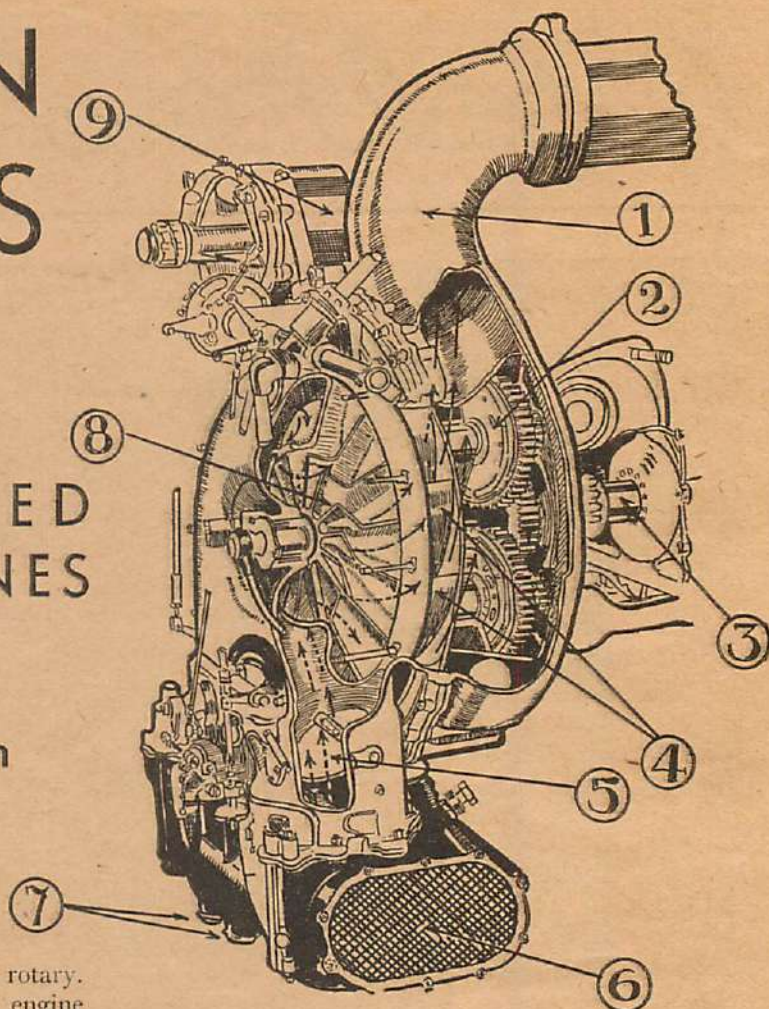
This month we want to take up the matter of modern high-power motors. We want to show what it is that enables an engineer to get 1,000 h.p.—or more—from a comparatively small piece of mechanism. It is a far cry from the chugging Pope-Toledo automobile engine the Wrights used to the modern 1,000 h.p. power plants we use to-day. The Wright engine was supposed to produce about 16 h.p. It had 4 cylinders and weighed 180 lbs. To-day there are a dozen engines on the market here and abroad that will turn out 1,000 h.p. with from 9 to 12 cylinders and which weigh in the neighborhood of 1,000 lbs.

What, then, has happened to the aircraft engine in about 30 years to produce this astounding power? What magic have the engineers wrought to confine 1,000 h.p. in the comparatively small mechanical marvel?

What branch of aviation produced this monster? Was it military aviation, commercial enterprise, or the racing fraternity?

The business of designing, building and developing an aircraft engine is a very expensive proposition, and it is natural that the designers cater to the demands of their best markets—a feature that will be noticed if one studies the top-rating engines in various countries.

In this country it is generally admitted that the commercial air lines, with their demand for greater speed and safety, have done the most for the improvement of the aircraft engine—particularly the air-cooled radial engine. In Europe, where military armament is uppermost in importance, it is obvious that most high-power



GENERAL DETAILS OF A MODERN AIRCRAFT
ENGINE SUPERCHARGER

1—Tangential delivery pipe. 2—Lay-shaft gear and clutch. 3—Drive shaft. 4—Diffuser vanes. 5—Throttle. 6—Air intake. 7—Twin carburetors. 8—Impeller. 9—Automatic boost regulator.

aircraft engines were designed for fighting planes, or for racing purposes.

The Great War is entitled to some credit for the improvement of aircraft engines, for during those 4 mad years aircraft engine horse power was raised from 100, as supplied in the old Gnome, to 425, as produced by the Liberty. That wartime period also saw a great improvement in the radial engine, when the A. B. C. was brought up to 320 h.p. and the famous Rolls-Royce water-cooled Vee started its great climb to its present position with the 360 Eagle.

For a short period after the War, designers seemed to content themselves with perfecting their engines rather than attempting to produce greater power. There was a general slump in the market, also, for early air lines were only using up surplus War materials; the military forces were being cut to the bone, and there was little money available for research.

It took the Schneider Cup races to boost the ratings to any great extent, for between 1922 and 1929 horse power rose from 450 (Rolls-Royce Lion) to 825 (Rolls-Royce "R") in these competitions. Later the Italian

Macchi-Castoldi racer, a development of the Italian Macchi Schneider Cup racers, broke the world's air-speed record with a speed of 440.67 m.p.h. by using the famed Fiat AS.6 engine, which developed 3,100 h.p.

This engine, as far as is known, is the world's most powerful aircraft engine, and for this reason we feel that we should devote a little space to an explanation of its general construction.

It must be thoroughly understood, of course, that the Fiat AS.6 is in no way a standard-production engine. It was built expressly to gain the world's air-speed record, and, as far as is known, only one of these engines was ever built. Whether the design will be continued and adopted in later military or commercial machines is a question.

We are offering a general diagrammatic drawing of the Fiat AS.6 to explain some of the interesting features, to show why it could develop this abnormal horse power.

To all intents and purposes, the AS.6 is 2 complete 12-cylinder engines bolted together. Thus, it has 24 water-cooled cylinders mounted on a single light-alloy crank case in 2 rows at 60 degrees Vee, and separated by an intermediate gear case into 2 units of 12 cylinders each.

These 2 units have independent crank gear, each crank shaft being fitted with a reduction-spur gear mounted in the intermediate gear case, and each turning its own air-screw shaft. These air-screw shafts revolve one inside the other, between the 2 front banks, and drive 2 air screws, fitted one behind the other, both in front of the engine and revolving in opposite directions at the same speed.

In this manner the strong prop torque experienced in single-propeller ships is eliminated, and in the case of a small, fast ship this is a very important feature.

The carburization system was quite new at the time. A large supercharger placed at the rear end of the engine drew fuel from 2 down-draft carburetors and fed it to both cylinder units through a longitudinal inlet tube set between the banks. The dry weight of this engine is 2,050 lbs.

To return to an American motor of high horse power, let us now investigate the Pratt and Whitney 2-row radial, which is rated at 700 h.p., but which can be boosted to 1,000 h.p. for racing purposes. This is the motor Howard Hughes used in his record-breaking transcontinental flight a short time ago.

The Pratt and Whitney Twin Wasp is a geared en-

gine weighing 1,265 lbs. The company makes 2 double-row Wasps, one called the "Twin Wasp-Junior," the capacity of 1,535 cu. in., while the Twin-Wasp has a cylinder capacity of 1,830 cu. in. Owing to rapid changes in various features of these engines, it is hard to keep up with the changes in rated horse power. For instance, the Twin Wasp-Junior is rated at 700 h.p. at 2,500 r.p.m. at 8,500 feet. The Twin-Wasp is rated at 1,000 h.p. (allowable for take-off) and 950 h.p. maximum power for continuous operation. Its cruising-power rating is 625 h.p.

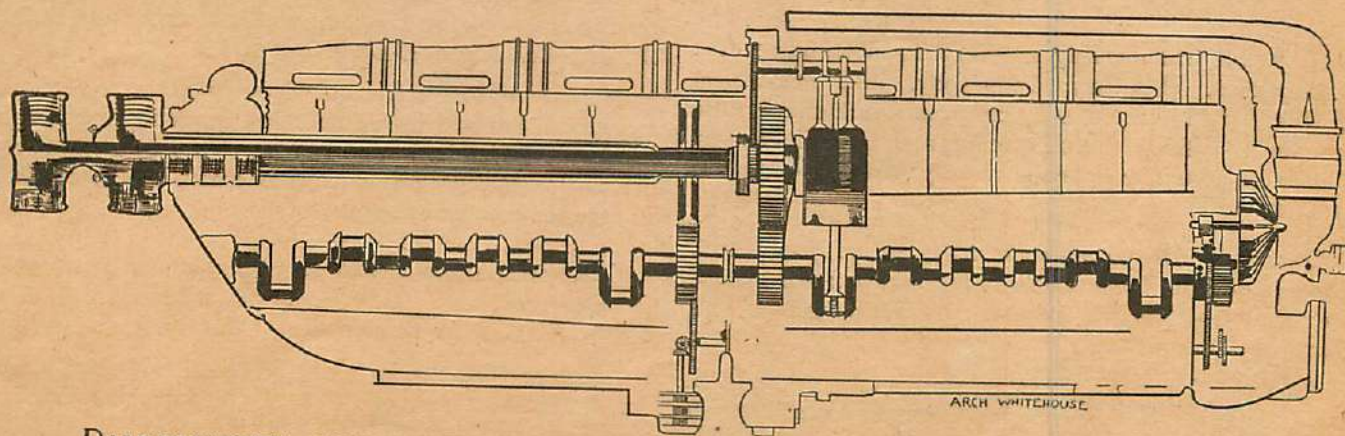
In general, these 2 radials are 14-cylinder, 2-row air-cooled engines using a supercharger set to run 12 times the crank-shaft speed. A double Stromberg carburetor, from which the mixture passes through blades in the rear-section intake elbow to the supercharger, thence through the diffuser vanes to the annulus in the blower section, and then into the intake pipes. A flat-type hot spot, consisting of a stainless-steel manifold in an aluminum casting, is mounted between the carburetor and rear section for heating the mixture. In addition to all this there is a Pratt and Whitney Automatic Mixture and Power Control, which automatically controls the fuel flow to a minimum-permissible consumption for any desired power output.

To understand more fully this supercharger business, which seems to be something of a mystery to many of our readers, we have offered a detail drawing on a modern supercharger as used in Vee-type engines. We have selected this particular supercharger because it lends itself better to this type of illustration.

A careful examination of the drawing will show how air first passes through a filter-fitted air intake shown in the lower portion of the drawing. From there it goes through the normal channels in the twin carburetors and mixes with the vaporized gasoline. From there it is drawn through the throttle valve into the vanes of the impeller, which is being whirled around at high speed. The impeller forces the mixture through a series of diffuser vanes, which distribute the flow evenly into the main delivery pipe, from where it goes into the main intake pipe.

Some means of controlling this flow of mixture which is now under great pressure in the intake tube was found necessary, so an automatic boost regulator had to be devised. In the early days of supercharging, the pilot was instructed in certain throttle adjustments, depending on his height; but as the military pilot

(Turn to page 91)



DIAGRAMMATIC LAYOUT OF 3,100 H.P. FIAT AS.6 AIRCRAFT ENGINE SHOWING HOW TWO CRANKSHAFTS ARE GEARED TO TURN TWO PROPELLERS IN OPPOSITE DIRECTIONS.

What's Your Question?

By CLYDE PANGBORN

Wing Commander



As soon as possible after the questions are received, the Wing Commander of the Air Adventurers will answer on this page such questions as appear to be of general interest to our members.

Question: I am interested in light planes. Can you tell me whether the Hammond-Y, the Waterman Arrowplane, or the Pitcairn Roadable-Giro are ready for the market as yet? J. K., Atlanta, Ga.

Answer: Orders will be taken now, for later delivery, on the Hammond-Y machine. Pitcairn intimates that they wish to experiment further with their Roadable-Giro before they place it on the market. I cannot say anything definite about the Arrowplane.

Question: What would be the gliding range of a Douglas DC-2 with a dead motor, at the height of two miles? C. W., South Norwalk, Conn.

Answer: This is one of those trick questions, but it can easily be answered by stating that a Douglas DC-2, at a height of two miles, with only one engine running, requires no gliding range. With one engine running and flying in still air and carrying the normal load, the DC-2 has a ceiling of 9,100 feet, so, theoretically, the pilot could fly the ship to his airport in safety. The performance figures on the Douglas do not indicate the gliding angle, but her landing speed is 62 m.p.h. Too many factors must be considered in a question like this: the load aboard; the strength and direction of the wind; how much fuel was left in the tanks at the time the two engines ceased to function.

Question: What subjects should I take in high school that would help me to obtain a position as a transport pilot? M. L., New York City.

Answer: The high-school subjects that become the most useful while taking a transport-pilot course are: mathematics, chemistry, geography, and mechanical drawing. With these subjects you should have little trouble in passing the theoretical and ground courses. But make certain you are physically fit also, for that is most important.

Question: Do you have to be a college graduate to get into the U. S. air service, and can you tell me the specifications of the GeeBee Super-Sportster? J. T., Jacksonville, Fla.

Answer: Your question concerning entering the U. S. air service was fully answered in my article: *Getting Into Aviation*, which started in the March issue of AIR TRAILS. Yes, you must have the equivalent of two years of university training and must pass a strict ex-

amination in United States history, general history, English grammar and composition, geography, arithmetic, algebra, plane and solid trigonometry and elementary physics.

The GeeBee Super-Sportster was a single-seater racing monoplane powered with a 900 h.p. Pratt & Whitney "Hornet" engine. It was a low-wing, wire-braced monoplane which Jimmy Doolittle used in winning the 1932 Thompson Trophy Race. It had a top speed of 294 m.p.h. The general dimensions were: Span, 25 ft.; length, 17 ft., 9 in.

Question: I have the names and addresses of all the major aircraft firms in this country. I would like to get all pictures and information on their planes. Will they send it to me? R. Q., Buffalo, N. Y.

Answer: You are asking for quite a lot. The advertising departments of the various factories do have pamphlets and photographs of their products, but they are intended for possible purchasers. Then again, firms making planes for the services are not allowed to give out information on such machines. In a few cases certain firms will send out photographs of their commercial planes to those who are interested or indicate an interest. But you can hardly expect these firms to provide free photographs and catalogues simply for collection purposes. However, there is no harm in writing to these firms and asking for what you want.

Question: Do the retractable landing gears now in general use on planes have some mechanical device for raising and lowering them, or are they worked by hand? M. H., Los Angeles, Calif.

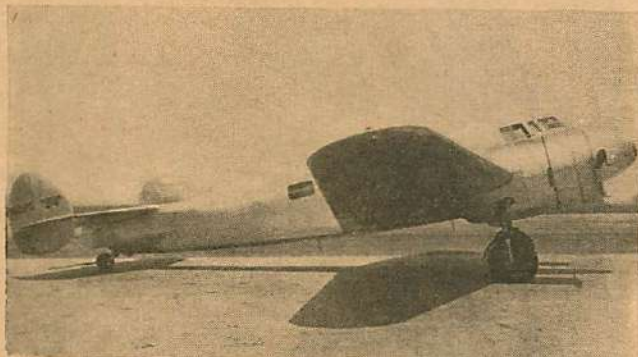
Answer: Most retractable landing gears to-day are raised and lowered by a small electric motor or through an engine-driven hydraulic system. They do have, however, a manual system which is operated by the co-pilot in case the mechanical system fails.

Question: I am considering joining the marines to learn a trade. Will they teach me any branch of aviation? Who is the commander of the marine corps?

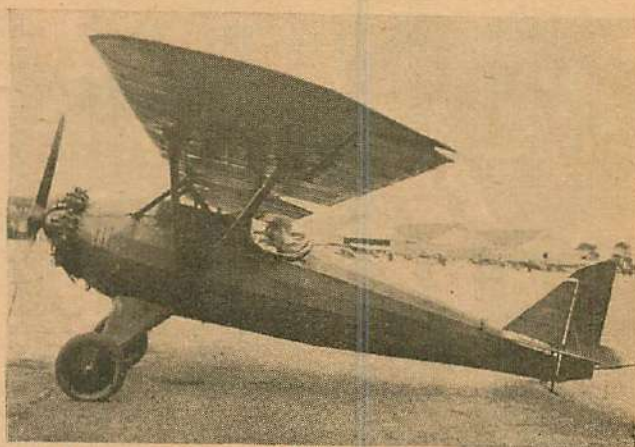
Answer: The marines will accept suitable applicants for certain branches of aviation. The training is of a very high standard. Colonel Ross E. Rowell, U.S.M.C., is head of the marine corps. His office is United States Marine Corps, Washington, D. C.

AIR TRAILS GALLERY

A Picture Page of Modern Planes for the Collector



Amelia Earhart's special Lockheed Electra, the "Flying Laboratory," designed for aerial research, has two Pratt & Whitney 550 h.p. Wasps. This plane was damaged in a take-off at Hawaii.



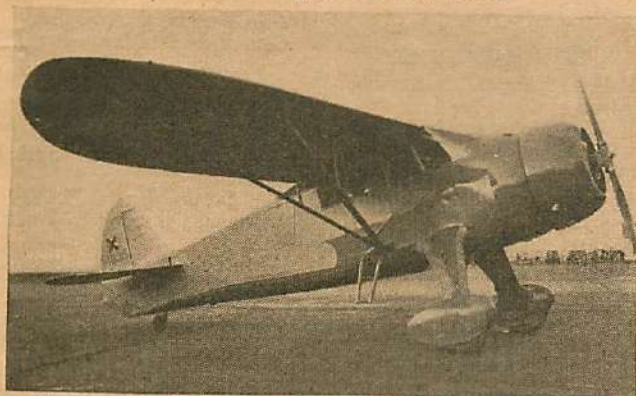
Terle sport, Salmson 40 h.p., is American answer to European "Flea." Span is only 16 ft.



Douglas Amphibian XO2D-1, 550 h.p. Wasp, has wheels folding into center float.



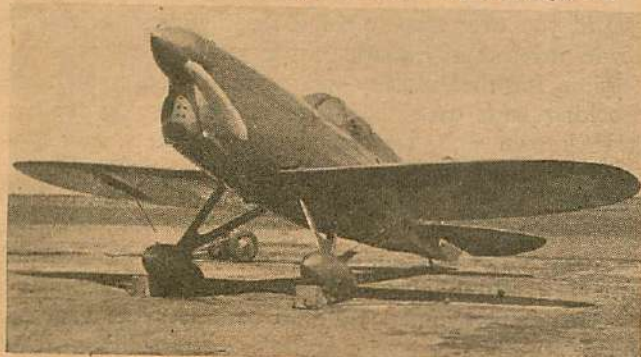
Beechcraft for 1937, cruises at 235 m.p.h. with 600 h.p. Wasp Junior, and constant-speed prop. It has a retracting tail wheel.



Howard DGA-8, "Mr. Finnegan," has Wright 320 h.p. Whirlwind. Solid plans and data on Page 62.



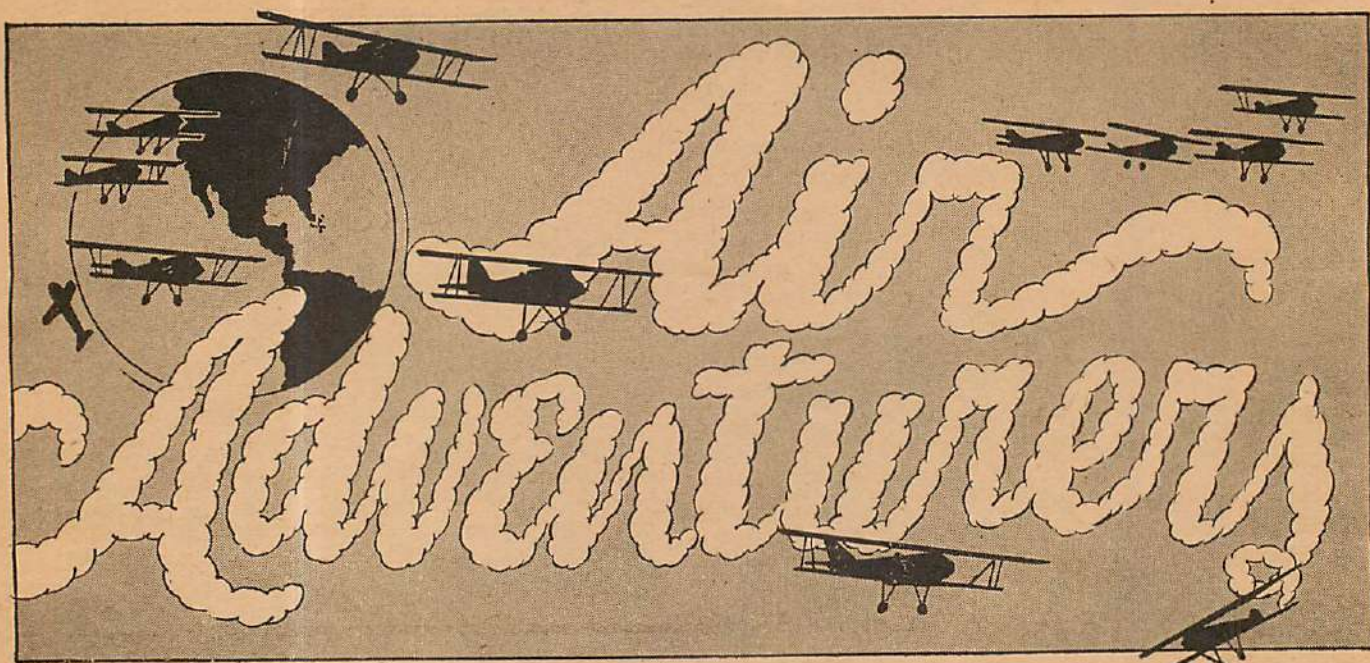
English De Havilland airliner, four D. H. Gypsy 200 h.p. engines and three vertical tails; does 152 m.p.h.



Lee Miles' "Racer," 250 h.p. Menasco, is consistent entrant at the National Air Races.



Douglas O-46A, latest army observation, has Twin-Wasp of 700 h.p. Span is 45 ft. 9 in.



The Honor Roll For June

FLIGHT LIEUTENANTS

Oscar L. Mildes, Spokane, Wash. 99%
First Flight Lieutenant to qualify in the United States

David Campbell, Vancouver, B. C., Can. 99%
First Flight Lieutenant to qualify in Canada

Miss Laverna Hoisington, Los Angeles, Cal. 88%
First girl to qualify as a Flight Lieutenant

George H. Wilber, South Lancaster, Mass. 99%

Edgar Dilts, Anderson, Ind. 99%

John Karl, New Brunswick, N. J. 98%

James Luepnitz, Moran, Mich. 98%

Walter Israel, Medford, Mass. 97%

Raymond Miller, San Francisco, Cal. 97%

Victor E. Durkee, Hebron, Yor. Co., N. S., Can. 96%

Laverne R. Doupe, St. Marys, Ont., Can. 91%

Andrew Reynaert, Sault Ste. Marie, Ont., Can. 91%

Thomas Adams, Milford, Conn. 90%

Harold E. Grathwohl, Southampton, L. I., N. Y. 86%

Warren Rose, Los Angeles, Cal. 86%

Arthur J. Simons, Oakville, Ont., Can. 85%

John D. Phillips, Mt. Royal, P. Q., Can. 81%

Jack Doran, Paterson, N. J. 80%

William Bates, Syracuse, N. Y. 80%

Danny Hanna, Greencastle, Ind. 80%

Richard Potter, Springdale, Conn. 76%

Charles Gulas, Niles, Ohio 76%

Leo Burnett, Camden, N. J. 84%

Herman Spenger, Jr., Berkeley, Cal. 88%

Edward Byerly, N. Y. C. 88%

Svend Rondum, Philadelphia, Pa. 83%

OBSERVER

Donald Turner, Jr., Leavenworth, Kansas

Sylvester E. Owen, Douglas, Minn.

Harold M. Preston, Jamestown, N. Y.

W. F. Barber, San Diego, Cal.

Jerome W. Cowan, Chicago, Ill.

Harold E. Grathwohl, Southampton, L. I., N. Y.

George Young, St. Louis, Mo.

Joseph Thompson, Denver, Colo.

TOPOGRAPHER

Robert Klinger, Northumberland, Pa.

Walter McCabe, Jr., Bronx, N. Y.

George Allsopp, Newark, N. J.

Edward Bergethon, Brooklyn, N. Y.

Michael Serduck, Thomaston, Conn.

William J. Karges, Wheeling, W. Va.

Melvin DuPont, Rutland, Mass.

M. D. Osborne, Ebenezer, S. C.

Sylvester E. Owen, Douglas, Minn.

PHOTOGRAPHER

Branon Sell, Dallas, Ga.

Norris Green, Fayetteville, Ark.

Bill Sobieralski, Seattle, Wash.

Robert H. Taylor, Aspinwall, Pa.

Dana Cunningham, Old Town, Me.

AIRPLANE MECHANIC

Arlo Koontz, Onawa, Iowa

Constance Whitmore, San Carlos, Cal.

ENGINE MECHANIC

Leo Burnett, Camden, N. J.

Bill Friend, Baxter Springs, Kansas

Ted Jacobs, Bronx, N. Y.

Lawrence O'Hanlon, Kearny, N. J.

Alvin Schein, Jersey City, N. J.

Driving For Smiles

CONGRATULATIONS, Air Adventurers!

Hope you get the smile in that line. There ought to be certain forms of type to express feelings, something with upward curves to it, like the cartoonists use to indicate cheerfulness in their drawings.

We're smiling this month—plenty. We have every reason to smile, considering the way the Air Adventurers Club is going forward. Every day brings new batches of applications and hundreds more are sending in their examination papers for promotions.

We want you all with us in this new billow of enthusiasm, but we want you to come smiling. We want you to line up with a smile and accept the Creed—that seven-point Creed of self-reliance, courage, initiative, loyalty, integrity, independence and obedience. There's nothing about smiling in the Creed, unless you interpret it in independence.

But we don't want front runners, those who will be with us while things are going strong. We want you in there smiling when the going gets tough.

Did you ever stop to think that every man who ever made any sort of a mark in aviation—or any other profession, for that matter—was a man who could smile? Looking back over the years and reviewing those we have known well, we can always see them smiling.

Before me I have two volumes called "The World in the Air," which contain photographs of airmen from the pioneering days up to the present. As I thumb through the pages, the startling thing about it all—and a point I never realized before—is that every one is smiling.

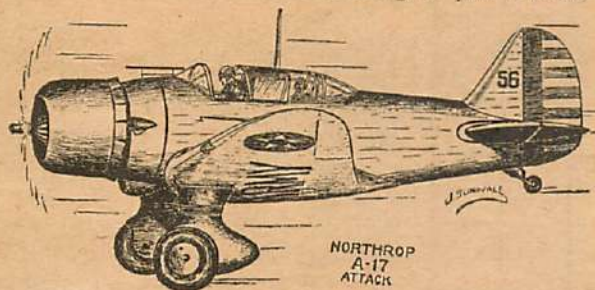
I remember youngsters who became great War aces. I can see them to-day, clean, alert, and smiling. There was young Albert Ball, Jimmy McCudden, Rhys-Davids, Billy Bishop, Rickenbacker, McLeod, Lufberry, with the

laughing Indian head on his Spad. I once met Guynemer. He was dying of tuberculosis, but he was smiling. I met Nungesser and he was laughing. René Fonck had a perpetual grin.

Of recent years all the top-notchers smile. Look at Miss Earhart, Frank Hawks, Clyde Pangborn, Chamberlin, Amy Johnson, Kingsford-Smith, Coste and Belonte, Jean Batten and Howard Hughes.

During the next few weeks many of you will be sweating over school examinations, which will pile into your Air Adventurers' work. Your scholastic work comes first, of course, and you will probably have a tough time working on your Air Adventurers' examinations, but you'll have to smile and grin.

Last month we pointed out the distressing period aviation all over the world had to live through. Thousands of men and women whose whole lives were wrapped up in the industry had to wear a shining badge of courage: their smile. It took a lot of smiling to put it over, but



Drawn by Air Adventurer John Sundvall of Plainfield, N. J.

they did. They refused to be beaten, and before they knew it they had every one else smiling.

We thank you for the prompt manner in which you have responded to the call. Many of you have already passed and we appreciate the clarity and neatness of your papers. We want to stress that point, for the work involved in fairly and accurately marking these papers becomes greater with each month. We are trying to face this great task with a smile because we feel that we are doing our bit toward furthering the advance of aviation all over the world.

Every day sees new aerial links welded, binding the continents and nations together. We are no longer isolated from our fellow men across the seas. The latest link binding the United States with New Zealand is an indication of how our world is shrinking. Pan-American Clippers will bring New Zealand to within a four-day journey by air. It takes at least sixteen by water.

Pan-American and Imperial Airways will be winging giant Clipper ships and Empire flying boats across the Atlantic in a short time. Men who can smile will have to beat the storms and fog of the North Atlantic. Men and women who can smile will have to use those ships and build up public confidence in transatlantic air routes. Men who can smile have worked for years designing these boats, planning the routes and building the power plants necessary for such long flights. All that remains now is the man who can smile—and carry on.

All of which, of course, leads up to the point that all Air Adventurers must prepare themselves for these glorious days to come. We of Air Trails are working hard to gather as much useful information as can possibly be printed in the pages of a magazine. We are trying to show you the way, realizing that in a few years the de-

mand for trained men, enthusiastic planners and skilled airmen will be far above the supply.

When that time comes a lot of Air Adventurers are going to smile. We want them to be ready to swarm into the hangars, the seaplane sheds, the cockpits, the drafting rooms, the engineering offices and the sky lanes, carrying with them the Creed—and a smile!

But get this straight, prospective Air Adventurers: We do not pretend to teach you to fly. Colonel Lindbergh couldn't teach you to fly if you have no desire to take wings.

Again, we do not pretend that we can teach you to design a Clipper ship, but if you intend to design one, we can't stop you. No one can. We cannot teach you the science of meteorology, but we can show you how important it is to aviation. We can't make a traffic manager of you, but we can show you what a traffic manager's duties are, and the rest will be up to you.

This is your magazine, your club, your obligation. We could go on month after month writing this story, but we know, and you know, that anything worthwhile needs new blood or it soon fades into a stagnant decay.

By now you should know the members we want: the kind of applicants that will work for aviation. We want workers, Air Adventurers. There are hundreds of prospective members who perhaps have never heard of our organization. It is up to you, Air Adventurers, to spread the word. To you new readers, and we are gathering you in by the hundreds every month, let us remind you that there is no time like the present. Here's your coupon printed below in the corner. If you feel that you honestly agree with the purposes and principals of our club and can conscientiously live up to the seven-point Creed (self-reliance, courage, initiative, loyalty, integrity, independence and obedience) fill in the membership application and forward it, together with ten cents, for your certificate and wings.

If your application is approved, both will be mailed out to you at once.

So, until next month then, keep smiling!

Your Flight Commander,

Albert J. Carlson

(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

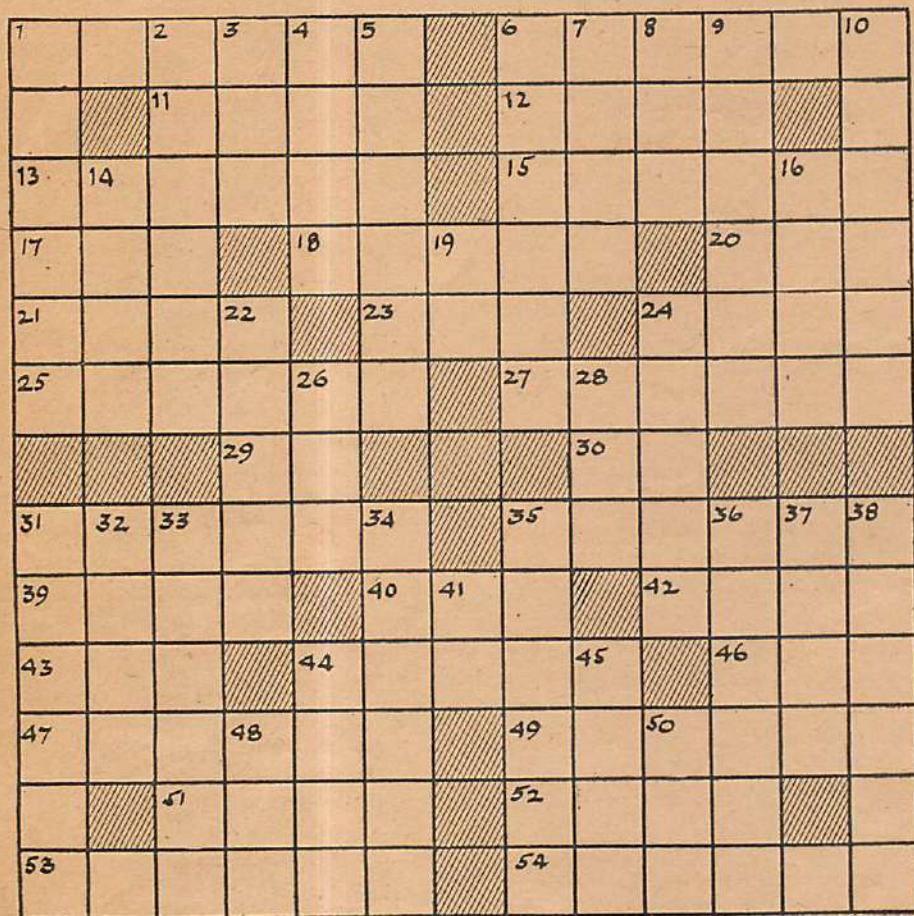
Address

☐ Check here if interested in model building.

(This coupon may not be used after July 15, 1937.)

CROSS WINDS

*Can you answer the
aeronautical definitions
in this puzzle?*



ACROSS

- 1—Element forming one-fifth of air
6—Curtiss attack plane
11—Military assistant
12—Fruit
13—Peril
15—Source of motive power of airplane
17—Deer with broad antlers
18—Approaches
20—Japanese coin
21—Centuries
23—Make of Rumanian plane
24—What new planes undergo
25—Scooped up
27—Ferments, noun
29—Third person singular of "to be"
30—Like
31—Coasts on air
35—Kind of war plane used against ground forces

- 39—Maker of Parakeet, American light plane
40—Type of Sopwith war-time plane
42—Make of German plane
43—Everything
44—Kind of pilot training given at Kelly Field
46—Make of Italian plane
47—Clergyman
49—Passenger inclosures on planes
51—Story
52—Fortified seaport in Arabia
53—Relationship of female child to other children of same parents
54—Pertaining to lines

DOWN

- 1—Trying experience
2—Jerked
3—Two-wheeled carriage
4—Adam's garden

- 5—Sea nymph
6—Manufacturer of gyroscopic compass
7—Domestic fowl
8—Waste piece of cloth
9—Colored portion of eye, plural
10—Occurrences
14—Seaweed
16—Bird's home
19—Abbreviation for anti-aircraft
22—To slip
24—One of the five senses
26—Compass direction midway between southeast and east
28—Devour
31—Adorns
32—Recline lazily
33—Small islands
34—One who spaces
35—Pertaining to the apex
36—Poisonous gas
37—Family
38—Title of former German ruler
41—First person pronoun
44—Fluid secreted by liver
45—Title of Mohammedan judge
48—Rodent
50—First name of "Mr. Mulligan's" maker

CROSS WINDS Answers for May

S	E	A	A	R	I	E	S	I	C	E
A	R	C	H	I	E	R	E	D	D	E
D	A	T	E	D	N	A	C	E	L	L
S	I	N	S	E	W	E	T			
L	E	O	S	C	O	U	T	S	I	P
U	R	N	C	A	N	N	O	N	C	R
N	S	C	A	R	S	P	C	A	A	
A	M	P	L	A	T	E	S	I	S	T
R	O	B	E	B	O	N	Y	L	E	T
R	O	D	W	T	A	E	R			
K	A	L	I	N	I	N	M	I	R	E
A	L	T	A	I	R	A	P	R	O	N
Y	E	S	P	E	R	T	H	N	E	T

The Discussion CORNER

The model art progresses through exchange of ideas. The Discussion Corner is a monthly sounding board for your opinions. This month readers discuss gas model construction handicaps. For July the subject is preferred model types. Other topics are listed below. Think about them, then write your opinion in 150 words or less and send it to The Discussion Corner. One dollar is paid for each answer printed.

THE greatest trouble that I have experienced with gas models is in motor operation. Most model builders can construct fairly crashproof planes from numerous advertised plans and kits, but the successful operation of even the reliable motors now advertised requires more than everyday experience and discretion. Following letter-for-letter instructions of the manufacturer is the surest and most economical way to obtain the necessary skill. My greatest difficulty lies in locating the correct needle valve and carburetor setting.

Increased expenses have not kept me from building models. The ever-decreasing cost of model material and the great drop in the price of a reliable, complete, or machined engine removes the excuse of any ingenious or slightly ambitious boy for not building a gas model.—ED. ROBINSON, Bridgeport, Ohio.

After finishing and flying my first gas model, I must say that the only difficulty I encountered was in construction. Since it is quite a transition from rubber-powered model construction to the advanced type used in gas "jobs," I laid my trouble to this.

As I find that most motors operate easily if handled with delicate instruments and due to the precision methods of motor manufacturer guaranteeing a minimum of trouble, that which occurs can frequently be traced to the operator.

Expense should not be an important obstacle in the model builder's path. Any model builder gains in a well-built model satisfaction and pleasure to a greater extent than any discomfort caused by cost. All in all, I feel that a successful gas "buggy" offers satisfaction which compensates for any construction headaches and penny-pinching.—JOHN VOPAT, JR., Garfield Heights, Ohio.

Motor operation does not cause as much trouble as construction, in that the motors are built by highly skilled mechanics.

Construction of your own gas-job design calls for painstaking detail and distribution of the weight. Building the model is a hard job, so as not to have the highly stressed parts too weak and the false work too strong.

The initial cost has kept me from building gas models, although the fear of an improperly designed model cracking up is predominate. With a greater demand for motors and kits, the price will eventually drop to fit

the average hobbyist's pocketbook.—BENJAMIN DUDUS, Utica, New York.

My greatest trouble with gas models is discovering the flying characteristics of each model. Each one has "bugs" which must be ironed out by shifting batteries and changing wing and tail settings. When this is finished, I consider my troubles practically over and really begin to enjoy the model.

As for motor operation, the new easy-starting engines leave little to be desired in the way of reliable starting when they are correctly mounted and supplied with gas, oil and spark.

Construction difficulties fall in the same class as motor operation, and can be eliminated as easily. The first step is to work from accurate, well-drawn plans and, second, to use only the best materials of the sizes called for in the plans. If the work is done slowly and accurately, there should be no cause for complaint in the finished model.

The greatest drawback to building gas models is the great cost. In my case, the forming of a partnership was the only course open, and even then the cost of getting started was too large for comfort.—REED HARRINGTON, Columbus, Ohio.

I have very little trouble with construction or motor operation of my gas models. The greatest trouble is keeping the model from going out of sight, which usually results in many hours searching after it has landed.

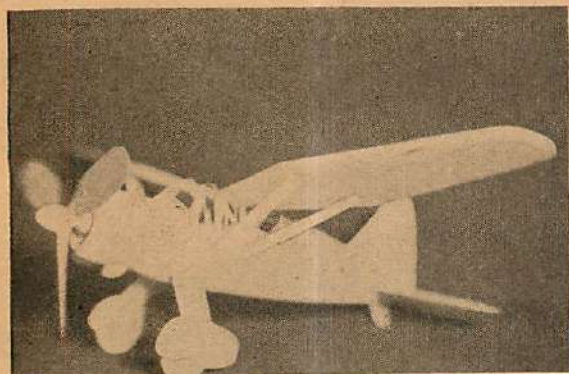
Increased expense does not keep me from building gas models. If I intend to build a new model, I save money for a new motor, and while saving the money, build the model.—WALTER CARACCILO, Jackson Heights, Long Island.

COMING UP are these topics:

For August—Do you believe that gas-model construction will either wholly or partially displace the long-popular rubber-driven model? Which of the two types is your preference? Answers must reach us by May 15.

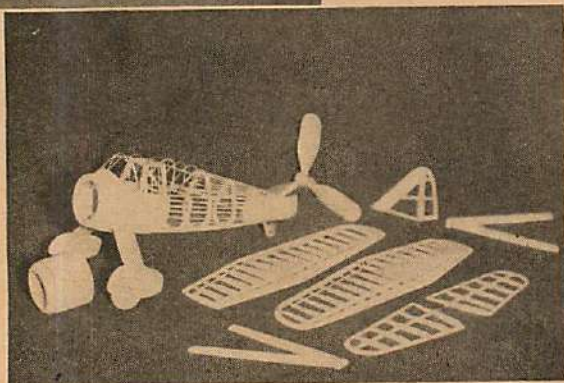
For September—For duration, has a tapered wing a marked superiority to justify its use? Which type of taper is most desirable, leading edge only, trailing edge only, or both? How sharp should the taper be? Answers must reach us by June 15th.

This Month's Topic
What trouble do you experience with gas models? Is it construction or motor operation? Has increased expense kept you from building gas models?



Above: The design of the large plane creates a model of excellent flying ability.

Right: The uncovered framework reveals a wealth of constructional details.



BRITISH WARBIRD

*A flying scale model of the
Westland Lysander—an
army co-operation plane.*

by

Alan Booton

ELEVEN MONTHS after the Westland A. C. was begun, an appreciable number were ordered by the British army. Even though the plane is on the secret list, many features are evident.

There is an automatic slot-flap arrangement by which the flaps are operated by the inner sections of the divided slots at low speed. The outer sections of the slots maintain a flow of air over the ailerons, to gain positive lateral control at low speeds, and the stabilizer is adjustable to negative incidence to govern the landing attitude.

The design as a whole is unusual: the pilot inclosure is higher, for improved visibility; the observer inclosure has many new advantages; the cowl has temperature control flaps; the propeller is a De Havilland automatic pitch; landing lights are inclosed in the peculiarly shaped pants; and the single spar wing is "V"-strutted.

With the exception of the automatic slots and adjustable stabilizer, the large ship features are included in the model. Note what a perfect set-up of factors we have to make a model from.

FUSELAGE

Make a 4x6" sheet of plywood of two thicknesses of $\frac{1}{8}$ " sheet. Careful attention will enable you to cut all of the formers from it.

The fuselage is assembled differently this time. After placing waxed paper on the top-view drawing, pin $\frac{1}{8}$ " square over the top longerons and cement the formers to them, inverted. Use pins to hold them vertical while drying. Bend the remaining longerons to the fuselage shape and cement them in the slots. Build the wing mount and cement it carefully in position, and smear

plenty of cement over the joints several times.

Strip the back off a piece of $\frac{3}{16}$ "-wide bamboo until it is $\frac{1}{32}$ " thick. Then heat it and bend it to the front inclosure outline. Strip the bent bamboo into $\frac{1}{32}$ " widths and cement them to the fuselage where shown. Add the straight pieces as you progress.

Now cement the bamboo stringers all around the fuselage, as shown on the side view. If all the stringers are held on with rubber bands and then cemented all at one time, time and fussing will be reduced.

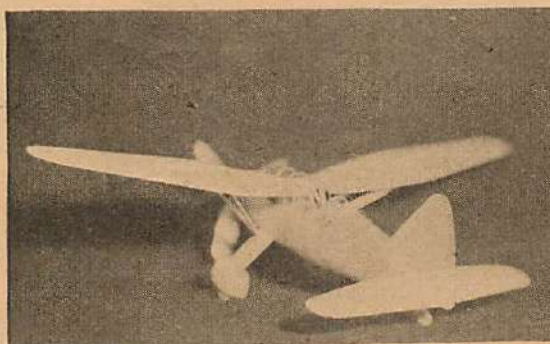
Cover the front and rear of the fuselage with sheet balsa. Cover the front, below the top longeron, with strips of $\frac{1}{32}$ " sheet about $\frac{3}{8}$ " wide. Cover the top with whole patterns. The rear of the fuselage should be covered with two pieces of $\frac{1}{64}$ " sheet below the top longeron and two above.

Cut two $2\frac{3}{16}$ " diameter disks—one $\frac{3}{8}$ " thick and one $\frac{1}{16}$ " thick—for the cowl. Butt joint four $1\frac{11}{16}$ " lengths of $\frac{1}{32}$ " sheet balsa and, when dry, wrap them around the cowl disks and cement them when arranged as per cowl drawing. Add the detail to the cowl after it has been rounded off.

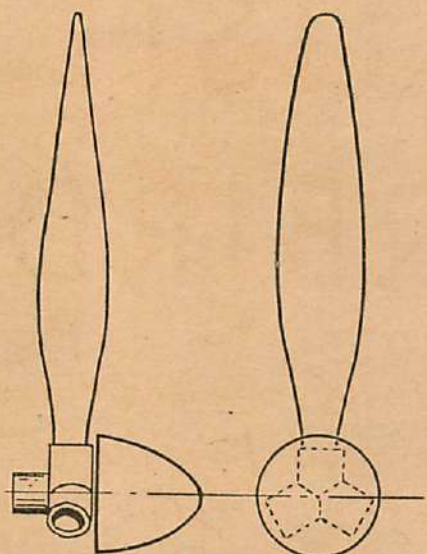
If the observer's cover is to be removable, add the extra bamboo parts, as the frame is assembled on the fuselage to insure a good fit, and then cut loose on completion.

WINGS

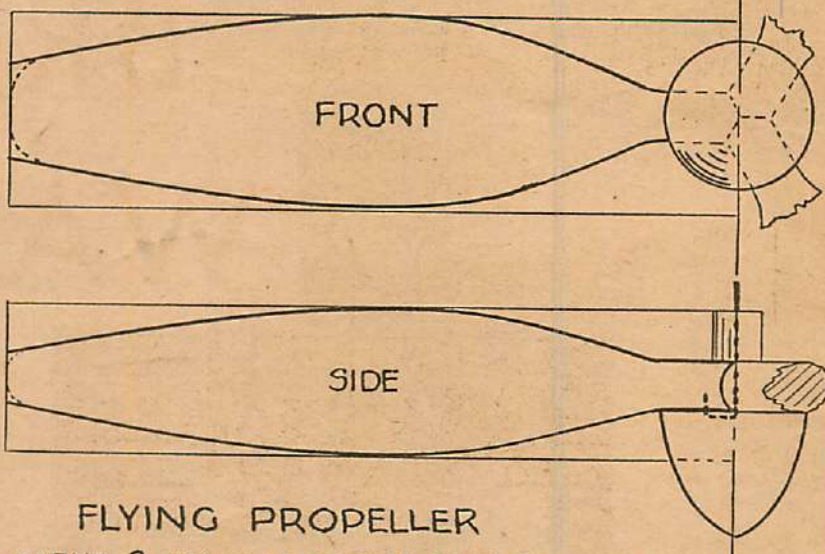
To obtain a right-wing pattern, trace on a white sheet of paper with an inverted carbon sheet under it. Place waxed paper on the drawings and assemble all parts, using pins to hold them in place. (Turn to page 70)



Birdlike, the model combines scale exactness with performance.

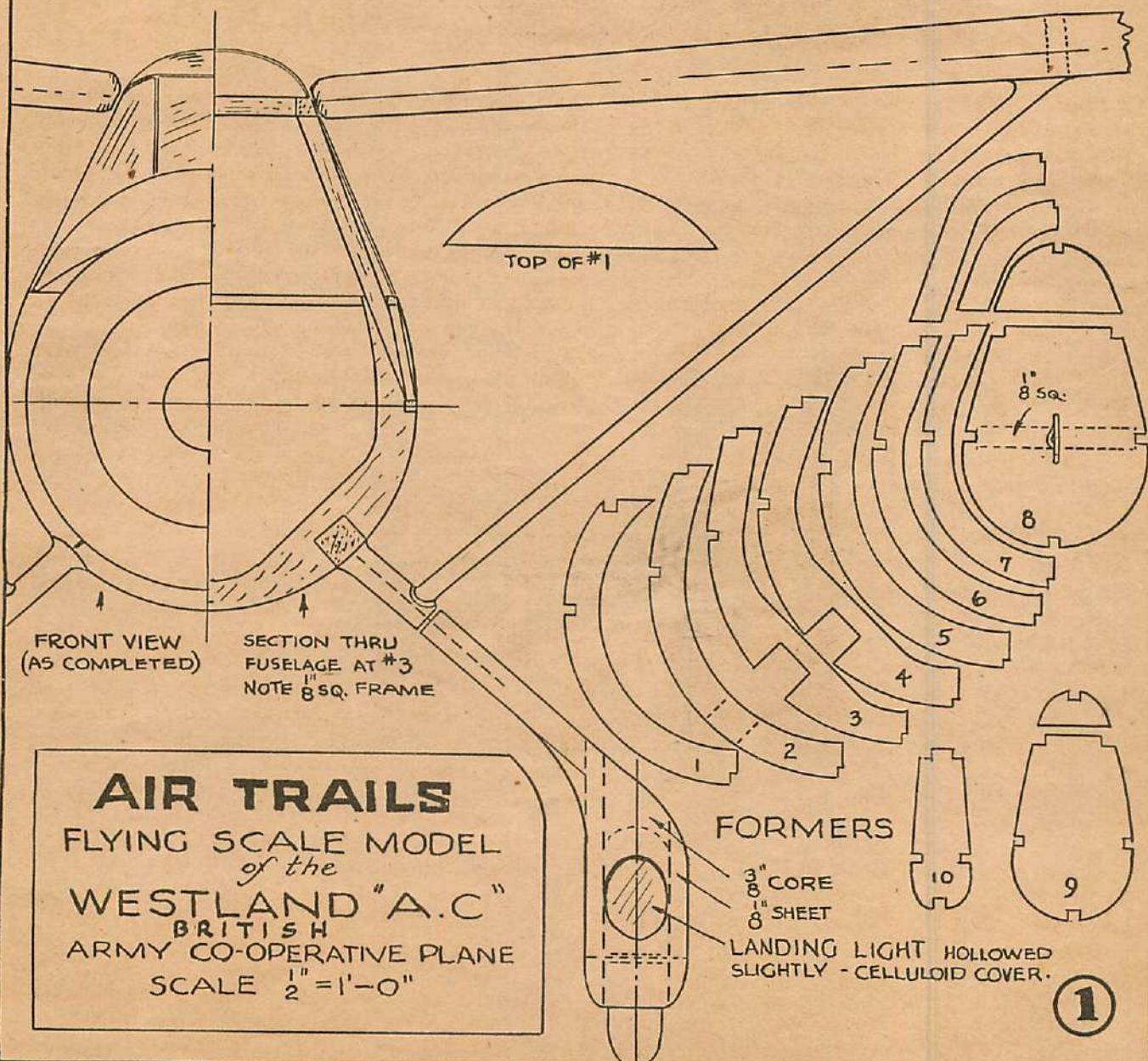


SCALE PROPELLER
(3 BLADES)

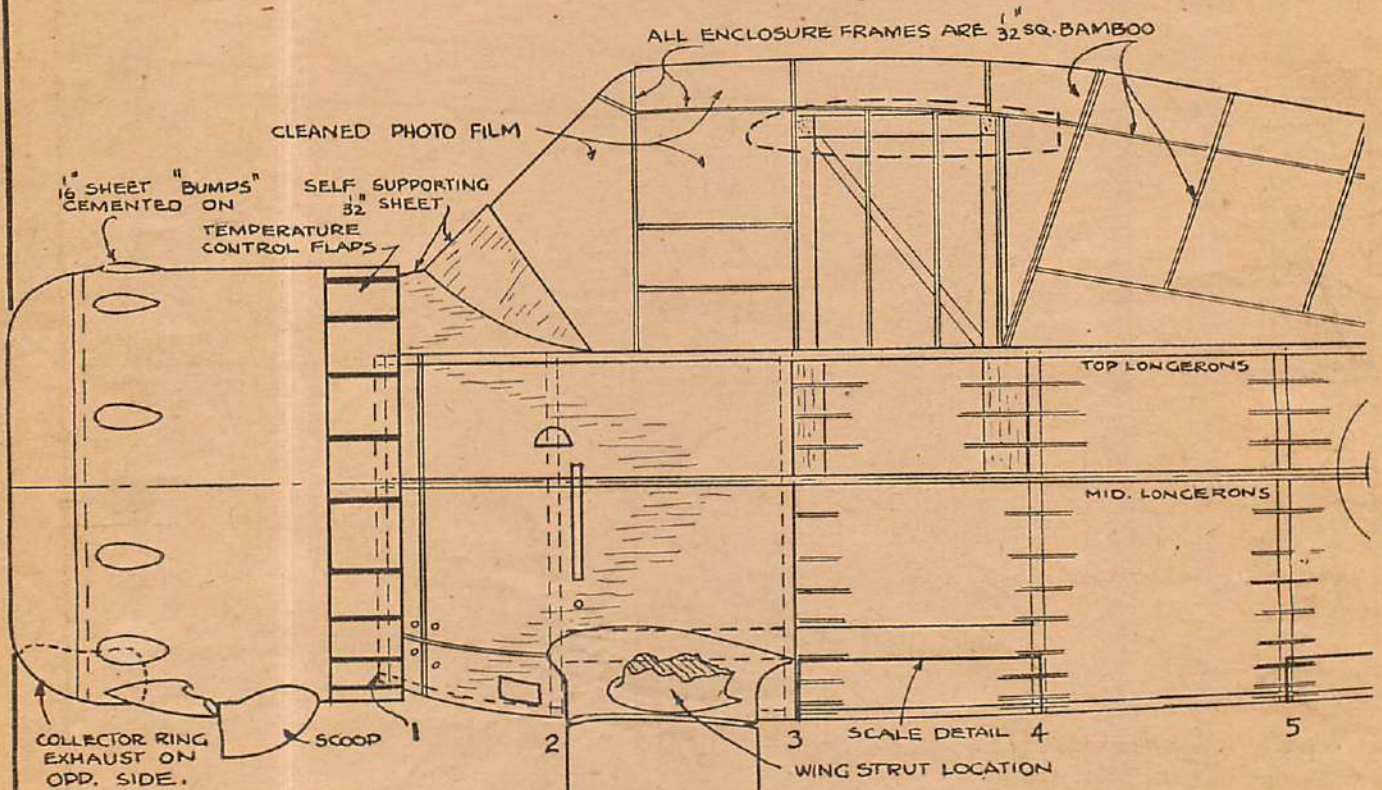
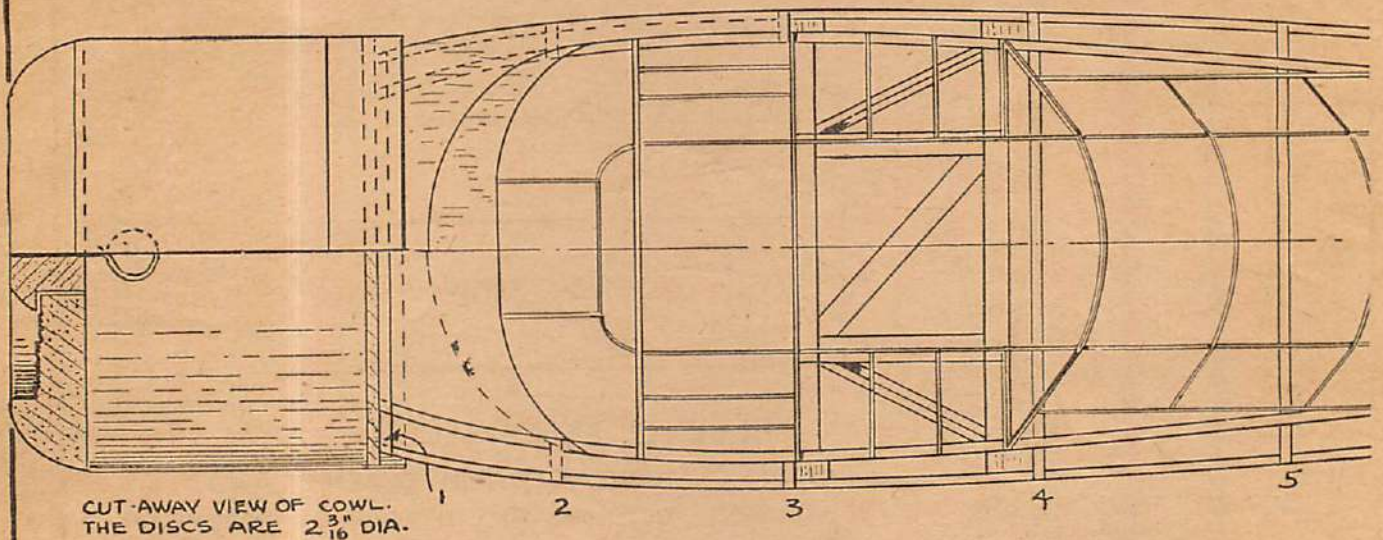


FLYING PROPELLER

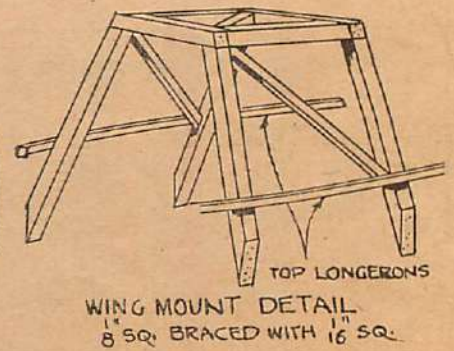
CARVE 3 HELICAL PITCH BLADES AND SPINNER. USE CEMENT HEAVILY ON ASSEMBLY.

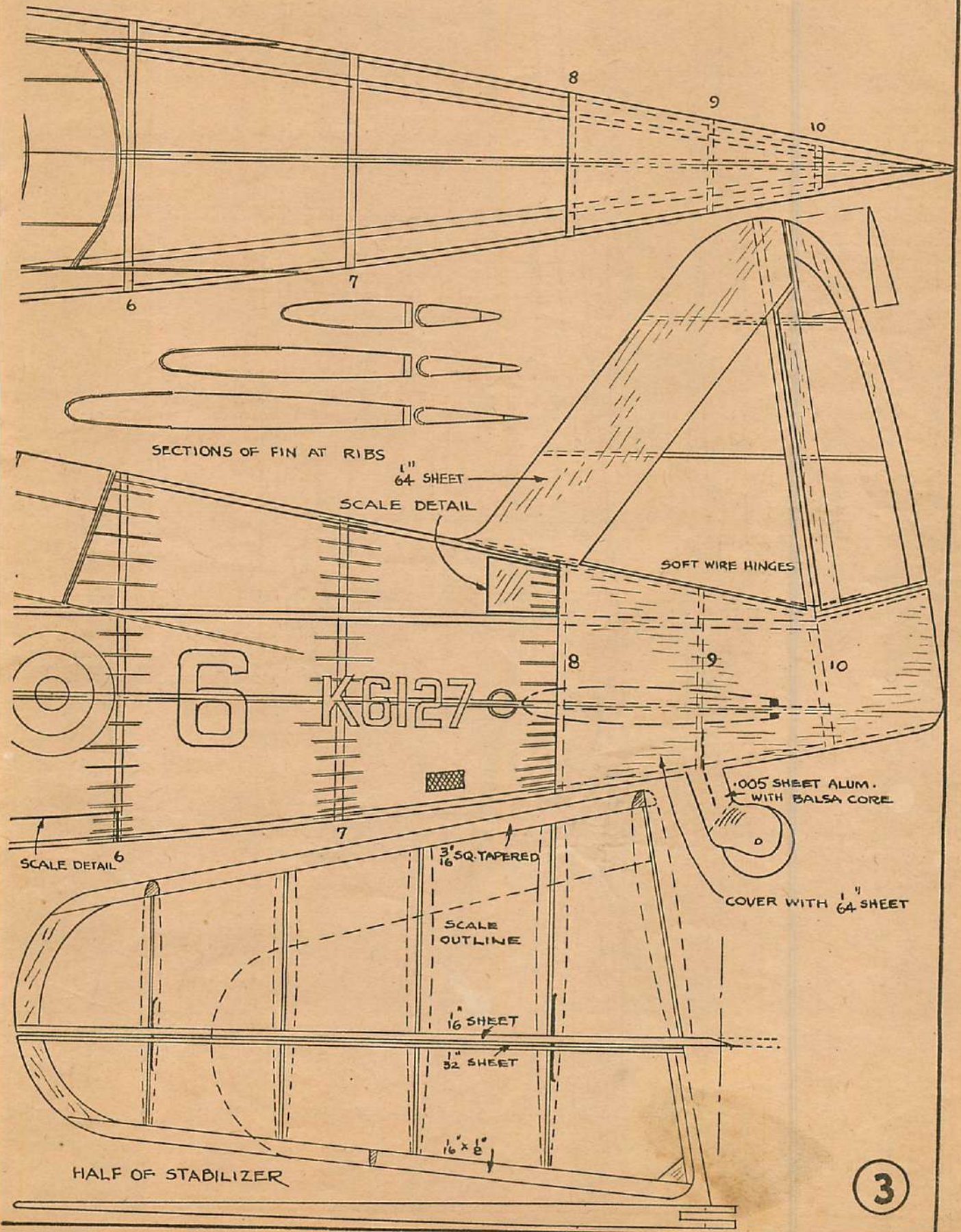


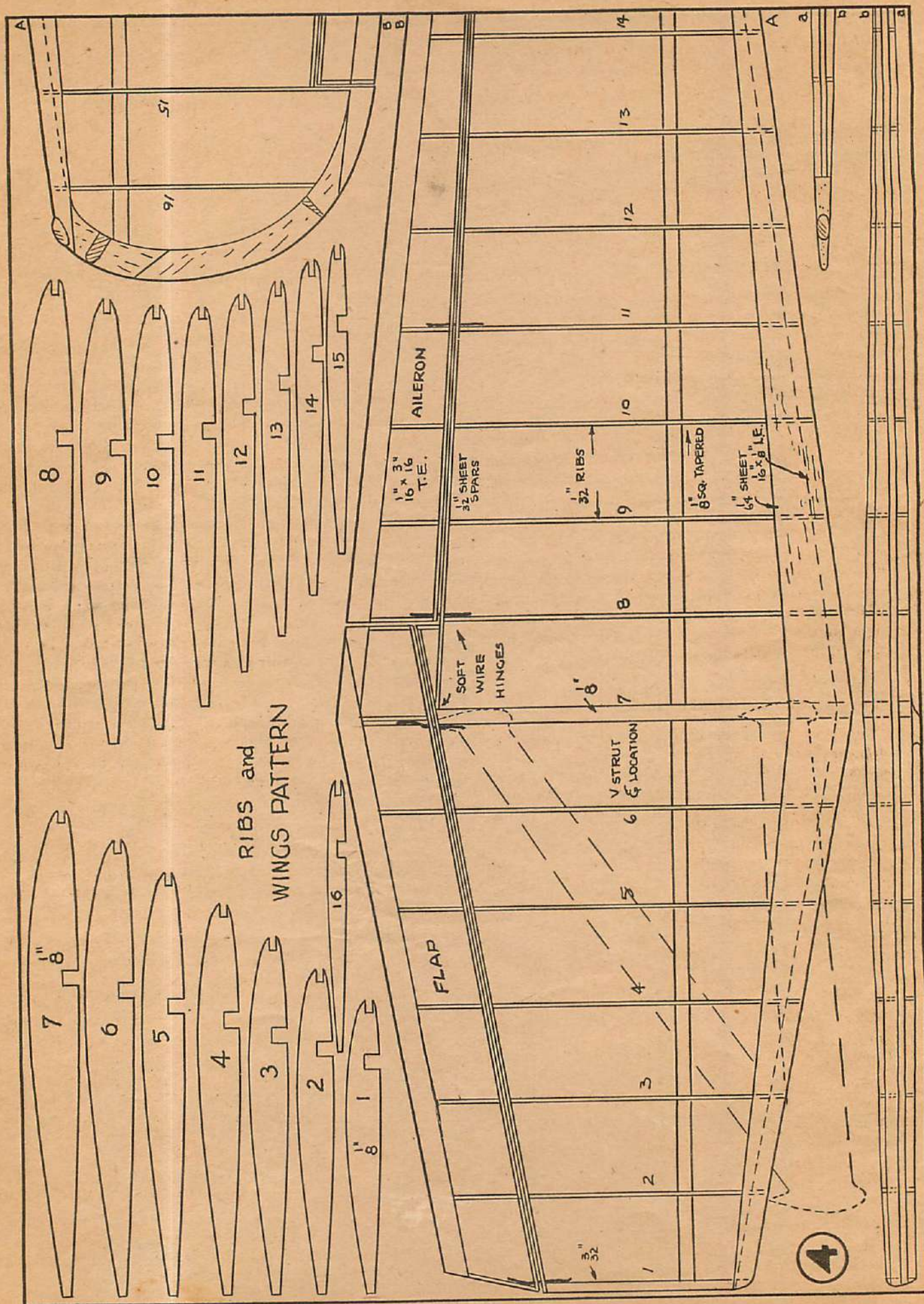
AIR TRAILS
FLYING SCALE MODEL
of the
WESTLAND "A.C."
BRITISH
ARMY CO-OPERATIVE PLANE
SCALE $\frac{1}{2}$ " = 1'-0"



2







Have you a question on model building or flying that bothers you? Bring us your problem and



we'll answer it in the interest of readers everywhere. Replies by mail require return postage.

SCOTCH TAPE

Question: What is scotch tape and how is it used? A. F., Leechburg, Penn.

Answer: Scotch or masking tape, as it is sometimes called, resembles adhesive tape. It is about an inch wide and is gummed on one side. It can be applied to any surface, where it sticks tightly, yet can be pulled off without leaving a trace. It comes in two colors: brown and transparent. When used for striping, the parts of the fuselage adjoining the stripe are covered with masking tape and then the stripe can be painted in with a few strokes of the brush. The tape will insure the edges of the stripe being smooth and regular. We have found that the roll of scotch tape is a convenient addition to a workshop. Outside of its usual tasks, such as in striping or in fastening drawing paper, it may be used in the model itself. For example, we use it to seal the joint between the halves of a demountable wing. Or, too, it can be used to good advantage in making a snug joint where the elevator joins the fuselage. The tape makes a tight joint and yet is readily removable when it is necessary to disassemble the model.

FORMER NOTCHES

Question: In building a fuselage of a model I have difficulty in notching the formers when the grain runs up and down. V. D., Honolulu, Hawaii.

Answer: Small "rat-tail" files are available from hardware stores for about thirty-five or forty cents. They are a big convenience in notching balsa wood and for a variety of other purposes where it is impossible to insert a large file or a piece of sandpaper. But a good substitute for such a file is to wrap sandpaper around the edge of a piece of thin balsa and use it to make the notches in balsa formers.

MICROFILM FORMULA

Question: What is a good formula for microfilm and how is it applied to the balsa framework? B. M. E., Chicago, Ill.

Answer: The formula for microfilm is: 1 ounce of flexible collodion, 4/10 ounce of amyl acetate, 6/10 ounce of model cement. Seven drops of castor oil are also added to make the film flexible. This solution should be kept in a light-tight bottle or can. The above formula should be enough to cover about a half dozen models.

Covering with microfilm is considerably easier than covering with tissue. Wet the wing spars and ribs with saliva (run your tongue over the framework) and put the wing frame on the sheet of microfilm. If the spars have a tendency to come off the film, press them down

with your fingers until they stick. Let the wing dry for about a half hour after applying the film.

LAUNCHING MODELS

Question: What is the best way to launch a model airplane? S. H., Terminal Island, Calif.

Answer: This may seem to be a minor detail of model technique. But launching is oftentimes the deciding factor in the flight of the model. Each model has peculiar characteristics. For example, if a model climbs steeply in a tight, right circle the most advantageous way of launching would be to point the nose upward and send the model off with a steady shove, holding the wing in a natural bank angle.

For a slow-flying model which shows no sharp circling tendencies, the best way to launch the model would be hold the model level, allow the propeller to turn a few times and then give the model a gentle forward push.

The wind is a factor to be considered when launching a model. Launch a tight-turning model so it begins its circle into the wind and gains altitude before it begins its treacherous downwind turn. Models which show no sharp circling tendencies would best be launched directly into the wind.

If you're troubled about your ability to launch a model properly, allow it to take off by itself. If it performs badly, you can be assured that it is a bad adjustment rather than an improper launching.

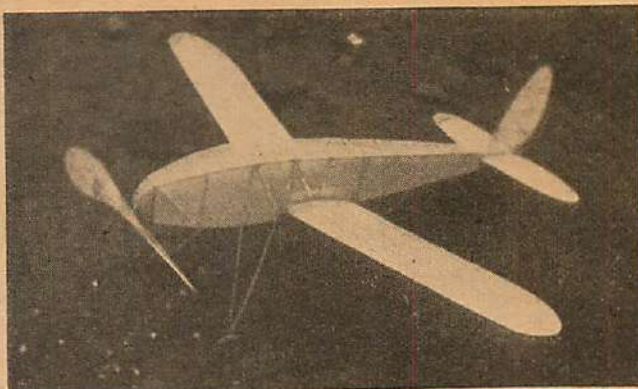
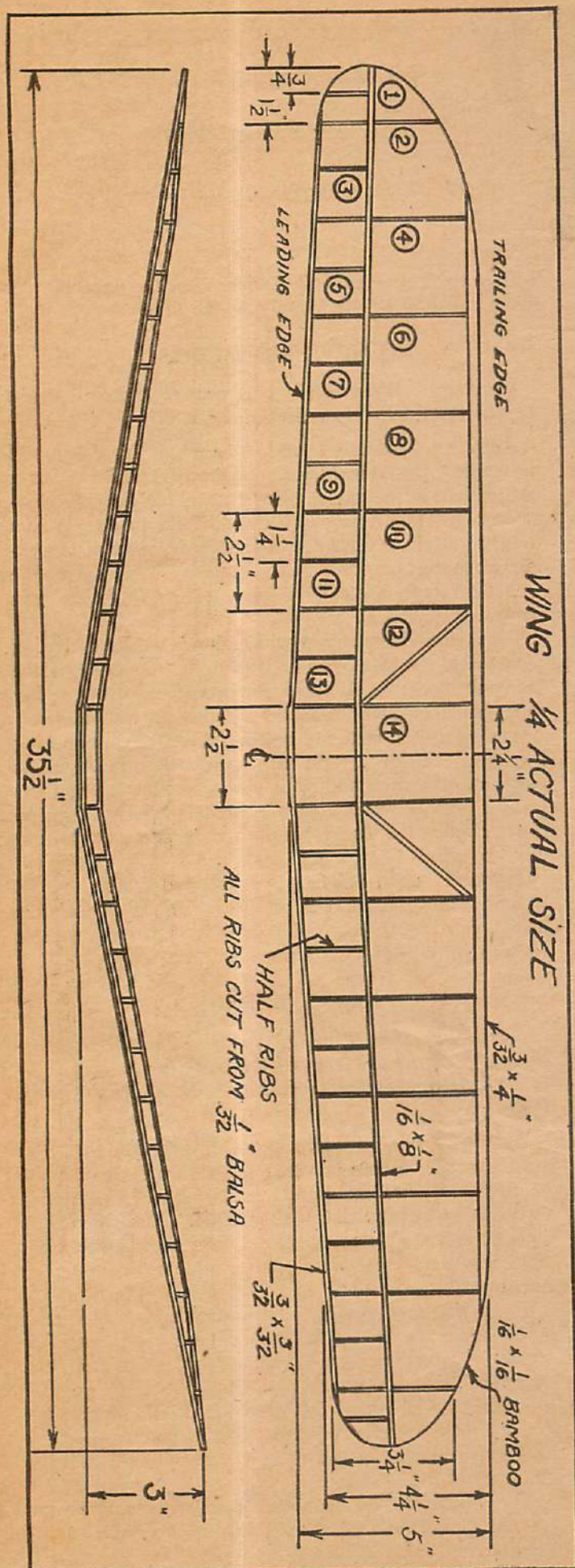
NEGATIVE THRUST

Question: Does negative thrust setting of the propeller reduce the efficiency of the model by making it fly at an increased angle of incidence? E. F., New Castle, Penn.

Answer: The widespread use of negative thrust in gas as well as rubber-powered models seems to indicate its usefulness and its effectiveness as well. Negative thrust is not essential for all models. But when it is used, it is intended to reduce stalling during the flight and consequently produce a flatter glide after the power is cut out.

The diving tendency of the negative thrust would tend to make the model fly faster and at a lower angle of attack. Reduction in efficiency might result from the decreased angle of attack and from the slight loss of propeller thrust, since the propeller would be pulling downward as well as forward. The apparent increased angle of incidence of the wing would not influence the efficiency of the model.

The advantages of negative thrust in smoothing out the flight of the model seem to more than overbalance its disadvantages. And it is doubtful if the decrease in efficiency would be noticeable.



The model proves by its stability that low wings are not taboo.

The Speedster

A snappy low wing with superlative performance.

LOW-WING MODELS are neglected by model builders. The reason which is usually advanced for the greater popularity of the high-wing type is its better stability and greater ease in adjusting. But we've seen too many good low-wing models to put much faith in these claims for superiority for the high wing. Probably ease of construction decides in favor of the high-wing type more than anything else. It is rather difficult to mount a wing on the bottom of the fuselage. And once it is mounted, it cannot be conveniently moved to balance the model. The high wing is an advantage on this count.

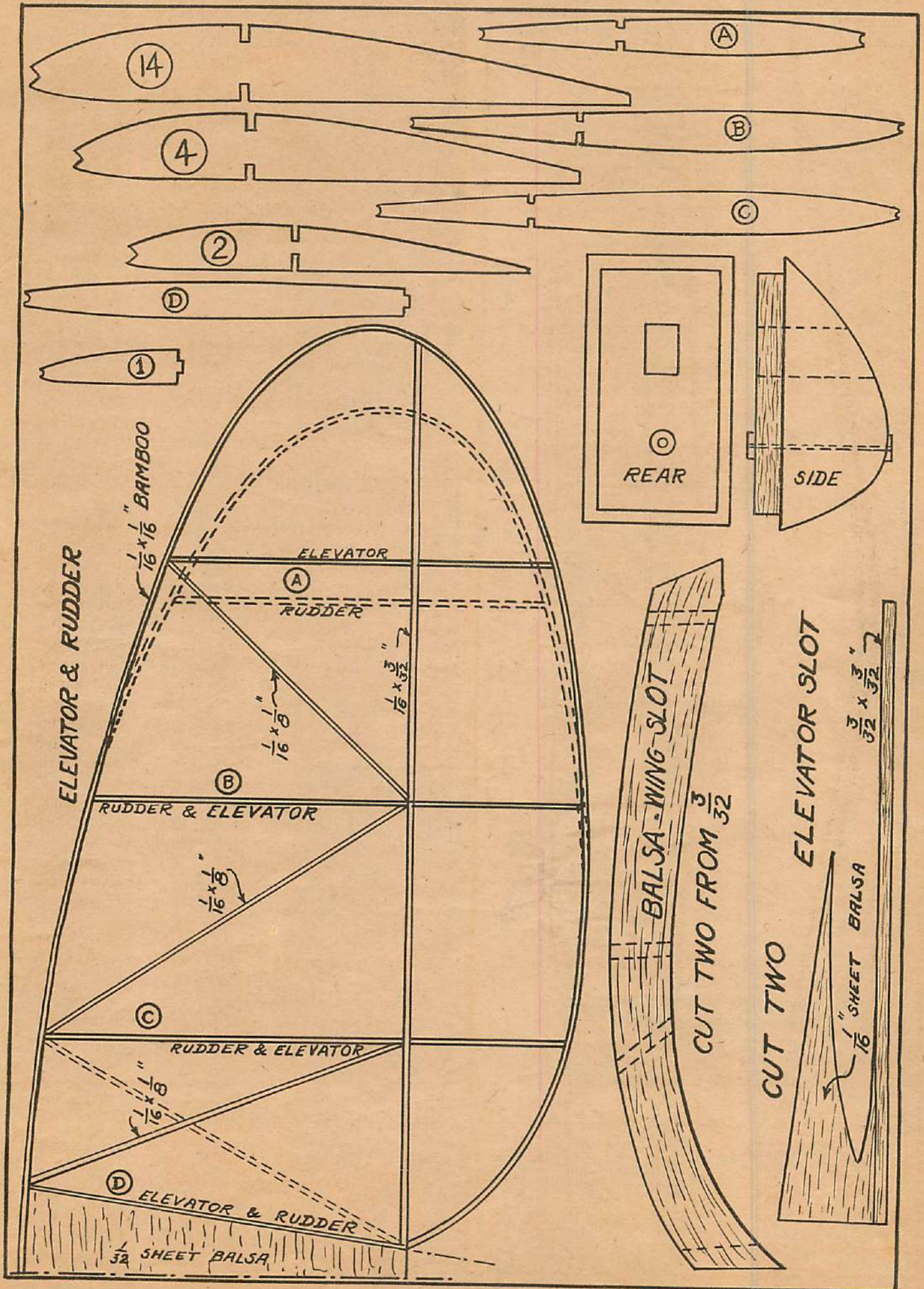
However, the method of attaching the wing in this model is not difficult. The one-piece wing is inserted through the bottom of the fuselage. With this method the incidence may be changed, but the wing itself cannot be moved. All adjustments will have to be made by shortening the length of the motor stick and by changing the elevator setting. Tail-heaviness is the most likely cause of unbalance. Shortening the stick an inch or two is a simple cure for this trouble, and it will not materially reduce the duration of the motor.

The motor stick is mounted in the fuselage, with the stick on top and the rubber hanging below. This method allows slightly more freedom for the unwinding motor.

The wing is tapered—a feature which is more attractive from an artistic viewpoint than from the standpoint of construction. But the attractive appearance makes the additional trouble worthwhile. The elevator is inserted through the rear of the fuselage in the same way as the wing. Rubber bands are used in both cases to attach to the fuselage.

FUSELAGE

The fuselage is shown in the fully dimensioned sketch. Use this when drawing up a full-size plan. A side view is all that is necessary. The two side panels are joined by merely cutting the cross braces to the correct lengths and pinning the two halves together while the cement dries.



The fuselage must be cut away to allow for inserting the wing. Keep the longerons intact, but cut away the upright braces. Strengthen this part of the fuselage with pieces of $\frac{3}{32}$ " sheet balsa. These pieces are shown exact size in the drawing. The notch in the fuselage should fit the wing snugly when it is in place.

The balsa elevator slot for the rear of the fuselage is also shown full-size in the drawing. When cementing these pieces of sheet balsa in position, fit them flush with the side of the fuselage. It will facilitate covering the model and improve the appearance.

MOTOR STICK

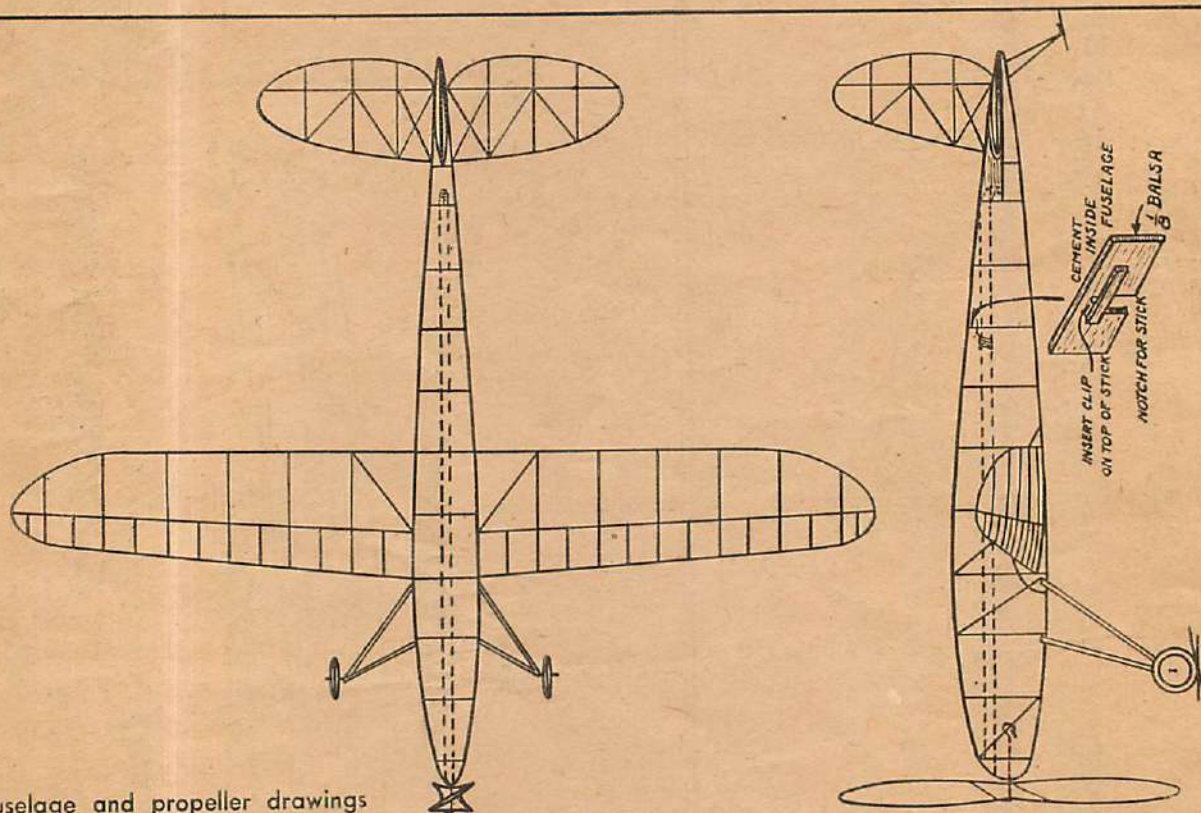
The stick is hard balsa— $\frac{3}{8} \times \frac{3}{8} \times 24$ ". Two views of the nosing, which is cemented to the front of the stick, are included in the drawing of full-size parts. But it is more important to fit the nosing directly to your model, as there is certain to be a slight variation from these plans. The rear edges of the nosing are grooved to fit inside the fuselage. It should be a tight, pluglike fit, since it provides the fastening for the front of the stick. The rear of the stick is supported by a notched piece of balsa which is cemented inside the fuselage.

The stick is secured by a wire clip, mounted on top of the stick, which slides through the balsa support.

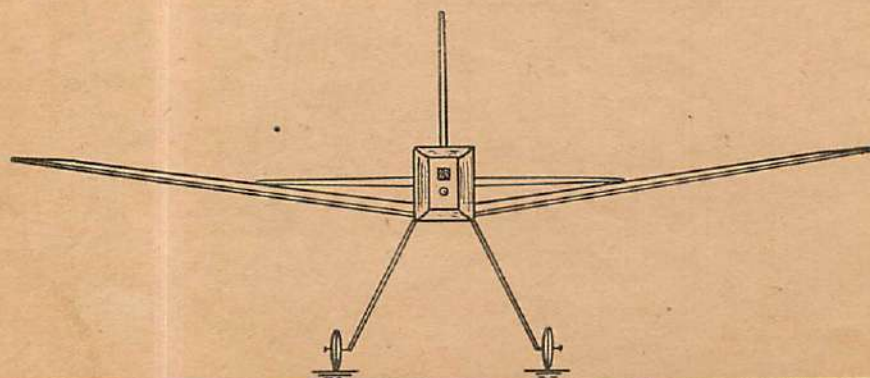
WING

Cutting different size ribs for a tapered wing is a tedious job. But it is made easier if you first cut ribs Nos. 4 and 14. Now cut the other ribs to shape, using these ribs as patterns. This can best be done by pinning pieces of $\frac{1}{8}$ " balsa together with No. 4 and No. 14 as the end ribs. Carve all the others to shape in one operation. And at the same time cut the notches for the spars, leading and trailing edges. Half ribs are used between the main ribs to strengthen the wing and to preserve the smooth covering over the top of the wing. These ribs extend from the spar to the leading edge.

When assembling the wing, constantly check to make sure that it is smoothly tapered. Failure to cut one or two correctly will destroy much of the attractive appearance. You can eliminate this trouble by lining up the ribs with a straight edge rested over the top of the wing. The center section of the wing is flat and is the same width as the fuselage at the point where the wing is inserted. As construction progresses (Turn to page 70)



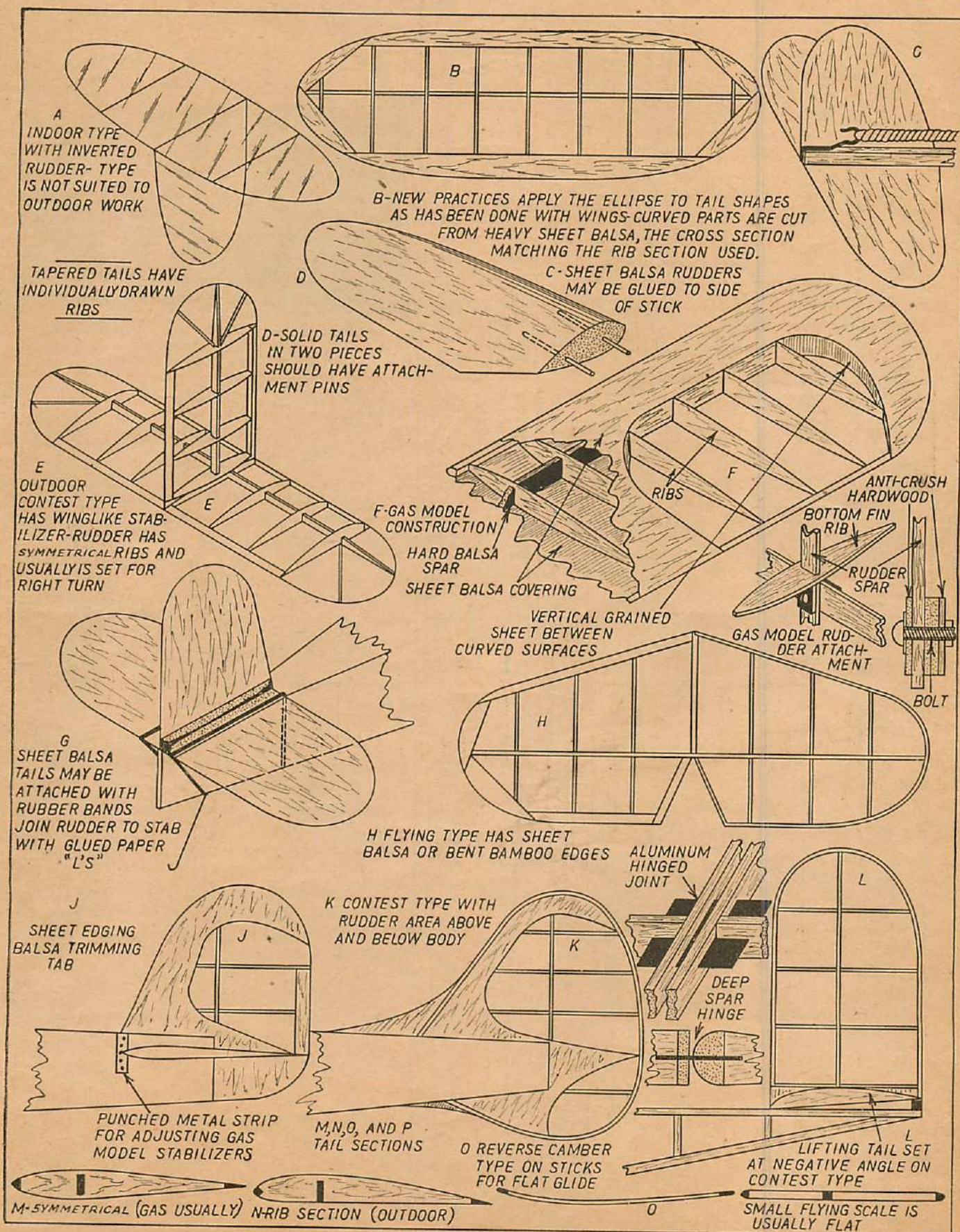
Fuselage and propeller drawings are to be found in back of book.

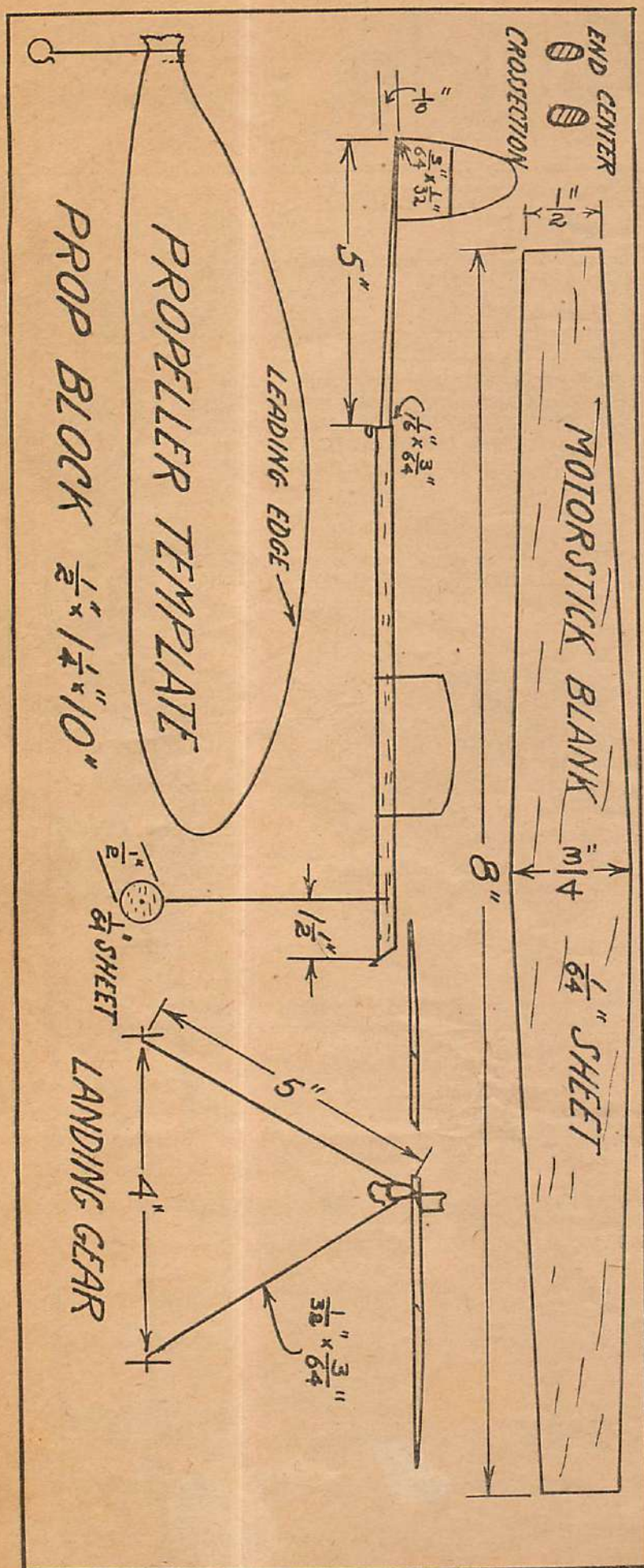


SCALE $\frac{1}{8} = 1"$
SPAN $35\frac{1}{2}"$
LENGTH $31"$
WING AREA $134"$
WEIGHT 2.78

Builder's Guide

Tails
by William Winter

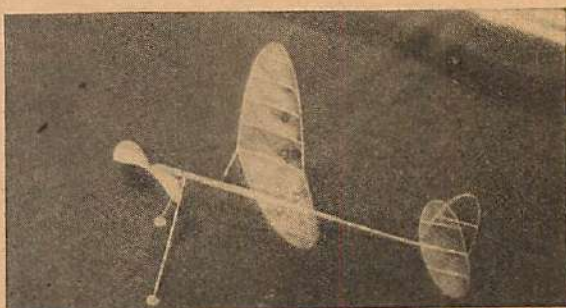




BABY R.O.G.

A simple indoor model with excellent duration.

By Lawrence N. Smithline



The Baby R. O. G. is interesting to beginner and expert alike, both in building and in flying.

MANY A TIME the urge to build a ship to play with has struck us model builders, but the length of time required to build a big job discouraged the idea. Sometimes, perhaps, we may have had the urge to fly a model, any model, but as we may not have had one the sooner we could build one the better we felt.

Building an R. O. G. will solve the problem. A model of the type shown here can be completely built in 4 hours. It was designed for low-ceiling flying and can turn in flights of up to 2 minutes in a large-size room and up to 12 minutes in a contest version. Outstanding on the model is the propeller, which makes it different from the ordinary "run-of-the-mill" model, as its diameter is 10 inches (on a 14-inch model) and has a pitch diameter ratio of 1.2.

The blades are designed to run as close to constant speed as possible, in order to cut down the climb. Also different from general practice is the flat tail surface and the rudder on top. Theoretically, this is better on a R. O. G., as the boom is much more flexible than on a larger ship and when the model stalls and falls off on the side the rudder on the top tends to twist the tail to an increased angle of attack, thus increasing the lift on the tail—which has not stalled yet, it being at a lower angle of attack than the wing—and dive the model.

Let us now get down to the business of building the model.

WING

The wing is of an elliptical shape. First trace the full-sized drawing of the wing on a piece of cardboard such as are around shirts when they come from the laundry. Cut it out and sand and cement the edges. Then cut out two strips from $\frac{1}{32}$ " soft sheet balsa

(Turn to page 63)

G.H.Q. Ready to Run GAS MOTORS

Offer this Amazing Guarantee!

FREE

One finished flywheel mounted on motor with every finished motor.

\$12⁵⁰

Postpaid



AND WHAT AN AMAZING GUARANTEE IT IS!

We give you 10 days' time to inspect all parts and actually run the motor. If at the end of that period you find any part defective we shall be glad to replace it free of charge. Can anything be more fair? Never before was such an open offer ever made. Here is the reason we are able to offer this unusual guarantee. The G.H.Q. motor is the result of years of exhaustive, scientific, aerodynamic research. Every motor is given a gruelling test and run before shipped to you. We have spared no expense in modern factory production so that we may be certain of one thing—that each motor is uniform in every respect. Our tremendous output (thousands of motors have already been bought) together with the fact that we are one of the largest concerns of its kind in the model airplane field, is your assurance that each G.H.Q. motor conforms to its high standard of performance. That is why we are able to offer this broad unconditional guarantee.

G. H. Q. MOTOR GIVES YOU LONG WEAR

It is the modern miniature motor designed exactly as present day real motors that has broken records for amazing performance. And look at the reason! In many cases we could have saved considerable money using inferior parts. Examine each part closely. Look at the life-time high-speed bronze connecting rod—and the crank shaft $\frac{5}{16}$ " thick as compared to other motors selling at twice the price having a thickness of only $\frac{3}{16}$ ". Then, too, G.H.Q. has one of the largest crank-shafts of any motor—as well as the fool-proof long life timer.

THE PRICE IS SO LOW—WE CAN'T SELL TO DEALERS

The G.H.Q. Motor is priced especially low so that you may deal direct with our factory. Even though dealers have asked to handle this product, we have not been able to give them a special dealer's price. This famous motor, complete, entirely assembled on stand, tested and run before shipment, performance guaranteed. No oil, gas or batteries included. Postpaid for only \$12.50. Free—\$12.50 one finished fly-wheel mounted on motor with every finished motor.....

G. H. Q. GAS KITS

Here is your opportunity to obtain a kit of this famous motor. Assemble it easily yourself and save money. Everything is in the kit including plug, coil, condenser, tank, ignition wire, cylinder, piston, connecting rod, timer, crank-shaft, all screws, nuts, bolts, etc. No oil, gas, batteries, or propeller included.

Postpaid for only..... **\$8.50**

STANDARD WARRANTY

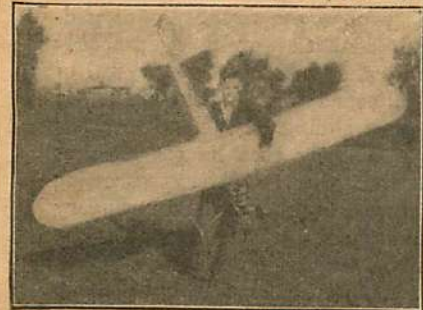


"We warrant each new G.H.Q. gasoline engine manufactured by us, to be free from defects in material and workmanship under normal use and service, our obligation under this warranty being limited to making good at our factory, any part or parts thereof, which shall, within ten (10) days after delivery of such motor to the original purchaser, be returned to us with transportation charges prepaid, and which our examination shall disclose to our satisfaction, to have been thus defective; this warranty in lieu of all other warranties expressed or implied and of all other obligations or liabilities on our part, and we neither assume nor authorize any other person to assume for us any other liability in connection with the sale of our G.H.Q. gasoline engine."

G. H. Q. SCORES AGAIN!

With this reprint of an editorial from April issue of Modern Mechanic

Gasoline powered airplane models are finding great favor with aviation fans and a \$3 prize was awarded to Francis Kosanda, of Hopkins, Minn., for his interesting letter:



Francis Kosanda, of Hopkins, Minn., holds gasoline powered model he and Robert Apper constructed. On its initial flight, the 9-foot model flew out of sight but was recovered again.

Hopkins, Minn.

Dear Editor:

Enclosed is a photo of a gas powered model airplane built by Robert Apper, of Minneapolis, and myself. It is of original design and powered with a G.H.Q. motor.

The model weighs five and one-half pounds, has a wing span of nine feet, and an aspect ratio of 8-1. On a test flight the model went out of sight after ten minutes, but was later recovered from a tree overhanging the Mississippi River.

Your articles on gas engines, gas models, and model airplanes are excellent.

Judging from the report, the gas model must be an excellent cloud chaser and we are glad it was recovered without serious damage.

FLASH!

If you are interested in special contest and speed work, write us (enclose 3c postage) for folder giving details on "souping" up and lightening your G.H.Q. engine.

Send 10c for illustrated catalog of gasoline motors, gasoline planes, gasoline accessories and parts. We have a complete line of kits from... 10c to \$1.00

G. H. Q. SPORTSTER KIT



The G.H.Q. Sportster kit especially designed for G.H.Q. Gasoline Motor but may be used for any other motor of like weight and power. Built according to scientific aero-dynamic principles—Has made hundreds of successful flights without crash—Marvelous glider... And what a climber!

A complete kit of all parts including plan, all wood, wire, wheels, metal and all other parts. Postpaid for only

\$5.00

5 ft. Flying Scale Models

$1\frac{1}{3}$ size of real planes!

\$1

EACH

PLUS 35c for PACKING, POSTAGE & INSURANCE

IF EXPRESS COLLECT SEND ONLY \$1.00

These are the giant models that have amazed the model builders of America. Imagine strong outdoor flyers that are actually one-third the size of passenger carrying planes—a \$10 value for only \$1.00. Everything is in the kit including all liquids—nothing else to buy!

CONTENTS: Each of these new G.H.Q. Giant 5 ft. Model Planes contains full-size Plans, all ribs, formers and curved parts clearly printed on best grade Balsa. Large bottles Cement and Dope, different colors Japanese Tissue, Special Endurance Rubber, finished Ready-to-Run Wheels, Wire, Balsa strips cut to size, Washers, and Movable Controls, shock-proof Landing Gear, Scale Details, Lettering, Numbering and Insignias, Flight Log, etc.



5 ft. Monocoupe, also 5 ft. Heath Parasol and 5 ft. Stinson Reliant.

G. H. Q. MODEL AIRPLANE CO.

854-T East 149th Street
NEW YORK, N. Y.

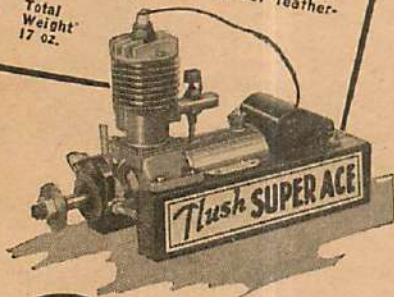
The LEADER!

TLUSH SUPER ACE

Winner of the Texaco Trophy at the Detroit "Nationals."

Sets a pace that can't be beat! Has a certain "plus"—an indescribable element that can't be defined in metallurgical or mechanical terms. In other words, every ounce a real motor, 900-12,000 R.P.M., 1/5 H.P. at 4500. Weight (bare motor) 7 oz. Has greater strength to weight ratio than any other motor of this type. Features include: Smallest and lightest coil and new foolproof feather-weight tank.

Total Weight 17 oz.



Complete
\$21.50
postpaid
in U.S.A.

TLUSH
SUPER ACE
MOTOR CO.

AT-755 Sixth Street, Lyndhurst, N. J.

G MEN GET THEIR MAN
So do the Mounties, all are Jiu Jitsu Experts, get illustrated course on 13 KNOCKOUT BLOWS above the waist line 15c
By the world's foremost Police Jiu Jitsu Instructor, Get Your Man! S. J. JORGENSEN, 330 Maritime Building, Seattle, Washington

WORLD WAR RELICS \$7.75 EA.



Vickers Aircraft Machine Guns for club-house or Den, cost Gov't. about \$700. ea., rendered unserviceable, no parts missing; weighs about 33 lbs. Send M.O., Check or Draft for \$7.75 (F.O.B., N.Y.) \$1 deposit on C.O.D. Orders. We are also selling Marlin Aircraft Guns rendered unserviceable, at the same price. Write for Catalog on Fiala Sleeping Bags & Camping Equipment.

FIALA OUTFITS INC., T-10 Warren St., New York

Build this New C-D BRISTOL FIGHTER



After repeated requests for over five years that we design a model of this famous war-time fighter it is now ready for C-D fans. Span 19 1/2 inches. Beautifully colored cream wings and tail, cream fuselage, silver nose and most effectively trimmed with red and white. Complete kit (except no liquids included) postfree only 95c
(Foreign shipments 10c extra)

Send at once for big 64-page catalog and Large Supplement

Hundreds of Model Railroads, Ships, Airplanes, Gas and Steam Engines, Racing Cars, Supplies, Accessories, Hard-to-get parts, sheet metals, rods, wires, bolts, screws, etc. etc. (all very fine sizes). Thousands of tiny items. Send 15c (coin) today—no free copies. DEALERS: Write for full details.

CLEVELAND MODEL & SUPPLY CO., Inc.
1866BB West 57th St. Cleveland, Ohio, U. S. A.

hollowed as indicated, the whole being cemented together again when the operation has been completed.

The attachment lugs are detailed on the plan and bolt to the front, plywood bulkhead. Each is cemented to the inside of the cowl.

The cowl is silked in the same manner as the fuselage. However, after the walls have been thinned down to approximately 1/8" to 1/4", silk is applied to the inside, also. Cover the exhaust side of the inner surface with sheet aluminium to serve as a fire wall.

The hooded portion is attached with a silk hinge.

MATERIALS

- 4 1/8x3x36" medium sheet balsa
- 1 6x12" 1/8" birch or poplar plywood
- 1 1/4x3x36" hard sheet balsa
- 3/16" sq. x6" spruce strip
- 3 1/4 sq. x36" hard strip balsa

- 2 1/4x1/2x60" hard strip balsa
- 3 1/4x1/2x36" spruce
- 1 1/4x1/2x36" bass
- 1 3/4" diameter dowel
- 1 12" aluminium tubing 1/4" inside diameter
- 1 1/4" diameter dowel
- 1 1/2" diameter dowel
- 1 5x6x8" soft balsa block
- 1 1/2 yds. model airplane silk
- Cement and clear dope as required
- 2 lengths 1/8" steel wire
- 1 length 1/16" steel wire
- 1 pr. 4 1/2" diameter air wheels or substitute
- 6 3/32" diameter machine bolts
- scrap strip brass
- 1 toggle switch
- 1 1/4x3/4x60" hard-wood jig stick
- 1/4x1/2" soft balsa as required for planking

TO BE CONCLUDED NEXT MONTH.

SOARING AND GLIDING

(Continued from page 10)

eights, over the hill or ridge, so as to remain within the area of rising air currents. He may be carried upward for a thousand or more feet if the current is strong enough.

He has good altitude from the slope wind, and he can now glide in any direction for some time. He looks around for a likely spot: a bare, sun-baked field, the roofs of a town, or any other place that reflects the sun's heat may create a rising column of heated air. Selecting such a place, he coasts straight for it, keeping an eye on his rate-of-climb indicator and a ready hand on the control stick in the meanwhile, for he may run into an unexpected thermal on the way. Thermals, big and little, often turn up unexpectedly, or fail to develop where they should. Arriving over the selected spot, he feels a lift and throws his craft into a circle. Although he is spiraling downward to remain inside the favorable area and keep flying speed, the thermal may raise him several thousand feet before it loses effect.

With plenty of altitude once more, he may look for a cumulus cloud. He heads for one, sacrificing much height to get there, but beneath it is the rising current that these clouds indicate. Circling again, he is carried up and into the cloud until his altimeter shows a very satisfactory figure. If he is in a record-breaking frame of mind, he may look for other clouds, for the long cross-country trips are usually made by "cloud-hopping."

Glancing around the horizon, he sees a chance to try the fourth type of soaring. A storm is approaching; he knows that the cold air, as it advances like a flat wedge along the ground, is push-

ing the warmer air upward and backward. It is possible to ride that ascending current—if one keeps safely ahead of the turbulent area—and advance in a straight line with the storm. But "cold-front" soaring is not to our pilot's taste; he sticks his nose down a little more and, with the help of one or two small slope currents, he reaches home and lands at the same spot from which he took off.

How did the pilot obtain his skill, his air knowledge—and his glider?

He is probably a member of a gliding club and the glider is probably shared by the club members, several of whom launched him on the flight. If he has been gliding for more than a few years, it is likely that he got his first training in a primary glider, progressing then to what is known as a secondary or utility glider, and finally to the big, slim-winged soarer or sailplane.

The primary glider is simple, cheap and rugged, all of which has made it popular abroad and earned it some fame in this country. It is hardly more than a plain wing and a tail group joined by an open framework, which also serves as landing skid and provides a saddle for the pilot. It can be built or assembled at home. Being easily repaired, it is a handy craft for its usual purpose: beginners' instruction.

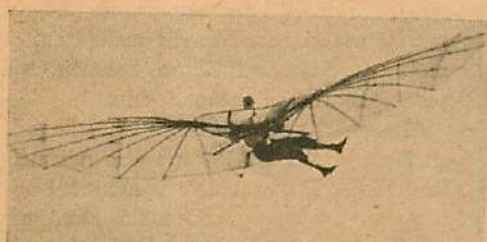
The beginner receives preliminary advice from the instructor; he is then strapped into the seat and gently launched on a smooth slope, so that he coasts safely a few feet above the ground until he slides to a landing at the bottom. As he progresses he makes longer and higher hops, is catapulted from a level surface, then tries mild turns. The

primary glider held its own in the instruction field until auto-tow launching developed the use of the utility type for primary training.

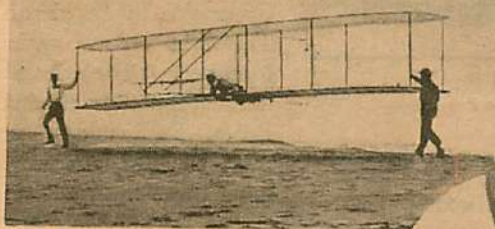
The utility glider is what its name implies: an all-around useful ship, suitable for both instruction and soaring. The wing has a greater span than the primary; the open framework is replaced by a faired fuselage; a partially inclosed cockpit accommodates the pilot; and in addition to a skid-type belly, it often has a single landing wheel inset, equipped with a brake. Generally, for strength, streamlined struts help support the wing. The utility type is not too difficult for home construction. As a trainer, it is auto-towed on level ground at just below flying speed, while the student uses the controls to maintain balance on the skid or central wheel. The instructor, riding in the auto, watches and criticizes his efforts.

Later a little speed is added and the student "flies" a few feet high. As his confidence increases he is given faster pulls and eventually turned loose. For soaring, the utility performs very creditably. As might be expected, it is the most popular type of glider.

The sailplane is the acme of glider development. It is usually of cantilever or strutless construction, streamlined and polished to cut air resistance to the minimum. In a covered cockpit, only the transparent head inclosure projects above the hull surface. Because of its



Above: Otto Lilienthal and hang glider of 1891.



Above: Launching the Wright Glider at Kitty Hawk in 1902.

perfect design, great span and high aspect ratio, providing a shallow gliding angle and low sinking speeds, the sailplane is the glider that sets the records. It is too delicate a job for home building, and is left to experienced manufacturers.

Glider, like all other aircraft, are subject to licensing by the government. Every one flown must bear an identification number, but to earn the preceding letter "G" (corresponding to the "C" on a commercial airplane), which means

FREE

SPRAY
for Your
MODELS
or
1 Dz. SHEETS
JAP. TISSUE
or
PLANS
20 in. MODEL
(Choice of 3)
CURTISS-WRIGHT
COUPE, HEATH
PARASOL, U. S.
BOEING P-12C
FIGHTER,
DRIGGS SKY-
LARK,
BELLANCA SKY
ROCKET

with
ORDERS
OF \$1.00 OR
MORE

TAKE ADVANTAGE of this special FREE offer now! Experience what a real pleasure it is to do business with a model airplane supply house that keeps promises! Every order is shipped same day received! All materials are of highest quality! Prove this to yourself! Learn why so many builders, dealers and clubs deal with SKYWAY! Dealers! Send for prices.

Wholesale Prices for Retail Buyers

18" Balsa Sheets 1/32x2 .5 for 5c 1/16x2 .5 for 5c 3/32x2 .4 for 5c 1/2x2 .4 for 5c 3/16x2 .2 for 5c 1/2x2 .2 for 5c For 3" Sheets, double above prices.	18" Balsa Strips 1/16x1/16 100 for 5c 1/16x1/8 35 for 5c 1/8x1/8 30 for 5c 1/16x3/16 20 for 5c 1/16x1/2 15 for 5c 3/32x3/32 30 for 5c 1/2x1/2 .12 for 5c 1/2x1/4 .6 for 5c 1/2x1/2 .3 for 5c 1/2x1/2 .3 for 5c	NOSE PLUGS. large .10c doz. small .5c doz. Clear Dope 1 oz. .5c 1/2 pt. .25c Miscellaneous Washers, 1/4, 1/8 Doz. .1c Sandpaper, .5c Colored Dope 1 oz. .30c 1/2 pt. .15c Clear Cement 1 oz. .5c 1/2 pt. .25c 1 pt. .45c Wood Veneer 20x30 .1 for 9c 2 for .17c	Celluloid Wheels 3" .5c 4" .7c 5" .9c 6" 1.1c 7" 1.3c 8" 1.5c 9" 1.7c 10" 1.9c 11" 2.1c 12" 2.3c 13" 2.5c 14" 2.7c 15" 2.9c 16" 3.1c 17" 3.3c 18" 3.5c 19" 3.7c 20" 3.9c 21" 4.1c 22" 4.3c 23" 4.5c 24" 4.7c 25" 4.9c 26" 5.1c 27" 5.3c 28" 5.5c 29" 5.7c 30" 5.9c 31" 6.1c 32" 6.3c 33" 6.5c 34" 6.7c 35" 6.9c 36" 7.1c 37" 7.3c 38" 7.5c 39" 7.7c 40" 7.9c 41" 8.1c 42" 8.3c 43" 8.5c 44" 8.7c 45" 8.9c 46" 9.1c 47" 9.3c 48" 9.5c 49" 9.7c 50" 9.9c 51" 10.1c 52" 10.3c 53" 10.5c 54" 10.7c 55" 10.9c 56" 11.1c 57" 11.3c 58" 11.5c 59" 11.7c 60" 11.9c 61" 12.1c 62" 12.3c 63" 12.5c 64" 12.7c 65" 12.9c 66" 13.1c 67" 13.3c 68" 13.5c 69" 13.7c 70" 13.9c 71" 14.1c 72" 14.3c 73" 14.5c 74" 14.7c 75" 14.9c 76" 15.1c 77" 15.3c 78" 15.5c 79" 15.7c 80" 15.9c 81" 16.1c 82" 16.3c 83" 16.5c 84" 16.7c 85" 16.9c 86" 17.1c 87" 17.3c 88" 17.5c 89" 17.7c 90" 17.9c 91" 18.1c 92" 18.3c 93" 18.5c 94" 18.7c 95" 18.9c 96" 19.1c 97" 19.3c 98" 19.5c 99" 19.7c 100" 19.9c	Model Pins pks. 5c Brushes No. 6c INSIGNIAS— French, American, English, German 1/4" .4 for 3c 1/2" .4 for 3c 1" .4 for 3c 1 1/2" .4 for 3c 2" .4 for 3c 2 1/2" .4 for 3c 3" .4 for 3c 3 1/2" .4 for 3c 4" .4 for 3c 4 1/2" .4 for 3c 5" .4 for 3c 5 1/2" .4 for 3c 6" .4 for 3c 6 1/2" .4 for 3c 7" .4 for 3c 7 1/2" .4 for 3c 8" .4 for 3c 8 1/2" .4 for 3c 9" .4 for 3c 9 1/2" .4 for 3c 10" .4 for 3c 10 1/2" .4 for 3c 11" .4 for 3c 11 1/2" .4 for 3c 12" .4 for 3c 12 1/2" .4 for 3c 13" .4 for 3c 13 1/2" .4 for 3c 14" .4 for 3c 14 1/2" .4 for 3c 15" .4 for 3c 15 1/2" .4 for 3c 16" .4 for 3c 16 1/2" .4 for 3c 17" .4 for 3c 17 1/2" .4 for 3c 18" .4 for 3c 18 1/2" .4 for 3c 19" .4 for 3c 19 1/2" .4 for 3c 20" .4 for 3c 20 1/2" .4 for 3c 21" .4 for 3c 21 1/2" .4 for 3c 22" .4 for 3c 22 1/2" .4 for 3c 23" .4 for 3c 23 1/2" .4 for 3c 24" .4 for 3c 24 1/2" .4 for 3c 25" .4 for 3c 25 1/2" .4 for 3c 26" .4 for 3c 26 1/2" .4 for 3c 27" .4 for 3c 27 1/2" .4 for 3c 28" .4 for 3c 28 1/2" .4 for 3c 29" .4 for 3c 29 1/2" .4 for 3c 30" .4 for 3c 30 1/2" .4 for 3c 31" .4 for 3c 31 1/2" .4 for 3c 32" .4 for 3c 32 1/2" .4 for 3c 33" .4 for 3c 33 1/2" .4 for 3c 34" .4 for 3c 34 1/2" .4 for 3c 35" .4 for 3c 35 1/2" .4 for 3c 36" .4 for 3c 36 1/2" .4 for 3c 37" .4 for 3c 37 1/2" .4 for 3c 38" .4 for 3c 38 1/2" .4 for 3c 39" .4 for 3c 39 1/2" .4 for 3c 40" .4 for 3c 40 1/2" .4 for 3c 41" .4 for 3c 41 1/2" .4 for 3c 42" .4 for 3c 42 1/2" .4 for 3c 43" .4 for 3c 43 1/2" .4 for 3c 44" .4 for 3c 44 1/2" .4 for 3c 45" .4 for 3c 45 1/2" .4 for 3c 46" .4 for 3c 46 1/2" .4 for 3c 47" .4 for 3c 47 1/2" .4 for 3c 48" .4 for 3c 48 1/2" .4 for 3c 49" .4 for 3c 49 1/2" .4 for 3c 50" .4 for 3c 50 1/2" .4 for 3c 51" .4 for 3c 51 1/2" .4 for 3c 52" .4 for 3c 52 1/2" .4 for 3c 53" .4 for 3c 53 1/2" .4 for 3c 54" .4 for 3c 54 1/2" .4 for 3c 55" .4 for 3c 55 1/2" .4 for 3c 56" .4 for 3c 56 1/2" .4 for 3c 57" .4 for 3c 57 1/2" .4 for 3c 58" .4 for 3c 58 1/2" .4 for 3c 59" .4 for 3c 59 1/2" .4 for 3c 60" .4 for 3c 60 1/2" .4 for 3c 61" .4 for 3c 61 1/2" .4 for 3c 62" .4 for 3c 62 1/2" .4 for 3c 63" .4 for 3c 63 1/2" .4 for 3c 64" .4 for 3c 64 1/2" .4 for 3c 65" .4 for 3c 65 1/2" .4 for 3c 66" .4 for 3c 66 1/2" .4 for 3c 67" .4 for 3c 67 1/2" .4 for 3c 68" .4 for 3c 68 1/2" .4 for 3c 69" .4 for 3c 69 1/2" .4 for 3c 70" .4 for 3c 70 1/2" .4 for 3c 71" .4 for 3c 71 1/2" .4 for 3c 72" .4 for 3c 72 1/2" .4 for 3c 73" .4 for 3c 73 1/2" .4 for 3c 74" .4 for 3c 74 1/2" .4 for 3c 75" .4 for 3c 75 1/2" .4 for 3c 76" .4 for 3c 76 1/2" .4 for 3c 77" .4 for 3c 77 1/2" .4 for 3c 78" .4 for 3c 78 1/2" .4 for 3c 79" .4 for 3c 79 1/2" .4 for 3c 80" .4 for 3c 80 1/2" .4 for 3c 81" .4 for 3c 81 1/2" .4 for 3c 82" .4 for 3c 82 1/2" .4 for 3c 83" .4 for 3c 83 1/2" .4 for 3c 84" .4 for 3c 84 1/2" .4 for 3c 85" .4 for 3c 85 1/2" .4 for 3c 86" .4 for 3c 86 1/2" .4 for 3c 87" .4 for 3c 87 1/2" .4 for 3c 88" .4 for 3c 88 1/2" .4 for 3c 89" .4 for 3c 89 1/2" .4 for 3c 90" .4 for 3c 90 1/2" .4 for 3c 91" .4 for 3c 91 1/2" .4 for 3c 92" .4 for 3c 92 1/2" .4 for 3c 93" .4 for 3c 93 1/2" .4 for 3c 94" .4 for 3c 94 1/2" .4 for 3c 95" .4 for 3c 95 1/2" .4 for 3c 96" .4 for 3c 96 1/2" .4 for 3c 97" .4 for 3c 97 1/2" .4 for 3c 98" .4 for 3c 98 1/2" .4 for 3c 99" .4 for 3c 99 1/2" .4 for 3c 100" .4 for 3c
---	---	--	---	---

SKYWAY MODEL AIRCRAFT SUPPLY CO.

383 Seventh Ave.
Dept. B.
Brooklyn, N. Y.

that it is fully licensed for hired instruction and flight, it must meet the airworthiness standards of design and construction set up for the government's approved-type certificate. These are reasonable standards and should be followed.

Pilots of gliders are also licensed—and here is where any one may become a real licensed airman, even if he can't qualify for other forms of flight. Fourteen years is the average minimum safe age. A glider-student permit is granted on request—no physical or written examination, no fee—entitling the student to solo-licensed gliders under a licensed pilot's direction. You can get your first regular license—non-commercial glider pilot—at fourteen years of age, which

At eighteen you become eligible for commercial glider pilot, which permits you to instruct others in licensed craft. Besides the noncommercial test flights, you must perform 360° turns, and pass the simplest of the airplane pilots' physical examinations—that given for student, amateur and private pilots—for which the physician's fee is ten dollars. There is no written examination. For any license, when under twenty-one, you must present parents' or guardian's consent.

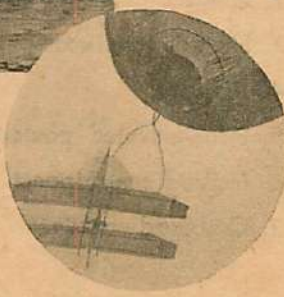
You have now achieved all government glider-pilot ranks, but there are others which you may add to your laurels. The world regulations body, the Fédération Aéronautique Internationale, issues through the National Aeronautic Association several glider-pilot awards. The first is the "A" license, whose owner wears a pin with a white gull on a blue background, and the second is the "B" license, marked by a pin with two gulls. Flight requirements are about the same as for our two government grades, which, in fact, are accepted by the N. A. A. as fulfilling the tests. The "C" license—three gulls—is won with a soaring flight of at least five minutes. The "Silver C," the most distinguished of all—three gulls inclosed in an olive wreath—calls for a flight of five hours' duration, three thousand two hundred and eighty feet altitude, and thirty-one miles distance. Only eight Americans now hold this rating.

Now some facts and figures about your chances of soaring and gliding.

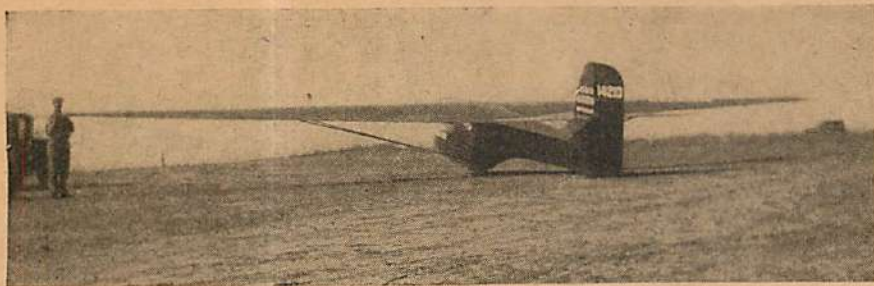
Briefly they're good, and you'll have the added reward of knowing that you're helping to build the American gliding movement.

You'll need membership clubs. Gliding is not a one-man affair, as airplane flying may be. Launching methods, if nothing else, make gliding a group ac-

is two to four years earlier than you could apply for an airplane license. With this you are a pilot, entitled to solo any glider anywhere. The only requirement is a test of three or more glides, with moderate banks and precision landings. There are still no physical or written examinations, no flight time, no cost.



Below: The Montgomery glider launched from hot-air balloon in 1905.



A soarer, or sailplane, is the type capable of extended durations.

tivity. But even if a one-man launching device is invented, clubs will still be desirable. Besides crystallizing and spreading gliding sentiment, they form a means of lessening costs, exchanging the various kinds of talent needed in caring for

and flying a glider, and of providing a lot of good comradeship. Instead of reducing individual air time, a club increases it by getting each member up oftener than he could arrange if he tried it alone.

There are many gliding clubs in this country. If you know of one in your locality, perhaps you can join. If there is no club near you, you can form one. You don't need many members; half a dozen may be enough to start with. You'll find it helpful in more ways than one to base your club on some other organization, such as a high school or church; from it you can secure new members, a common meeting place, and so forth. If the Teaneck, N. J., high school can buy a two-place Aeronca airplane and train air-minded students on it, certainly hundreds of other high schools throughout the country can give moral, if not material, support to glider clubs.

FRITZ FLIES THE MAIL

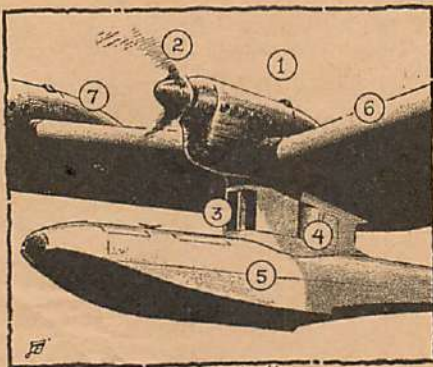
(Continued from page 21)

permitting the use of short pylon-type connections between the wings and floats. The wing roots are faired into the fuselage at the points normal in low-wing monoplane practice. Instead of springing straight out on a level plane, however, each wing root drops diagonally outward at a sharp angle to a point well below the belly of the fuselage. At this point the inboard engine is mounted in the leading edge with a pontoon-supporting pylon beneath it. The outer wing panel is attached just beyond the engine mount and the wing structure rises again at a sharp dihedral angle. The arrangement is somewhat similar to that used on the Bellanca "Aircruiser." Bellanca, however, has confined the trick to his wing-supporting members, whereas the Germans have adopted it to the wing itself.

The Ha.139 is powered with four Junkers "Jumo" 205 Diesel engines developing 600 h.p. each. These remarkable engines burn crude oil and are "true Diesels" of the opposed-piston, compression-ignition type. Used in many of Germany's civil and military planes, the "Jumo" boasts several advantages over the conventional gas engine: The fire risk is eliminated—crude oil will not burn at normal temperatures—and electrical ignition is eliminated—with a consequent gain in radio reception. The fuel is cheap and, pound for pound, it carries the plane about one third farther than gasoline.

The only objection to the Diesel lies in its relatively greater weight. Careful design, however, has brought the weight ratio of the "Jumo" 205 down below two

pounds per horse power, a figure which compares very favorably with present gas models. The engines are liquid-cooled through radiators inclosed in the pontoon pylon. Front openings are provided with air-control shutters operated



1. Air scoop.
2. Inboard motor nacelle.
3. Shuttered radiator.
4. Air vent.
5. Pylon-mounted pontoon.
6. Inclined center panel.
7. Outboard nacelle.

by the pilot. Heated air is exhausted through streamlined vents in the sides of the pylons. The twin pontoons are of the single-step type, constructed entirely of metal, and are divided internally into twelve air-tight compartments.

The fuselage is beautifully streamlined in a long, slender cigar shape. The in-

closed pilot house is placed well in advance of the leading edge of the wing and contains every facility for overseas flying. To the rear of the pilots' seats is a radio-navigation compartment lighted by large portholes on either side. A vertical mast directly above it carries the Pilot tube and main radio antenna. A directional "loop antenna" is also provided. Four heavy-duty lifting eyelets are attached to the main frames of the fuselage to facilitate hoisting the plane aboard the catapult ship.

Along with the rest of the plane, the tail surfaces of the Ha.139 are also unusual in design. The stabilizer is mounted on a pylon projecting above the stern of the fuselage and is externally braced on either side by a pair of inclined struts. The twin vertical surfaces combine to form perfect circles bearing the Swastika insignia found on all aircraft of the third Reich. Both rudders, as well as the one-piece elevator, are provided with trimming tabs.

The Ha.139 has a span of 88.56 feet, is 63.96 feet long and measures 17.05 feet from top to bottom. She has a wing area of 1259.95 square feet, and her total horse power, 2400, pulls her along at a maximum speed of 186.3 miles per hour. Cruising at 155.2, the big girl is capable of 3105 miles of flight carrying a full load.

The Hamburger outfit has produced quite a sandwich. Their new baby combines originality with clean design. She is fast, economical, and able. As long as German aircraft engineers are able to turn out ships like the Ha.139, Germany has no need to fear foreign competition.

FLASH! MEGOW BRINGS OUT SENSATIONAL NEW GAS-POWERED

Fellows! We have it now! You want to build a gas-powered model that will perform with the best of them . . . a beauty to look at, and yet easy to build. You don't need to work for weeks, experimenting, you just follow our large clear, full-size plans . . . and use any model airplane engine you prefer. It challenges the world with a new low price . . . and *airwheels* are included!

Easy to carry in an automobile, wings easily removed and landing gear folds back. Wheels well forward of propellers for safe landings and to protect propeller. Fail-proof landing gear absorbs hard shocks. Rudder adjustable, stabilizer semi-adjustable, motor easily removed.



\$4.95 EQUIPPED WITH 3 1/4" SPECIAL WHEELS
Postage 30c extra 1-5 h.p. Brown Jr. Motor, \$21.50

3 1/4" Wheels. Fail-proof landing gear. Two full-size plans 28" x 34". Cutout propeller blank. Extra hard Balsa wood. Special steel wire, sheet aluminum for cowl, bamboo paper, cement, etc. Chord, 9 1/4". Wing-span, 5 ft. 7". Length 47".

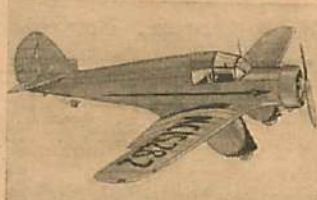


The "BOUNTY"

One of a long line of model kits of beautiful, romantic and historic ships, accurate, colorful, appealing. The "Bounty" kit contains all necessary material to build a complete and authentic model of this ship so famed in story and motion pictures.

1/8" scale model \$1.00
postage extra, 15c
Smaller size 25c
postage extra, 10c

Two Wonderful 1/2" Scale Megow Models



AERONCA. A new 1/2-inch scale flying model—wonderful to build. Aluminum drag ring, shaped wheels, complete supply of material and liquids. 50c
Postage, 15c extra



STINSON RELIANT. Top-batter of all 1/2-inch scale flying models. Movable controls, aluminum drag ring. Shaped wheels, all insignia. Complete plans 75c
Postage, 10c extra.



FOKKER D.VII. Outstanding German war-plane. Built to scale from original plans. Great favorite with fighting plane model builders. 25c
Postage, 10c extra.



CAUDRON RACER. The winning sensation of the Thompson Trophy race, flown by the famous French flier, Detroyat. Complete. 25c
Plus 10c postage.

...and here are two from the Megow 25c line

MODEL BUILDERS: Mail this Coupon for big 24-page Catalog!

DEALERS: Write for our new local contest plan. It's a business-getter . . . a money-maker.

MEGOW'S

Dept. AT, Howard and Oxford Streets
Philadelphia, Pa.

Chicago Office and Warehouse:
627 Lake Street, Chicago

MEGOW'S, Dept. AT, Howard and Oxford Streets
Philadelphia, Pa.

I am enclosing 5c in postage for latest 24-page catalog of Megow Airplane and Boat Models.

Name

Street

City State

BRITISH WARBLER

(Continued from page 48)

PROPELLERS

The scale propeller enhances the model's appearance when it is not being used for flying.

The flying propeller has been designed as a three-blader for this model. Carve three helical pitch blades similar to the way a two-blader blade is carved. Cement them together heavily with several coats of cement. Install the prop shaft and plug and then cement the spinner on.

COMPLETING THE MODEL

Use one sheet of white tissue for covering. The wing frames can be covered with one pattern on each side. Cover all the remaining portions. But when covering the fuselage, apply to one section at a time.

Cement the wings to the wing support in the position shown on the side view of the drawing and block the tips up 1" until the "V" struts can be fitted and cemented. Cement the tail surfaces on, and then the tail wheel assembly. Place bushings in the wheels and install the wheels in the pants. Cement the cowl on firmly.

When all of the parts have dried, spray the tissue with water. When dry, give the whole model a coat of silver dope, except the lights and wheels, of course. Now cover the inclosure frames

with this sheet celluloid, not cellophane, and add as much of the detail as you wish.

FLYING THE MODEL

The design of this model, thanks to the Westland folks, makes it a natural flier. Run your first tests in tall grass to determine the necessary adjustments. The power for the model varies from 4 to 6 strands of $\frac{1}{8}$ " flat rubber. Happy landings!

LIST OF MATERIALS

BLOCKS

3 $\frac{3}{4} \times 1 \times 3\frac{3}{4}$ " 3 $\frac{3}{8} \times \frac{1}{2} \times 2\frac{1}{2}$ "

SHEETS

1 $\frac{3}{8} \times 2 \times 10$ "
1 $\frac{1}{8} \times 2 \times 18$ "
2 $\frac{1}{16} \times 2 \times 18$ "
4 $\frac{1}{32} \times 2 \times 18$ "
2 $\frac{1}{64} \times 2 \times 18$ "

STRIPS

1 $\frac{3}{16}$ sq. x 18"
2 $\frac{1}{8}$ sq. x 18"
6 $\frac{1}{16}$ sq. x 18"
2 $\frac{1}{16} \times \frac{3}{16} \times 18$ "
4 $\frac{1}{16} \times \frac{1}{8} \times 18$ "

1 $\frac{1}{2}$ " sq. .005 sheet aluminum
3 cleaned film negatives
1 oz. cement
1 oz. silver dope
1 oz. banana liquid
4" #12 music wire
6" soft wire
66" $\frac{1}{8}$ " flat rubber
1 pr. $\frac{1}{8}$ " wheels

TAIL SURFACES

The stabilizer halves are built up in the same manner as the wing frames. The fin and rudder assembly, however, is different. The leading edges of the fin and rudder are $\frac{1}{64}$ " sheet and can be assembled by holding in the hands, unless the scrap balsa clamps referred to last month are used. The lightweight tail assembly eliminates the use of weight in the nose.

LANDING GEAR AND STRUTS

Cut the $\frac{3}{8}$ " cores out large enough for the wheels and cement $\frac{1}{8}$ " sheet sides to them. Then cement $\frac{3}{16} \times 1$ " streamline struts to them to match the angle on the front-view drawing. After the cement is thoroughly dry, carve and sand to the required streamline shape, then cement to the fuselage where the $\frac{1}{4}$ " square supports are, with reference to the drawings. Push pins through from the inside of the fuselage into the l. g. struts as permanent parts. Cover the "light" hollows with celluloid.

THE SPEEDSTER

(Continued from page 56)

check this center-section width to make sure it has not been changed by adding the dihedral to the wing.

TAIL SURFACES

The slight variation in area between

the half elevator and the rudder is shown by the dotted lines on the drawing. The construction is identical and the same size ribs are used. When putting the $\frac{1}{16} \times \frac{1}{16}$ " bamboo outline on the tail sur-

faces, pin the balsa framework to a flat surface. This precaution is worthwhile throughout the entire construction, since it is necessary to keep the tail surfaces free from warps. And this is especially difficult when it is necessary to keep the construction light in weight. Diagonal bracing is added to further strengthen the surfaces. The rudder is cemented to the top of the fuselage and the elevator is inserted through the fuselage in the slot which has been provided by the balsa elevator slots.

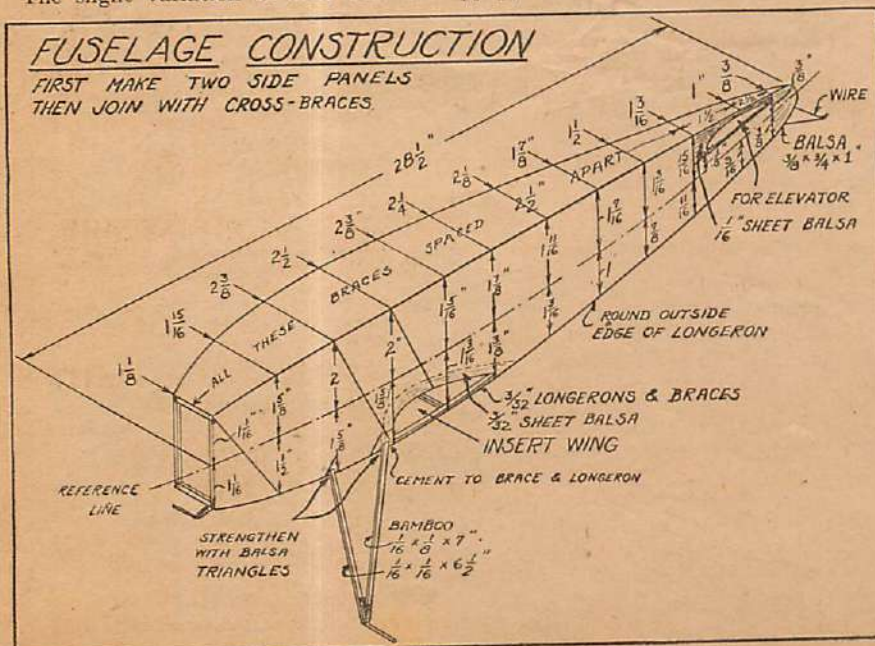
PROPELLER

Select medium balsa for the propeller. This is advisable if you're a beginner and still troubled by propeller carving. Don't bother to thin out the blades. Make them at least $\frac{1}{8}$ " at the tips and taper to about $\frac{1}{4}$ " at the hub. This decreases the efficiency to a slight extent, but it makes the propeller considerably more durable, not to mention less work in carving.

The free-wheeling catch is a piece of wire bent at right angle and inserted into the propeller. The propeller shaft slips under this wire prong and turns the

FUSELAGE CONSTRUCTION

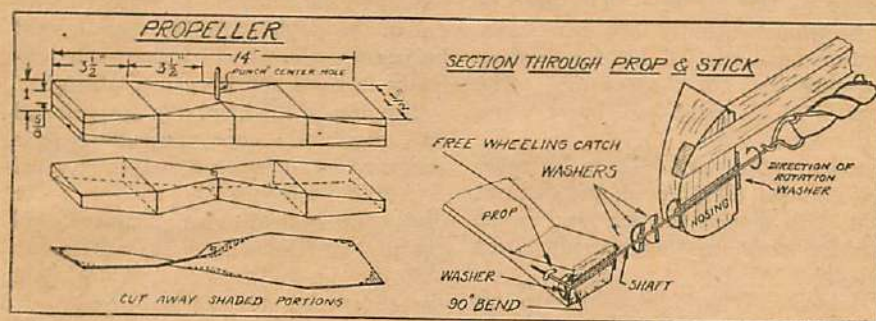
FIRST MAKE TWO SIDE PANELS
THEN JOIN WITH CROSS-BRACES



propeller. But when the rubber is unwound, the propeller revolves free of the shaft—the wire prong slipping under the shaft as the propeller turns.

COVERING

Cover all the parts of the model before assembling. The grain of the tissue runs lengthwise. The tissue shows considerably more strength and is less likely to rip—especially over the top of the wing. Apply thoroughly at least one coat of banana oil to the framework before applying the tissue. Not only does this make covering easier, but waterproofs the balsa against the water which is later sprayed on the tissue to shrink it. Keep the wing and tail surfaces on a flat surface while covering them, and be sure to pin them to the surface to prevent warping after dopping.



FLYING

Shorten the length of the motor stick until the model balances at the spar of the wing. The slot for the wing in the fuselage is large enough to permit changing the incidence. This can be done by merely inserting small blocks of balsa between the wing and the fuselage. A good setting of the wing is to have the flat undersurface parallel to the line of the rubber motor. All adjustments for flying should be made by raising or lowering the elevator. Once your model is adjusted for a good glide there should be no further trouble in getting a good flight.

The model requires no negative thrust to keep it from stalling under full power. As is typical of most low-wing models, it showed excellent power-on, power-off characteristics. That is, the flight was steady and smooth, whether climbing or gliding. The center of resistance and center of gravity both fall near the thrust line, giving the model this desirable characteristic. And this is a quality that few high-wing models are able to claim.

The model was not intended as a duration ship, but rather as a sport model. It is an interesting little ship

that proves to be a pleasant departure from the more conventional types of models. The low-pitch propeller spins rapidly throughout the flight, giving it a nice climb. 14 strands of $\frac{1}{8}$ " rubber are used to turn it. The climb ties in nicely with a good glide, to give a pleasing flight only low wings can provide.

WEIGHTS

Wing43 ounces
Propeller, stick and rubber. 1.50 "	
Fuselage complete with landing gear and rudder. .70 "	
Elevator15 "

Total, ready to fly... 2.78 ounces

MATERIAL

(balsa unless otherwise stated)

Wing

$\frac{1}{32}$ " medium grade for ribs

$\frac{3}{32} \times \frac{1}{4} \times 28$ " for trailing edge
 $\frac{3}{32} \times \frac{3}{32} \times 33$ " for leading edge
 2 pcs. $\frac{1}{16} \times \frac{1}{8} \times 35\frac{1}{2}$ " for spars
 Bamboo for tips

Tail Surfaces

$\frac{1}{32}$ " medium grade for ribs
 3 pcs. $\frac{1}{16} \times \frac{3}{32} \times 15$ " for spars
 2 pcs. $\frac{1}{16} \times \frac{1}{8} \times 12$ " for auxiliary braces
 $\frac{1}{16} \times \frac{1}{16}$ " bamboo for outline

Fuselage

10 pcs. $\frac{3}{32} \times \frac{3}{32} \times 28\frac{1}{2}$ " for longerons and bracing
 $\frac{3}{32}$ " sheet balsa for wing and elevator slots

1 scrap block of balsa for rear tip
 Bamboo for landing gear
 Medium wire for axles and tail skid
 1 pr. $1\frac{3}{4}$ " wheels
 $\frac{3}{8} \times \frac{3}{8} \times 24$ " hard-grade motor stick
 1 nose block $1\frac{1}{8} \times 1 \times 2\frac{1}{8}$ "

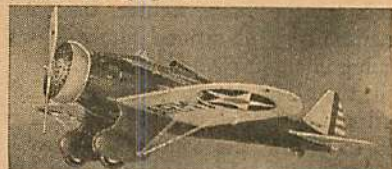
Propeller and Additional Items

$1\frac{1}{2} \times 1 \times 14$ " medium-grade block
 28 feet of $\frac{1}{8}$ " flat rubber
 6 washers, medium wire for shaft and rear hook
 Cement, dope, banana oil and tissue.

—G. S. L.

Build your next Model 100% SuperDetail

Build better models—don't waste your time and money on kits that cannot be built into finished models. Pick your next model from these beautiful, "Super Detail" Guaranteed Flying Planes, all in exact scale with cockpit operated controls, designed by flying men. Invest your money in one of these models and you'll get full value in pleasure and flying thrills:—



BOEING P-26-A Wingspan 21 1/4 in. Length 13 in., weight 2 1/2 oz., Scale 3/4 in.; beautifully colored olive drab and yellow. Complete Kit.....\$1.75

CURTIS GOSHAWK—Wingspan 23 1/2 in., length 16 1/2 in., weight 3 1/2 oz., exact 3/4 in. scale. Coated with new IDEAL high lustre finish, with silver, yellow, red, and black coloring. Kit complete, postpaid.....\$2.00

RYAN ST—Wingspan 22 1/4 in., Length 16 1/2 in., Weight 2 1/2 oz., Scale 3/4 in.; with dual control system operated in either cockpit; adjustable wing flaps, and plans for making an engine with 4 cylinders, carburetor, spark plugs, etc. Complete Kit.....\$1.50

STINSON RELIANT—Wingspan 32 5/16 in., Length 21 1/4 in., Weight 3 1/2 oz., Scale 3/4 in. Complete Kit.....\$2.50

MARTIN BOMBER—Wingspan 35 in., Length 22 1/2 in., Weight 4 1/2 oz., Scale exact. Complete Kit.....\$3.50

Kits Postpaid East of Denver
 West of Denver, 25c extra for Postage

Build 24 in. Model Ships



Clipper Ships and SOVEREIGN of the SEAS

Construction Kits contain Carved Wood Hulls; Printed Balsa Decks; Lifeboats, Anchors, Rits, Wheel (all Cast Metal) Chains, Masts, Spars, Rigging, Cement, Colored Lacquer, Full Size Plans and Instructions—Your choice of either Model, Complete Kit.....\$2 Plus 15c Postage

Send for Catalog Model Ships, Fittings, Materials—10c
 IDEAL AEROPLANE & SUPPLY COMPANY, Inc.
 28 West 19th Street : New York, N. Y.

ONLY BENJAMIN HAS THE GENUINE SAFE COMPRESSED AIR PISTOL

For Target & Small Game—Economic—Accurate—Practical—Adjustable Force—Amazing Maximum Velocity—Safe—Single Shot with Bolt Action—Hammer Fire—Hair Trigger—Safety—cal. 177 or 22 or BB Price \$7.50. Holster \$1.75. Also 177 and 22 Single Shot Air Rifles \$7.50. Single Shot BB Air Rifle \$6.00—35 Shot BB Repeater Air Rifle \$7.50—at Dealer or Direct—No license required—SAFE. The Only Genuine Compressed Air Pistols & Rifles on the Market. Full Details—Targets—Free—Write Today for Introductory Offer.

BENJAMIN AIR RIFLE CO., 641 N. B'way, St. Louis, Mo., U.S.A.

Imported CORONATION AND WORLD WAR SOUVENIRS

Glasses, plaques, scarfs, handkerchiefs, spoons, etc. King Edward VIII farewell (actual voice) "Woman I Love" message phonograph record \$2.00 postpaid.

List for 3c stamp on request
 MARVIN A. NORTHROP AEROPLANE CO.
 Minneapolis, Minnesota

LOCKHEED P23A NAVY FIGHTER

Send 5c coin for illustrated catalog showing other models, gas motors, etc.

32" Span; Length, 22"; Weight, 3 1/2 oz. This is a combination land and seaplane set. Set contains all parts printed on balsa, silver paint, glue, turned 3 1/2" motor front, large scale drawing and all parts. Set, Postpaid, \$2.95.

MINIATURE AIRCRAFT CO.

83 Low Terrace, New Brighton, New York

UNDER THE MIDNIGHT SUN

(Continued from page 18)

"Say," he said, "I could take it out with my legs and hands tied. I—"

"All right!" Bill said. "Wrap it around you!"

Sandy was on his feet in an instant, his freckled face glowing with anticipation. In another minute he was in the cockpit of the little fighter that had been literally built around him and was fastening his safety belt.

Bill throttled his engines as Sandy waved a hand at him and signaled to Miles to throw the switch that would bring the powerful suspension gear into play.

As Miles threw the switch, the floor of the transport divided into two segments and swung downward. Then, the telescoping crane supporting the tiny fighter moved slowly downward and the Eaglet slid through the opening in the fuselage.

When the little plane was about twenty-five feet below the undercarriage of the carrier Sandy turned a crank that operated a high-speed worm manipulating the folding wings. There was a metallic click as the locking lugs turned; then the wings began to turn on their hinges. Another click and the gull-type wings were locked in flying position.

Bill's hand was wrapped around the control wheel of the heavy transport like a steel band. His forehead and body were covered with cold, clammy perspiration. He wondered for a moment why he had ordered the kid out for a night test. The thought that something might go wrong made him a little sick. He held the ship steady while he waited for the first blast of Sandy's engine. As the roar of the powerful eight hundred and thirty horse-power twin Wasps joined the crescendo of the two supercharged Diesels of the transport, a smile flitted on his lips. His tanned face wrinkled with pleasurable pride. Nothing, he thought, will happen to the kid.

"He's got what it takes," he said aloud.

While Sandy warmed up his engine he tested the controls. When he flicked his hand above his head, Miles pulled the release lever. The Eaglet dropped away into the night in a steep glide, leaving the transport far behind. The fighting single-seater left the carrier with scarcely a tremor to indicate its leaving.

Bill exhaled his breath explosively and flipped the key on his short-wave radio panel.

"Nice work, kid," he said. "Circle back and get on my tail. Let me know when you are ready to come in. Test your landing lights."

"O. K., Bill," came back Sandy's voice. Two quarter million-candle-power landing lights cut the darkness ahead of

the flying hangar as Sandy threw a switch. Bill watched him as he flashed vertically upward, rolled to the right and came dashing back beneath him.

Lifting a Verry pistol from its polished clamp Bill fired a signal out of the port. Miles threw a switch that directed the powerful rays of a searchlight on the wire hook that jetted down from the belly of the transport.

"Careful," Bill said into his microphone.

"Coming in," Sandy said.

Bill braced himself to hold the big ship on an even keel. After what seemed an eternity he twisted around in his seat and glanced down through the opening in the fuselage. The nose of the Eaglet came slowly into view. Perspiration again dotted his forehead as he swung back to the controls. The knuckles of his right hand were white on the wheel.

Suddenly, the ruby light on his radio panel gleamed, disappeared, and gleamed again. He flipped the key and heard Tony Lamport chanting his call letters excitedly.

"Hold it, Tony," he said into his microphone. "Sandy's just coming in for a landing. In—"

"It won't keep, Bill!" Tony sputtered. "A man just staggered into the administration building, Bill. He wants to see you before he dies. He says he has a message from Nels Larsen, Bill. He doesn't have long to live!"

"Tell him I'll be down there in a few minutes!" Bill rapped into his microphone. "Sandy, did you hear Tony's message?"

"I heard it, Bill," Sandy said, breathlessly. "Who is it?"

"Never mind that," Bill snapped. "Hook on, fast. We've got to get down."

"O. K. I'm coming in now," Sandy answered.

The big transport shook from stem to stern and the two power plants whined in protest as Sandy hooked the Eaglet

onto the trapeze. Bill held the ship steady with hands in which the muscles bulged.

The long latticelike trapeze that was the lifting crane began a slow, ponderous movement. As the Eaglet began to move upward Sandy folded back the wings and locked them. The braced metal hook built into the middle section of the Eaglet's upper wing came into view. Metal clamps fastened on the sides of the little fighter to hold it rigidly steady as it settled in place in the fuselage. The under sections of the fuselage slid back into place, blotting out the night.

"Hold everything!" Bill shouted into the intercockpit phone, as Sandy climbed out of the Eaglet. At the same instant he jammed the wheel of the carrier violently forward and opened his throttles.

The nose of the huge ship dropped and its powerful, supercharged engines screamed as the wing structure strained under the force of the sudden power dive. Bill's eyes were narrowed and gleaming as his thoughts rushed back to that day he had last seen that gallant descendant of the ancient Norsemen, Nels Larsen.

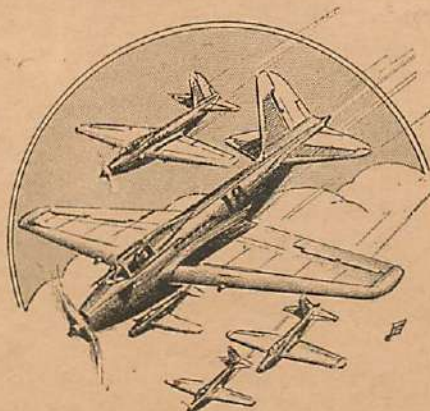
It had been two years since Nels had come to say good-by to him. And every time during those two years that Bill had thought of Nels Larsen he had worried. He had worried because of the strained, fearful expression in Larsen's eyes and the cryptic words with which he had made his farewell.

Bill knew that there was not a better technician or pilot in the world than Nels Larsen. He had been one of the first pilots to fly the Atlantic. He had flown across the frozen wastes of the arctic and the antarctic on two expeditions. He had done things that few other men had been able to do.

That was why Bill had wondered at his reluctance to accept the great opportunity offered to him by his native land, Finmark. When it had come he had gone to Bill for advice and counsel.

"I should think you would jump at the chance to develop the airways of Finmark," Bill had said to him. "It's virgin territory, really—no competition, the government behind you, almost unlimited capital."

"It's a great opportunity," Larsen had said; but his steel-gray eyes were troubled. "It's a great honor, too. But there are things and conditions there you wouldn't understand, Bill. It is a land of contrasts. It is mountainous; yet the whole country is adjacent to the sea. There is an almost continuous zero ceiling. They need air transport because of the geographical handicaps of the country. Yet the man who tries to



A squadron of mysterious green fighters came hurtling down—down—

develop her air lines may be biting off more than he can chew. A series of disasters would ruin him. I don't know whether air transport would be practicable."

"It's the chance of a lifetime," Bill said, firmly.

A month later Nels Larsen had come to say good-bye to Bill. Bill could see that he was happy and yet he was troubled by some vague uneasiness that made him jumpy and nervous.

"You're still only half sold on the idea," Bill accused. "That's no way to take on a new job."

"Strange things happen up there under the midnight sun, Bill," Larsen had said. "Strange things that go away back a thousand years to the days of the vikings."

"Nonsense, or 'nuts' as young Sandy would say!" Bill exploded. "You talk as though you were afraid of spooks, Nels. If you see any let me know. I've always wanted to meet a spook personally."

"I'll let you know, Bill," Larsen said, and he wasn't smiling. "If I ever need you, Bill, will you come?"

"I'll be there in my Sunday pants," Bill had said, laughing.

Then they had grasped one another's hands.

"If I send for you it will mean I really need you, Bill," Nels said. "Good-bye." "I'll come, Nels," Bill answered. "Happy landings, fella!"

Since that time Bill had had only one cryptic note from Larsen. It had mentioned the progress he had made. But between the lines Bill could read other things. He could feel the vague uneasiness that had hovered over Larsen while he wrote the letter.

"If I send for you it will mean I really need you, Bill," rang in Bill's ears as he eased the plummeting carrier transport out of its dive.

He checked the illuminated wind sock as he banked over the field and the cluster of hangars and buildings swung dizzily under the port wing.

The enormous wheels of the big ship kissed the runway and sped toward the apron. He killed his engines as he threw on his wheel brakes and jumped for the steps. Miles was holding the large door in the port side open. Bill ran out on the concrete and across the apron, with Sandy at his heels.

Bill took the steps three at a time as the door opened. "Shorty" Hassfurth, Bill's chief of staff, stood there. His usually good-natured face was twisted now. He waved a hand behind him.

"You'll have to hurry, Bill," Shorty said. "He's in your office and he won't talk to any one but you. He's dying."

Bill dived past him and ran down the corridor. The door of his office was open. On the floor, lying on a coat, was a man whose face was a mask of

agonized yellow. Dr. Humphreys, the field doctor, was bending over him. In his hand was a hypodermic needle he had just emptied into the man's arm. Around him were clustered all of Bill's fliers: Bev Bates, Cy Hawkins, Mort Henderson, Tony Lampert and "Red" Gleason. They knew they were watching a man die in one of the most painful ways a man can die.

"Three slugs through the stomach," Doc Humphreys said to Bill. "He's bleeding internally and going fast. I doubt if he can talk to you."

"I'm Barnes," Bill said, as he dropped on one knee.

The man's twisted face became still and his eyes opened. In them was the suffering of all the world. He stared at Bill for a moment and then he nodded his head.

"Nels needs you," he said, slowly and painfully. "There is a note for you in a belt around my waist."

"I have the belt, Bill," Doc Humphreys said.

A ghost of a smile flitted across the lean Scandinavian face of the man on the floor. He made a motion with his hand as blood poured out of his mouth. It was an indication that he was satisfied. He had accomplished his mission. And then, he died.

IV—A MESSAGE

BILL BARNES' eyes were soft with compassion as he watched that lone figure gasp and then grow still. He touched one of the inert hands, then rose to his feet and scanned the faces of his men. They were hard-bitten and tense as only they could be hard when they knew a brave man had died because of his bravery.

"Murder!" Shorty Hassfurth said, and his voice was like the clang of steel.

"How did he get here?" Bill asked.

"He came from nowhere," Tony Lampert said.

"How?" Bill snapped.

"I thought I told you," Tony answered. "He was piloting a Whirlwind-powered biplane. He made no contact before he landed. He was in before we knew he was coming. The electric eye in the traffic tower picked him up, but we didn't know he was going to land. His plane was a sieve. Some one got him on his way here."

"He got here with those slugs in his stomach, Bill," Red Gleason said softly.

"There were no planes following him?" Bill asked.

"None," Tony said.

"Did he tell you anything?"

"He couldn't talk," Tony said. "He gasped that he had a message for you, said he would know you if he saw you and wouldn't talk, or couldn't, to any one else. He still had enough guts to know what he was doing."



Fly this PUSS MOTH

"A Prize Winner in Every Contest Entered"

Wing Span: 26 in. Weight: 1 1/2 oz. Distance: 1500 feet. A perfect Model of the famous British Trans-Oceanic Flyer. Gives amazing performance and holds its own with any model in its class. Kit complete with accurate, detailed plans, all parts clearly stamped; and includes 8" finished propeller, improved semi-finished cowling block and our new Ball Bearing Prop. Flange that increased flying speed 50 percent. Formerly \$1.50, now only.....

\$1.00
Postpaid

32" Endurance Model with 12" finished Prop., equipped with the new Ball Bearing Prop. Shaft that steps up endurance time one-third.....

\$1.00
Postpaid

24" Cabin Model with V-shaped sheet balsa monocoque fuselage and finished propeller.....

50c
Postpaid

Beautiful Racing Stick Model. Can be built in 2 hours. Kit contains plenty of materials, plus finished propeller.....

50c
Postpaid

CRESCENT MODEL AIRCRAFT

Dept. 10 8642 - 18th Avenue, Brooklyn, N. Y.

AVIATION

APPRENTICES

Ambitious, air-minded young men, interested in entering the well paid field of Aviation, write immediately, enclosing stamp, to

Mechanix Universal Aviation Service

Incorporated

Strathmore Station Dept. T Detroit, Mich.

SCROLL SAW

This Balsa wood cutting saw will make your models neater, finishing them in one-half the time. Finest detail work easily done. Cuts out parts all at once, without the use of dangerous razors or knives. Runs easily by hand or small motor. Safe, efficient, easy to use. Do better work with a Craftsman's Scroll Saw.

Electric Model \$2.00
Complete with Motor
CRAFTSMEN, INC.
Dept. AT1
4303 Cottage Grove Ave.,
Chicago, Ill.
Hand Model \$1.00
Complete

COLT

45 CAL. Frontier Model

Basswood construction kit with working plans and all necessary hardware. Barrel and cylinder are machined.

COLT 45 Cal. "FRONTIER" model kit.....

5 1/2" barrel.....

COLT 45 Cal. "FRONTIER" model kit, 7" barrel.....

COLT 45 Automatic Pistol Kit.....

COLT 25 Cal. automatic pistol kit.....

THOMPSON SUB MACHINE GUN model kit.....

Savage Cal. 32 automatic pistol kit.....

LUIGER 9 M/M auto. pistol kit w/6" barrel.....

LUIGER 9 M/M auto. pistol kit w/6" barrel.....

All kits make beautiful full scale models. Postpaid in U. S. A.

GUN MODEL CO., Dept. W26, 2908 N. Nordica Ave., Chicago, Ill.

AVIATION

NEWSPAPER

"CONTACT"—TWICE MONTHLY

SEND ONE DOLLAR FOR ONE YEAR

(3c COIN FOR SAMPLE COPY)

156 SPRINGFIELD AVE., RUTHERFORD, N. J.

DIESEL

ENGINE MANUAL

JUST PUBLISHED "Audels Diesel Engine Manual"

It's a new, practical, concise treatise with questions and answers on the theory, practical operation, and maintenance of modern Diesel engines—

300 pages—fully illustrated—easy to understand.

A compact handy book that will answer your Diesel questions—save fuel and operating trouble.

—Price \$2, postpaid to any address. —Money back if not satisfied. —Send for free Diesel folder today.

THEO. AUDEL & CO., 49 W. 23rd St., New York

Please mail a copy AUDELS DIESEL ENGINE MANUAL.

\$2. If satisfactory I will remit \$2 on its safe arrival, otherwise I will return the book.

Name.....

Address.....

Occupation.....

"Notify the police," Bill said. "Shorty, you handle things. Where is that belt, doc?"

Dr. Humphreys reached behind him and took a blood-soaked money belt from off a chair. "It's pretty messy," he said.

"I can stand that," said Bill, and his eyes were two blue-white pieces of ice. "I'll want to see all of you in my rooms in about half an hour. Tony, see if you can get Nels Larsen on the radio telephone at Solo, Finmark. He is technical director of the Finmark Airlines. They have another name, but I can't remember it. If you can make contact with the Sikorsky plant in Bridgeport at this time of night they may be able to help you. He is using some of their planes. Let me know. All hands in my rooms in thirty minutes."

Bill turned abruptly and started toward the door. But before he reached it he stopped. "Tell the operators to be sure to 'scramble' the radio waves on that call, Tony, so that no one can listen in on the conversation."

Bill crossed the distance from the administration building to his living bungalow with long, impatient strides. Inside his living room he pulled the shades, locked the door and opened the fastened clasp of the bloodstained belt. Inside the one large pocket was a sealed envelope. He ripped it open and extracted two sheets of paper covered with typing. Nels Larsen's signature was attached to the second page. Bill, nervously, tried the door and glanced at the curtains again. He knew that he was probably taking silly precautions, but he remembered other times when he hadn't bothered to take precautions and had nearly paid for his carelessness with his life.

He spread the letter out on his desk and read:

DEAR BILL: The time has come for you to put on those Sunday pants you spoke about. To say I am worried is putting it too mildly. I am becoming frantic with anxiety. I don't think any of the things that have happened over here have reached the rest of the world. Even our own people know very little about them. We have tried to keep things quiet, fearing the people would lose what confidence they have gained in us.

You don't know these people who live along the fiords of the north Atlantic as I do, or you would understand their superstitions more readily. Lots of them still believe when they see a bright rainbow that it is the bridge over which the gods ride to their home, Asgard. Thunder to them means Thor the Strongest, rattling past in his cart or banging his great hammer. An airplane that roars above their heads is something

they have not learned to understand. They associate it with their other gods that ride the skies.

Remember that the forbearers of these people were the wild raiders of everything around them in the old days. They believed that the only honorable death was a violent one. Much of this has come down to them. If they do not believe in a thing they eradicate it.

I am constantly receiving mysterious setbacks in my attempts to develop the air lines. The destruction of beacons and lighthouses resulted in the loss of a plane and its crew. Two more ships that fly what we call the Midnight Sun Route disappeared entirely. We have found no trace of them. There has been sabotage, and I have received warnings.

The worst of them came just the other day. You will recall that when the old viking leaders died their bodies were placed in one of their high-prowed boats with full sail set and a fire lighted. As it drifted out to sea it became the funeral pyre of the leader. As the boat burned the leader made his entrance in Valhalla, the land of the gods.

Just a few days ago, when I was at one of our airports on a northern fiord, such a boat, in miniature, came drifting toward the port. Laid out on the deck was my body in effigy.

The thing has me down, Bill. I can't disregard that warning. Yet I won't quit. The qualities of daring and steadfastness that came down through the centuries from my viking ancestors will not let me quit in the face of danger. But I know the men who are working against me have those same qualities. They will not stop until they have gained what they are after. And I have no way of fighting them. I don't know who they are or what motivates them.

That's why I am asking you to come to my aid, Bill. You have tackled things like this before. And you have won. I'm afraid I'll go crazy if I don't get your help, Bill. The strain and responsibility is too much for me.

I am sending this letter to you by a special messenger because I am afraid to trust any other means of communication. That should convey to you how desperate I am. The bearer, Gustavus Sweyn, can be trusted. He is going to the States to buy equipment for me. If you can help him in any way, I will appreciate it.

It is hard to tell you what I am trying to say without becoming hysterical about it. That, as you know, is against my nature. I told you

when I said good-by to you that if I sent for you I would really need you. I need you now, Bill.

Sincerely, NELS LARSEN

Bill read the letter through twice. And just as he had been able to read between the lines of Larsen's previous letter, he could read between the lines of this one. Something of Larsen's feelings when he wrote the letter crept under Bill's skin and gave him an uneasy feeling of fear that was akin to panic. He understood how Larsen felt. Knowing Larsen as he did, he knew that Larsen would never "take down his hair" and let himself go long enough to tell how he really felt. But Bill knew he was afraid of some intangible thing, something that was like a fantastically shaped bit of low-hanging fog encountered in a graveyard at night.

Bill paced back and forth across the room for ten minutes while he made his decision. He knew that Nels Larsen was not the kind of man to ask for help if he didn't need it. Planes had disappeared in almost every other country in the world. There was nothing so strange about that. Yet the funeral pyre with Larsen's effigy lying on it was something else. It was enough to make any man hysterical.

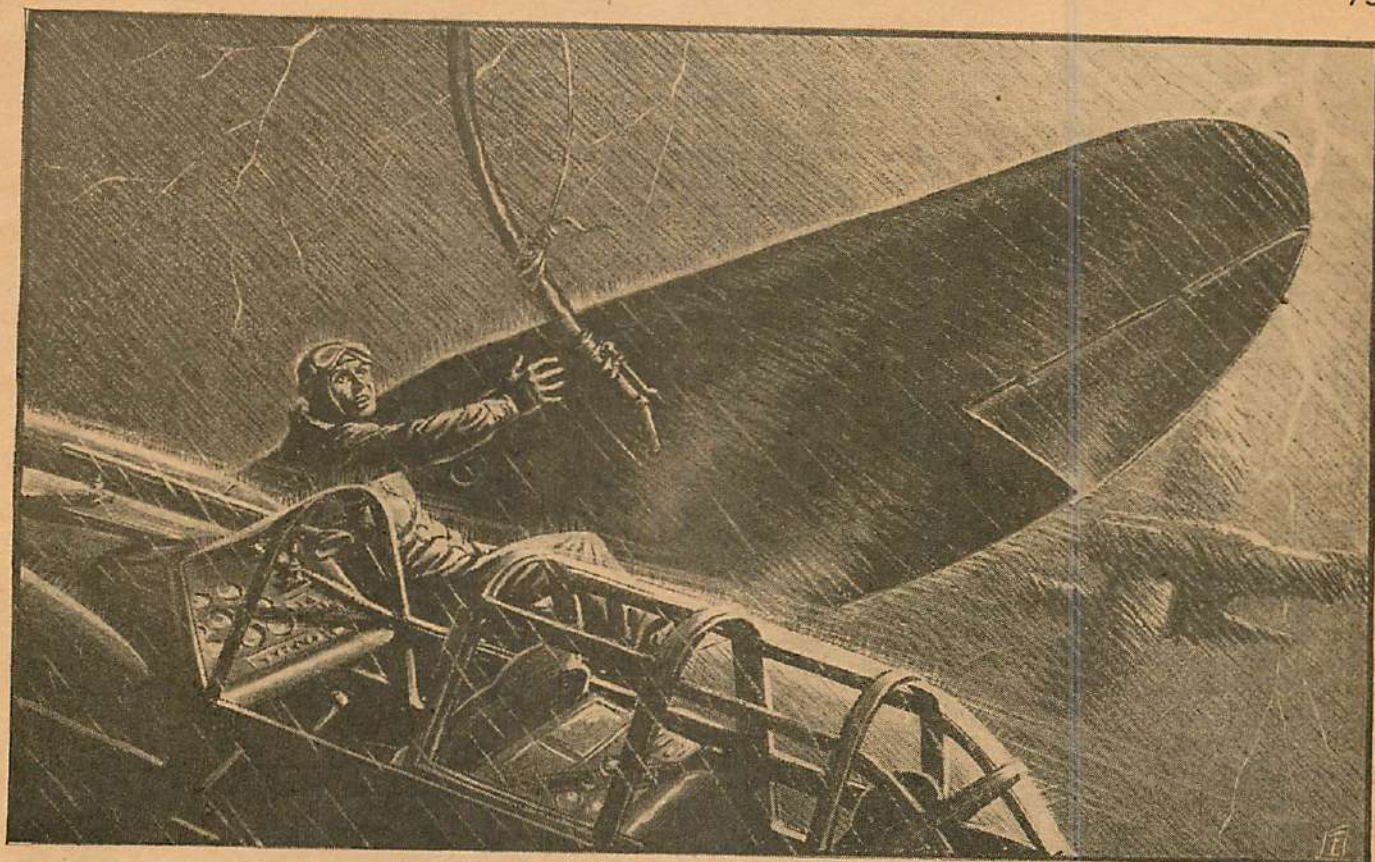
When Bill came to a decision he acted. He picked up a telephone on his desk and asked the operator for Scotty MacCloskey.

"Hello, Scotty," he said. "Check four Snorters, the Lancer, and the carrier transport—equipment, fuel and ammunition. Have 'em ready for a hop across the Atlantic at dawn. Tell Red, Bev, Cy and Mort Henderson to check their own Snorters when you get through. Shorty will fly the Lancer. Sandy and I will handle the transport. Full crew on the transport. And tell 'em all to come to my rooms now. Get it?"

"I got it, boy," Scotty said. "They'll be ready. Do you want me to come over there?"

"Yes," Bill said, and hung up.

A few minutes later Bill's eyes roved over the little sea of faces before him with pleasurable pride. These, he thought, are as fine a collection of men as were ever banded together: Beverly Bates, the brown-eyed, soft-spoken Bostonian with the Harvard accent and the heart of a lion; Shorty Hassfurther, the blue-eyed, broad-faced Pennsylvania Dutchman who had been fighting and flying since he was a kid of nineteen during the World War; Red Gleason, the carrot-thatched veteran who had fought side by side with Shorty through those terrible days in France; Cy Hawkins, the leathery-faced, drawling Texan who looked half asleep at all times but could move with the speed of a striking rattler; Mort Henderson, the mining engineer who could not find enough ex-



He saw Red lying flat on the wing—the rain and wind lashing at him.

citement below the ground, so chose to find it above the ground; young Sandy, the kid of seventeen who had become a veteran in those few years since Bill had taken him under his wing. These were men.

Bill laid the facts before them in as few words as possible. When he had finished he said, "Any one have any suggestions or objections?"

There was a silence for a matter of thirty seconds. Then the sleepy-eyed Cy Hawkins got to his feet and stretched his hands above his head. "I'm going to bed," he said, while he yawned.

"Don't you think we ought to make this trip, Cy?" Bill asked anxiously.

"Hell, yes!" Cy said. "But I want to get some sleep. It's only about five hours until dawn. I don't want to arrive in Finmark with bloodshot eyes!"

"I'll be glad to see old Nels Larsen again," Shorty said. "That guy's a gimper."

"Nobody has any objections then?" Bill asked.

"You ought to learn to get over being surprised when we all agree to follow where you lead," Red Gleason laughed. "See you with the early birds."

They all followed him out of Bill's living room. To-morrow was just another day to them. Starting for Finmark at dawn across the Atlantic Ocean was just another day's work.

V—THE START

AN HOUR before dawn the next morning Barnes Field became a bedlam

of feverish activity. Bill Barnes was like a man with six arms and legs during that hour, lashing men to greater efforts.

At five o'clock the sixteen-foot props of the big carrier transport gleamed dully as a mechanic blasted the three thousand horses in the two Diesels.

The props of four black-and-red-and-yellow Snorters and the twin props of the famous Silver Lancer were ticking over slowly on the apron beside the transport. The goggled, white-helmeted heads of Bill's men jutted above the rim of the fast amphibians. They were waiting impatiently for Bill to check the crew of the carrier and signal the dispatch tower.

Bill climbed into the commander's seat of the transport with Sandy just behind him. He flicked the intercockpit telephone switch and checked Martin, the bomber and machine gunner in the forward cockpit; McCoy and Neely in the cockpits abaft the engines; Miles, who rode down under the belly of the ship in the retractable gun pit when they went into action; and old Charlie, the cook, who operated the gun in the tail.

As Bill finished speaking to each of them, Tony Lamport came running up the steps to the bridge. "No luck, Bill," he said. "I've been trying for five hours to get through to Larsen, but I can't get him. They can't seem to locate him."

"Keep trying, Tony," Bill said sharply. "Tell him, if you do get him, that we're on the way. But be careful how you say it. That man Sweyn was

shot in the air last night. We don't want any one trying the same thing with us. We want to get to Finmark in one piece."

"O. K., Bill," Tony said. "Any other instructions?"

"No," Bill said. "I'll keep in contact with you by radio. We're going to shove now. I—"

Bill never finished that sentence, because just at that instant two twin-motored, cantilever monoplanes came roaring out of a solid mass of cumulus clouds three thousand feet above Barnes Field. Bill could tell by the angle of their dive and the bulge in their bomb bays that they carried trouble.

He had seen too many enemy ships come roaring out of the heavens, with the destruction of Barnes Field in mind, to think that these two were loaded with garlands of flowers. His ice-blue eyes narrowed as he released the wheel brakes of the transport and threw his radio key at the same time.

"Shorty," he screamed. "Get into the air. Give 'em hell!"

He blasted the two powerful Diesels in the transport as the first fifty-pound bomb came looping out of the belly of one of the diving monoplanes.

At the same instant, Red Gleason's Snorter started a frantic scramble around into the wind, followed by Shorty and Cy Hawkins. Bill saw the concrete fade away from beneath Red's wheels as he stuck the nose of his Snorter up in an almost vertical climb. He could feel the carrier rock and

tremble as the first bomb struck where the carrier had been only a few seconds before. Dirt, concrete and rocks rattled off the metal skin of the big ship as a cloud of dust enveloped its tail. Then the explosions came, faster and faster, like a salvo from a battery of five-inch rifles. As Bill eased the nose of the transport into the air he could feel it rock and knew that the port wing had nearly dipped into the ground as he got away.

"Stay low," Bill growled into his microphone. "Don't try to follow them into the clouds or you'll have a crash. It is a solid bank that may reach to thirty thousand. Be ready to come up under their tails if they come back out of the clouds. Is every one all right?"

All five of his men checked in.

"They're taking it on the lam, Bill," Shorty reported. "I lost 'em in the clouds. There is too much danger of a crash to try to follow them. I don't think they'll be back. I buried a hundred bullets in one of them before they got away from me."

"All right," Bill said. "Every one back for a landing. Look out for bomb craters. I want to see how much damage they did before we go."

"Gosh, Bill," Sandy said, "are you going on with those two bombers hanging around to blow the field apart?"

"I am," Bill said. "They aren't apt to bother the field again. They were after our ships before we started. The field will be safer if we get away from it."

"Who do you suppose they were?" Sandy asked.

"Your guess is as good as mine, kid," Bill said. "But it proves there is something to Larsen's story. Some one doesn't want us to help him—which makes me want to help him more than ever."

Bill threw the radio switch and chanted Tony Lamport's call letters into the mike. "Can we get in for a landing all right, Tony?" he asked.

"If you use the east-west runway," Tony said. "They dropped ten bombs, but they didn't do much damage except to the field and windows. They were aiming at your ships."

"O. K., Tony," Bill said.

Three minutes later he took the transport in and climbed down off the bridge to survey the damage the two bombers had done. His face was twisted into an angry scowl as his men gathered around him.

"Well," he snapped, "this won't hold us up. Get back to your ships. We've lost a half hour now. Scotty, you're in charge. You know what to do. Keep a couple of Snorters on the apron, ready to go. I don't think they'll be back. They are more apt to follow us. C'mon, men! Back to your ships. I'll give you

our formation and course when we get in the air."

As Bill went up the steps to the bridge of the carrier again he fell over two long, flat pieces of board that were lying on them. He caught his balance as he plunged forward and began to curse.

"Now, what in— What are those things?" he roared at Sandy.

"Gosh, Bill!" Sandy said, and his eyes were round. "They're just my skis."

"Skis!" Bill screamed. "Where do you think you're going—up to the Lake Placid Club? Where do you expect to find any snow for skiing in the summertime?"

"Or the wintertime, either," Sandy complained. "I wasn't able to use 'em all last winter because there wasn't any snow. I thought there might be some in Finmark."

"Stow 'em away and get those radiophones wrapped around your wooden head!" Bill roared. "There's no more snow in Finmark in the summertime than there is here."

Again Red Gleason's Snorter raced down the runway and into the air, followed by Henderson, Bev Bates, and Cy Hawkins. Then the three thousand horses in the nose of the Lancer snorted as Shorty Hassfurther flipped a hand into the air in farewell. The twin automatic-pitch propellers in the nose melted into the air and the big ship raced down the runway with breath-taking speed. As the runway faded away beneath it the retractable gear rose smoothly to disappear into the fuselage and the wings. The Silver Lancer joined the circling Snorters overhead as Bill slipped his boots into the rudder stirrups and gunned the supercharged power plants.

The six ships fell into a tight formation at ten thousand feet. Two Snorters were on each side of the transport and two thousand feet above, and in front of it, rode the Silver Lancer, with Shorty's hand wrapped around the control column.

As the little squadron sped above the tip of Long Island the red light on Bill's radio panel gleamed. He threw the key and heard Tony Lamport's voice chanting: "Calling B. B. . . . Calling B. B. . . . Calling B. B."

"O. K., Tony," Bill replied automatically. "B. B. answering. What is it? Go ahead."

"I just got through to Larsen, Bill," Tony said excitedly. "He's in a panic, Bill. He says things are crowding down on him so fast he can't handle them."

"What kind of things?"

"He didn't say. He was too nervous and excited to talk plainly. When I told him you were on the way he said 'Thank God!' and he sounded as though he meant it, Bill."

"O. K., Tony," Bill said.

"Are you going to refuel at Harbor

Grace?" Tony asked. "I'll make arrangements if you are."

"No," Bill said. His face was white and strained under its coat of tan now. "We've laid our noses on St. Johns. From there we'll fly the Great Circle across the tip of Ireland and land at Croydon, outside London. Make arrangements there."

"How soon will you make it, Bill?"

"Ten hours if we don't run into too many head winds. About ten o'clock to-night, their time," Bill said. "I'm signing off, Tony. Keep me informed."

"Signing off, Bill," Tony echoed.

VI—FIGHTING THE ELEMENTS

ADJUSTING his radiophone dials, Bill spoke to all his men while they plowed on and on through a never-ending bank of fog.

"Keep your speed at three hundred," he said to them. "We'll stay at ten thousand until after we leave St. Johns. We seem to have a pretty fair tail wind. It may become a cross wind beyond St. Johns. Keep your eyes open and take it easy."

As the tip of Cape Cod showed dimly below them the sun came shining out of the sea to the east to light the heavens. Bill turned off his running lights and spoke to Sandy.

"It's clearing," he said, "but I'm afraid we'll run into another fog bank off St. Johns."

"Yeah," Sandy said. "I can feel it in my bones. When it is going to cloud up my bones begin to ache."

"You and the old man of the mountains," Bill growled.

As St. Johns flashed beneath their wings fog came rolling in toward them again—fog that immersed them completely. Bill checked his instruments and took his bearings, then asked Tony to recheck his position for him.

A wrench and a twist slapped the big transport down three hundred feet. The starboard wing began to climb and the little bubble in the turn-and-bank indicator began to shimmy like a black boy on a Mississippi levee.

The radio howled and scratched like a symphony of alley cats, as Bill threw the switch to speak to his men. "Hold your positions as closely as you can," he shouted. "The barometer is falling. We're going to have some dirty weather. Keep in contact with me as long as you can."

Great drops of rain appeared through the licking fog and spattered against their windshields and overhead hatches. Ascending and descending currents of air carried them up and down like ocean liners riding a heavy sea.

Banks of angry black clouds raced at them and settled down around them. They could just see the tips of their wings as they plowed on and on through a day that was almost as dark as night.

Rain that clattered like machine-gun bullets on their windshields and overhead hatches lashed at them with renewed fury. As the wind increased it bobbed them about like bits of driftwood on an angry sea. Rain seeped down through the hatches and trickled across the decks and down their necks. They were all flying blind and their radios were nearly useless.

For five long, tedious, terrifying hours they fought a head wind that was made even heavier by the lashing of the rain. It was two o'clock in the afternoon, by the chronometer on Bill's instrument panel, when he managed to get through to his men clearly.

"We're not far from the coast of Ireland," he said. "We'd better nose down through the fog. I—"

"Bill! Bill!" Red Gleason's agonized voice cut in on him. "There is something wrong with the line from my starboard wing tank. It won't feed. I'm almost out of fuel. I've been trying to get through to you for an hour!"

"Can't you blow it out?" Bill asked. "It'll never do to try landing on the Atlantic in this kind of weather. We'd never get off again." He tried to keep his voice level and even, but all his men could feel the tenseness of it.

"I've tried everything, Bill," Red said. "I've got to do something fast. My engines are going to start missing in a few minutes."

"Just a minute, Red," Bill said, as calmly as he could. "Let me think." He gazed straight ahead with narrowed eyes.

Suddenly he spoke to the wide-eyed Sandy. "See how much fuel you have in the Eaglet, kid."

"She's full, Bill," Sandy said. "I checked her before we left."

"Good boy," Bill said softly. "You'll have to take her out, kid. You'll have enough petrol to take you to Croydon. Without the weight of the Eaglet I can give Red some fuel and still make Croydon myself."

"My gosh, Bill!" Sandy said. "You can't get any fuel into Red's tanks in this kind of weather. You don't have a chance. One of those air pockets will slap you down on top of him and you'll be fish food."

"Never mind that," Bill snapped. "You get back and wrap yourself in the Eaglet." He bit his lip as he gazed at Sandy with worried eyes for a moment. "Do you think you can manage the Eaglet, get it away and take it to Croydon in this weather, kid?"

"Manage it?" Sandy shouted above the roar of the motors. "Manage it? I—I—" he spluttered, indignantly.

"All right, kid," Bill grinned. "Get going!"

"O. K., Red," Bill said into his microphone. "Sandy is going to take out the Eaglet and fly it the rest of the way to Croydon. That will give me less weight

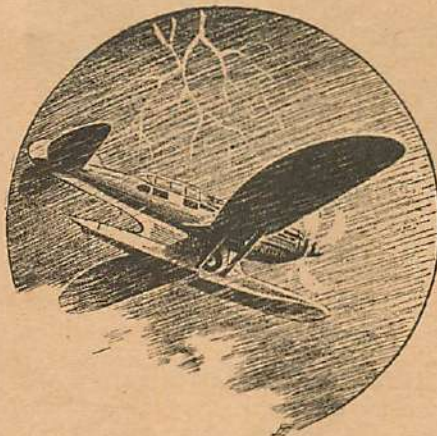
to carry and I'll give you the fuel I won't need. I'll make contact with you as soon as Sandy is away."

"Right, Bill," Red said. "I'll stand by."

Sandy yanked his helmet down over his forehead and stood up. To him the prospect of flying the Eaglet through that storm was not work. It was pure joy. The kind of joy that only a seventeen-year-old could get from flying a plane that had literally been built around him in the manner a tailor makes a suit of clothes.

"You'll have no overhead hatch to protect you from the storm, kid," Bill said. "You want to be sure your engine is warm. When you go off the hook both the Eaglet and yourself must be ready to take a beating."

"I can take it, Bill," Sandy said. "You'll have to," Bill said. He knew, because he had built it, that the Eaglet was a fast, powerful little fighter with a



High over the Atlantic the storm raged.

small wing surface but high lift that was tricky to handle in any kind of weather. But he also knew that Sandy and the Eaglet dovetailed perfectly. They spoke the same language. The Eaglet was a one-man horse and Sandy was the man who fitted the saddle.

He held the carrier as steady as he could while he watched Sandy climb into the cockpit of the little ship and flip a hand at Miles. He died a thousand deaths while he waited for the roar of the twin Wasps in the nose of the Eaglet. As it joined the duet sung by the two Diesels in the transport a trace of a smile flitted on his lips. He watched his chronometer, while Sandy warmed up his engine.

As Bill saw Miles reaching for the release lever a terrific upsurge of air caught the carrier, shot it upward. Bill fought desperately to hold the ship steady, but it was bucking like a range horse at a rodeo. Great beads of perspiration broke out on his face as he glanced back over his shoulder again. The release lever was down! Sandy had been shaken off or had taken off as that ascending current of air bounced the

carrier upward. He flicked the inter-cockpit telephone switch and shouted Miles' name in it.

"Did he get away all right?" he screamed.

Miles grinned and nodded his head. "He got away without a tremor, right at the top of our bounce," he said. "It was a pretty take-off."

"Sandy! Sandy!" Bill chanted into his mike.

"O. K., Bill," Sandy's voice came back to him. "I'm riding your tail. I'll hold it here until you have refueled Red's ship."

"Nice work, kid," Bill breathed, and spoke Red's name in the microphone. "All right, Red," he said. "Come down underneath me. Miles will feed out a coupling from our port-wing tank. You'll have to lock your controls and make the connection some way. I don't know how in hell you're going to do it. After you lock your controls I'll try to follow any deviation from course your ship might make. Work as fast as you can. It's getting darker every second."

"O. K., Bill," Red said. "I'm easing down under your belly now. Can you see my running lights?"

"Just," Bill said in a moment. "Miles is running out the connection now. Can you locate it?"

"Faintly," Red said. "I'm locking my controls. I'll be out on the port wing in a moment if I can get there. I've snapped on my landing lights now. Do they help?"

"Yes," Bill said. He looked down, and what he saw brought his heart up into his mouth. He saw Red lying flat on the wing stub, with the wind and rain lashing at him with all their fury, while he tried to grasp the dancing hose that dangled above him. Time and again as the bouncing Snorter bored on at two hundred miles an hour it seemed he must be swept off the gleaming wing.

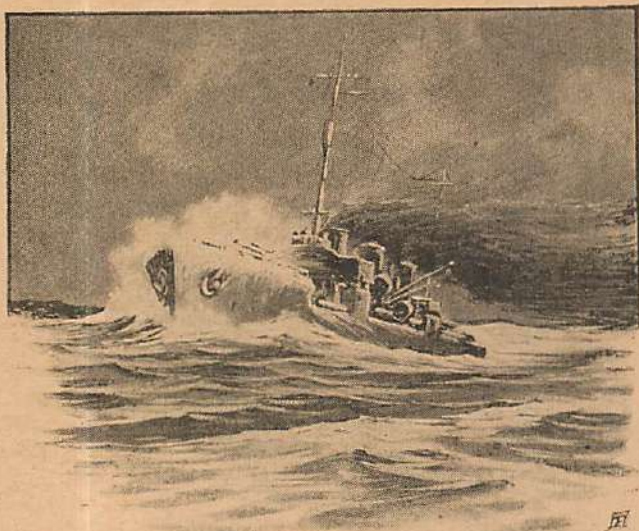
Then they saw him catch and insert the dangling hose into the open port to the tank in the wing stub. Bill Barnes fought his controls until his arms ached and it seemed his head would burst from the terrific concentration of the job. He was handling the big transport as though he was anticipating every strange whimsy of the storm, nosing it upward as the bouncing Snorter rose, gliding it easily down as a descending current of air slapped the Snorter down.

It was one of the greatest examples of daring and precision flying that any of Bill's men had ever seen. And although they could see only dimly they realized too well what the slightest slip would mean to the crew of the carrier and to Red Gleason.

"All right, Bill!" Red's voice came over the radiophone. "I've cast the hose clear. My engines are picking up again. We did it, fella!"

"Yes," Bill said, and his voice was

weak. "We did it. But I don't want to do it again. Hold your positions every one. Sandy, you stay on my tail. Try to check back every fifteen minutes." The high-pitched scraping of the static drowned out his own voice. He threw the switch as night closed in about them. It became as black as a dungeon in the next few minutes. What, he asked himself, was below them in that unplumbed depth of fog? He eased his controls as the motors burst into a screaming crescendo again. The light on his radio panel gleamed red.



A series of icy gales lashed and battered at the treasure-laden destroyer!

Young Sandy's voice brought him out of a doze as he shouted in his mike that he could see the lights of the city of London ahead.

"Follow me in," Bill ordered. "Croydon is about ten miles south.

Cutting south, Bill picked up the steady beacons of Croydon. They thundered above the great field and circled it once. Then they set their seven ships down on Croydon with a military precision that brought a gasp of admiration from the grease monkeys cluttering the apron.

the North Sea and up the Skagerrak to Solo, say so."

His eyes flitted over the faces before him until Cy Hawkins drawled the word, "Phooey!" and they all laughed.

"O. K.," Bill said. "It's two o'clock now. We'll shove at eleven in the morning. The crew of the transport will stay aboard her and stand watches to guard the other ships while they're being refueled and checked. The rest of us can grab off a few hours sleep in a hotel. Tony has made all arrangements for us. The field manager will know about things."

"Let's go to bed," Sandy said through swollen lips.

"I want you to fly the Eaglet to-morrow, Sandy," Bill said. "McCoy can relieve me at the controls of the carrier. Let's shove!"

Shorty Hassfurth gazed around the hotel room he was sharing with Bill and then flipped the British shilling he had received in change, a few minutes before, into the air. Three times he flipped it and the third time he pretended to be studying it as it lay in his palm. Finally, he lifted his eyes and looked at Bill.

"Listen, fella," he said. "Do you have any idea what this trip is all about?"

"I don't know anything more than you know, Shorty," Bill said earnestly. "But I know Nels Larsen and I know he'd have to be in serious trouble or he wouldn't ask for help."

"He's in his own native land," Shorty pointed out. "He ought to be able to get help from his own countrymen. He may get into a lot of trouble calling us in—to say nothing of the trouble we may get in."

"Listen, Shorty," Bill said. "Aviation is a new industry in Finnmark. His countrymen couldn't do much to help him if his trouble comes from the air. Whoever is bucking him must have money and equipment. Otherwise that attack wouldn't have been made on us this morning. If you want to pull out and stay here you're certainly at liberty to do so. I know we're going into this thing with a blindfold over our eyes. But I know Nels. He is in desperate trouble, as I said before, or he wouldn't ask for help. I'm going to find out what it is."

"Don't get sore, Bill," Shorty said. "I just thought you might have something up your sleeve. You know I don't want to pull out. I'm going to get some sleep now."

"You'll need it," Bill said. "We're going to run into things to-morrow. Good night."

"Good night, fella."

A few seconds after eleven o'clock the next morning Bill Barnes wrapped his hands tightly around the control wheel of the giant bomber as it began its ponderous journey down the runway. The low-winged monster eased upward with

"I think I saw a light below," Shorty's voice said in his ears.

"Try and locate it again," Bill barked. "Get down to three thousand feet. Hold your formation." A light flashed ahead, then disappeared as Bill shoved the carrier into a steep dive.

When the light came on again Bill knew it was the flashing, intermittent beam of a lighthouse. He checked his position and spoke to his men again.

"We're across St. George's Channel," he said. "That lighthouse is on the south coast of Wales. Hold your course due east. We'll be over Cardiff and Bristol soon. These head winds are carrying the fog out to sea. It may clear before we have to sit down at Croydon. Hope so."

The little formation sped on and on above the English countryside, their red and green running lights clearly visible to one another now.

Bill stuck the nose of the carrier on the first air beacon they had seen since they left the tip of Long Island at six o'clock that morning. The night had completely cleared. The little villages that sailed behind them were dark and still. Their powerful engines droned on and on as their whirling props cut the still night air. Bill Barnes was slumped down in his chair, thoroughly exhausted from having fought the elements in the unwieldy transport for fifteen hours.

VII—CROSS FIRE

BILL locked his wheel brakes and slid out of the commander's seat of the transport. His feet were numb and lifeless. He stamped them on the deck and flailed the air with his arms.

"All pilots report to me on the bridge of the transport," he said into his microphone, as the Lancer, the Eaglet, and the four Snorters came rolling in behind him.

"That," said Shorty Hassfurth a few minutes later, "was one of the toughest crossings I've ever had. What about you, kid?" he asked Sandy. "Your face looks like a chunk of raw beef."

"So would yours, you big lily, if you'd been riding that storm in an open cockpit," Sandy snarled.

"All right," Bill said wearily. "Stow it! How much fuel did you have left, Red?"

"About a teacup." Red grinned. "She was beginning to suck when I nosed her down for a landing."

"Well, we made it," Bill said. "I don't know what this mess is that Larsen has stirred up. The ships that tried to bomb us this morning were trying to keep us from reaching Larsen. We've made it this far, but I have a hunch we're going to run into some more opposition to-morrow. If any of you want to pull out of this expedition, now is the time. If you don't want to take the ho, across

lugubrious grace, as Bill yanked back on the wheel.

The seven ships fell into a tight formation six thousand feet above the great British airport. To the north the Thames River wound through the far-flung city that was London. Airliners from the Continent dipped their wings in salute, as Bill gave his men their course and stuck the nose of the transport on an invisible destination across the treacherous North Sea.

Two Snorters were drilling through the air on each side of the transport, at a steady two hundred and fifty miles an hour. On the starboard side rode Red Gleason and Bev Bates; to port, Cy Hawkins and Mort Henderson. Two thousand feet above, and in front of the transport, Shorty cut the thundering Diesels in the Lancer to hold her back. Below the tail of the carrier young Sandy was taking his Eaglet through a series of acrobatics that would have done credit to Bill himself. He knew that Bill could not see his performance.

"This is the last leg," Bill said to himself, as he eased the throttles of the carrier open a notch to buck a fresh north-east head wind. "After this—" He left the sentence unfinished and shouted for McCoy to take the dual controls in the co-pilot's seat.

Bill had just finished a thorough inspection of the BT-4 and was about to take back the controls when a far-away sound that was not the drone of his own engines brought him to a quick halt. He listened for a fraction of a second. Then, he leaped for the intercockpit telephone and roared forth orders. He didn't bother to look out the windows. He knew the sudden roar of a dozen attacking planes only too well.

"Battle stations!" he roared. "We're being attacked!"

Machine-gun bullets tore through the wing and tail surfaces of the big transport. It reeled dangerously and shuddered like a battleship that has been raked by a broadside.

"Keep the controls, McCoy!" he bellowed. "Hold her steady on her course. I'll man the one-pounder." He threw the radio key and spoke to his men.

"Come back and help me keep them off the transport, Shorty," he bellowed. "The rest of you break up their formation. There are twelve of them in two Vs of six each. Give 'em hell! Stay in close to the transport, kid. Don't let 'em cut you off."

Martin, in the forward gunner's cockpit, thumbed the sun and swung his gun as old Charlie leaped to his station in the tail cockpit and Miles let himself down in the cylindrical turret beneath the belly of the carrier. Their guns poured a hail of lead into the diving planes as they came within range.

Bill whirled the rapid-firer around and got the leader of the first squadron

under its sights as it dived on the transport. For one brief instant the green ship moved within his telescopic sights. The breach of the one-pounder burned against his cheek as he clamped down on its trigger. A half dozen savage barks sounded above the throbbing roar of the diving motors.

That first green ship became a great puff of black smoke, dotted with orange, as the shells from the rapid-firer drove into its engine block. Ribbons of orange shot out of the smoke in all directions as the other five ships of the V broke their formation to get away from the flying debris. An eddy of wind puffed the smoke aside, and what had been single-seater fighter, with short, flat wings and a lean fuselage, was now bits of skin and bone and steel and wood.

As Shorty came streaking back and down in the Silver Lancer, the four Snorters and the Eaglet tossed their tails in the air and dived on the eleven remaining planes as they went by. Tracer smoke, white and yellow, rose in a dull haze as the green planes came out of their steep dive and began to angle upward.

Bill's eyes glittered and his fingers fastened tight around the trigger guard of the one-pounder, as he watched Shorty whip the Lancer through the roaring heavens with his usual reckless abandon.

Green planes skidded crazily out of his path, to escape his lightning acrobatics to bring them under his sights. A green ship zoomed upward and went far over on its side, with its rudder biting into the air, to get away from Shorty. But the first burst of fire from Shorty's guns cut the rudder from its post. As the green ship skidded, Shorty smashed its center, his fire raking forward. The pilot came up in his seat screaming, as that hail of lead tore into him. His body dangled half in and half out of the stricken ship as its nose dropped.

Two of the fast, green ships hurtled down on the tail of Red Gleason's Snorter, as he leveled off to come out of his dive. As their bullets ripped the air above his head he kicked his ship out of range. Then he brought his Snorter around in a tight loop on the tail of one of the green planes. His guns drew a line like the track of a snake from rudder to engine. Smoke and flame billowed out of the engine housing as the pilot went over the side, his parachute stringing out behind him.

Up near the speeding transport, two of the rugged, green biplanes were trying to get Cy Hawkins in a cross fire. Their crisscrossing lines of tracers showed that he was outmaneuvering them while he tried to get them into position for an attack.

As Sandy's little Eaglet sped in close to the transport with three of the green

ships in pursuit, Bill's fingers clamped down on the firing trip of the rapid-firer again. The transport bucked and trembled as he fired burst after burst after the enemy ships. But they were out of his range, as they managed to get Sandy within the vortex of their fire and prepared to annihilate him.

Bill watched with anguished eyes as it seemed that there was no escape from that trap for Sandy. He cursed as he watched Sandy desperately trying to find a way out. The three green ships were circling around him now, trying to draw the circle tight enough so there could be no escape for the freckled-face kid.

Bill shouted aloud, as Sandy came up and over in a flashing Immelmann and went back to the attack in a screaming chandelle. He tore that little circle of three ships apart with his chattering guns vomiting lead and death. Then he was across the rear of one of them. His fingers clamped down on his triggers as he got the ship under his hair sights. The burst of fire lasted just long enough. The plane slipped away from his deadly aim and began its last descent, as the pilot fought desperately to bring the nose up.

Bev Bates was riding his Snorter with the calm, deadly efficiency characteristic of him. Bill saw him following a green ship as it pulled steeply up into the sky and flashed back in a dazzling Immelmann with its guns chattering. He saw bullets ripping through the port wing of Bev's Snorter, as Bev slapped his stick forward and went into a dive to escape that hail of lead.

Then Bev yanked his control column back into his stomach and zoomed vertically up and over on his back. Neutralizing his controls, he opened his throttles and poured soup into his engines as he got on the green ship's tail. With his head hanging downward in an inverted position, he lined the green ship under his sights and tripped his guns. His powerful .50-caliber bullets ripped into the tail surfaces and crept forward, as the enemy pilot tried to skid it out of range. But he had moved too slowly. His helmeted head disappeared as Bev's bullets drove into his neck and all but severed it.

At the same instant Mort Henderson flashed over in a dazzling, inverted loop, to come up under the tail of one of the green planes that held Cy Hawkins in a cross fire. As his guns poured lead and tracers into the green plane two more of the green ships dived on him from above. A savage curse ripped from Bill's lips as he saw clouds of black smoke and orange flame pour from the engine housing of Henderson's Snorter. He leaped for the steps and threw the key on the radiophone.

"Shorty!" he shouted. "They just got Henderson. His ship's afire! I think

he's going to bail out. Protect him on the way down and pick him up. There he goes!"

The flaming fuselage of Henderson's Snorter was whirling toward the waters of the North Sea, when something shot out of the cockpit to go tumbling and turning beside it. A white streamer came out behind, which a moment later became a great white ball of cotton.

Bill's face was livid with anger as he saw one of his precious Snorter's fluttering to its death. "Get in there, Cy!" he shouted. But underneath his rage Bill was filled with pride as he saw his men outfighting, outsmarting, outmaneuvering the green ships that had been two to one against them.

He saw Shorty plummeting down on the two green murderers who were circling Henderson's swinging body. They dived and zoomed and skidded, to get out of the way of Shorty's stuttering guns, as he dived on them like a swooping hawk. But they were no match for him. They fought with desperate fury as they tried to feint him into a mistake.

But this was the day Shorty was making no mistakes. Hanging head downward, with all his weight on his safety strap, he carefully lined up one of the green ships in his sights and clamped down on his gun trip. As the ship skidded away from him to the left he threw his stick and rolled right side up, as the North Sea seemed to rock into the sky with him. He came around in a tight, vertical bank and again the green ship came under his sights. This time his bullets drove into the engine block of the fast fighter until oil spouted. Then black smoke belched from the engine house as fire—crimson jets of fire—licked out and back toward the white-faced pilot. The nose dropped as a tank exploded, and what had been a plane became a roaring ball of fire.

Then Bill became aware that three of the green ships had peeled off from the fight and were closing in on the transport. The three remaining green ships were fighting desperately for their lives with Red Gleason, Bev and Cy, as Sandy dived his Eaglet to the aid of Shorty.

Bill swung the rapid-firer around as machine-gun bullets beat like hail on the bulletproof glass above his head. But the green fighters were below his range before he could clamp down on his trips. They dived underneath the carrier and came up from below with their guns snarling.

But Miles was down there in the smokehouse that was a retractable machine-gun turret. As the first green plane came up his fingers tightened on the firing trip of his heavy .50-caliber gun. The air between the single-seater and the turret was suddenly laced with white streamers.

The streamers swerved, as Miles cor-

rected his aim in a split fraction of a second. The oncoming plane took the full force of the shattering impact of those powerful bullets. They tore the prop to a thousand pieces and drove into the high-powered motor as though it was putty. The face of the pilot disappeared. Smoke billowed from the housing of the stricken plane as it yawed wildly and burst into flame. The nose of the pilotless plane dropped. It went plummeting toward the North Sea, five thousand feet below.

For the next forty seconds Miles thought he was inside a steel furnace, as he bore the brunt of the attack of the other two ships and fought back. With his eyes glued to his gun sights, he fired burst after burst at the two ships which were circling around him with their guns belching fire. His face was black and grimy from fumes and powder, as Red Gleason came diving out of nowhere to rake the first ship with a withering fire. He worked the raising mechanism and staggered out on the deck half strangled, to hear Bill chanting instructions from the bridge.

"Come back, Cy and Bev!" Bill was shouting. "Let 'em go. Stand by while we pick up Henderson. Don't land; the water is too choppy. Shorty is down and will pick him up."

Shorty Hassfurther swooped down on the choppy waters of the North Sea, sending two great geysers shooting up on each side of his main float. He taxied around as close to the struggling Henderson as he dared, and idled the twin Diesels until the two props were barely turning over. Then he dropped down on the main float and threw out a sea anchor, which Henderson used as a line to pull himself aboard.

"Are you all right?" Shorty asked him as he got one knee up on the float.

"I'm all right," Henderson growled. "But what is Bill going to say about my losing a Snorter?"

"He won't say anything," Shorty answered. "He'll be too glad to know you're O. K., fella."

The radio light on the panels of the Lancer were gleaming red as Shorty and Henderson climbed into the cockpits. Shorty threw the switch and spoke his name.

"You're sure he's all right?" Bill repeated in a moment.

"I'm all right, Bill," Henderson said. "I'm sorry I lost a Snorter."

"We'll get that back before we get through with this trip," Bill said grimly. "You'd better get into the air as soon as you can, Shorty. We're all going to circle around here for a bit to see if there are any men alive in those planes. Some of them have already sunk."

For over an hour they circled low above the area where the running fight had been waged. But there was no sign

of life on the surface of the water or within the fast-sinking green planes.

"All right," Bill ordered at the end of that time, "take your old positions around the transport. Sandy, you drop in behind Cy on the port side. Speed three hundred miles an hour. We'll be above Solo in a little over an hour. Keep your eyes open!"

Forty-eight minutes later the red-tiled roofs of the white city of Solo appeared off their port quarter. The thousand-year-old city curved around the southeast coast of the mighty Christiana Fiord in an amphitheater of pine-clad hills. The fiord, which was picturesquely dotted with wooded islands and lined with ancient quays, ended in a harbor that was divided into two inlets by a rocky promontory. On this promontory was the ancient royal palace and the giant landing field that had been blasted out of solid rock.

"I'll make contact with Larsen, if I can," Bill said into his microphone. "We'll circle the airport twice. Follow me in in the regular formation. The hangars are in the side of the hill that adjoins the airport, underground."

The white, strained face of Nels Larsen appeared below the rim of the port door of the transport as Miles threw it open and worked the gangway for Bill to descend to the apron.

VIII—MYSTERY

"HELLO, BILL," Nels Larsen said, as though they had parted only yesterday.

Those of Bill's men who already knew Nels Larsen shook his hand enthusiastically. The rest were awed by the things Nels Larsen had accomplished in the air.

"I hear they're trying to throw monkey wrenches in the machinery," Shorty Hassfurther said to him with a grin.

"Live monkeys," Nels Larsen grinned back at him.

"You've made arrangements for my ships and men?" Bill asked Larsen.

"Gunnar Halling, one of my men, has taken care of all that," Nels said. "But I want to talk to you now, Bill."

"And I want to talk to you," Bill said grimly. "I want to find out what mug is going to pay for the Snorter I lost getting across the North Sea. You'd better let my men handle their ships while they're being serviced and repaired. They're full of bullet holes."

"Bullet holes?" Larsen said, his eyes wide.

"Bullet holes," Bill echoed. "Shorty, you're responsible for everything. You know what to do. Put Martin in charge of the ships and you keep an eye on every one. I may need all of you at any minute. Es—" Bill stopped, and his face reddened as he saw Sandy's head appear in the doorway of the transport. "Hey! You nitwit," he shouted, "put those skis back in that transport!"

Where the—the—" He stopped speaking again. "Keep an eye on him, Shorty, or he'll be starting for the north pole. O. K., Nels," he said to the grinning Larsen.

"What's this about bullet holes, Bill?" Larsen asked a few minutes later as he closed the door of his private office in the administration building.

"Let me start from the time your man, Sweyn, made a landing on Barnes Field," Bill said. "Tony Lamport told you about him, of course?"

Larsen nodded his head. "I can't understand it, Bill," he said. "What kind of a maniac is loose in the world, and why is he picking on us?"

"I don't know who he is, Nels," Bill said. "But I can tell you why. I've run into all kinds of situations and machinations since I started my little outfit. Every time I've had some murderer to fight he was after one of two things: gold or power. People wouldn't laugh as they do when they quote: 'It's the root of all evil,' if they knew how true it is."

"But—" Larsen began.

Bill silenced him with an upraised hand. "We're wasting time, Nels," he said. "I told you I didn't know who. Let me tell you what has happened to me since Sweyn died on the floor of my office."

Larsen listened without interruption while Bill told him of the attempt to destroy his ships with bombs, their flight across the Atlantic and the attack over the North Sea.

"A dozen single-seater fighters!" Larsen exclaimed. "Where did they come from? Who sent them?"

"Take it easy, Nels," Bill said. "Who, besides Sweyn, knew you had made contact with me?"

"I can't answer that, Bill, because some one has been tampering with all my correspondence and cutting in on my telephone conversations. Secret police are working on things, but they haven't accomplished anything. A thousand people might know it."

"Tell me about your job here," Bill said. "Maybe I'll get an idea. Give me an outline of what you're trying to do. What routes are you developing? You're pretty close to Europe here and your boundaries are the other Scandinavian countries. It may be illicit trade or smuggling. You're not far from Amsterdam, the biggest diamond center in the world."

"Perhaps," Larsen said, nervously extracting a cigarette from a package and lighting it. "You see, Bill, Finnmark is unlike any other country trying to develop air lines. At one moment you're flying over mountain peaks at high altitudes and the next you're down to zero. So far the air lines have followed the sea and fiords. Now, we're developing cross-country routes to the west coast

of Finnmark and across Sweden to Stockholm.

"The first line operated in Finnmark was developed by a German concern, flying German ships. Two years ago, when I came here, all the lines were consolidated under one head. Solo is the hub from which all of them operate. Up until we developed the overland routes all of our transports were on floats, sea-planes. Landing fields have been scarce, but there is plenty of water.

"All of our cities of any importance, except Solo, are along the west coast. The Gulf Stream keeps the coast clear of ice, even in the winter. There is little icing of planes and not much bad weather. Visibility is fine most of the time, in spite of occasional low ceilings. Lighthouses along the coast maintain radio beacons and we have a fine weather-forecasting service. The whole country is becoming air-minded. That is, they were until these things began to happen."

"What things?" Bill snapped.

"Sabotage," Larsen answered. "It's hard to make you understand how I know there is an evil force working, Bill. We are not a talkative people, but we feel things very keenly. Call it intuition if you want to, Bill. You know it isn't easy to change the manners and customs people have known and used for hundreds of years. The great arms of the sea that are the fiords reach back into the interior almost like rivers, and have been the chief highways of travel back into the dim ages. In the wintertime most of the population travel on skis. Even our soldiers are trained to run on skis and to ski-jump in formation. Inland, the people use a *stolkjaerre*—a

horse-drawn cart—for transportation. Except in the southeast Finnmark is mountainous, so we have few automobiles and only about twenty-three hundred miles of railroads all told."

"Listen, Nels," Bill said. "I know all about the wild picturesqueness of Finnmark. What I want to know is what has happened?"

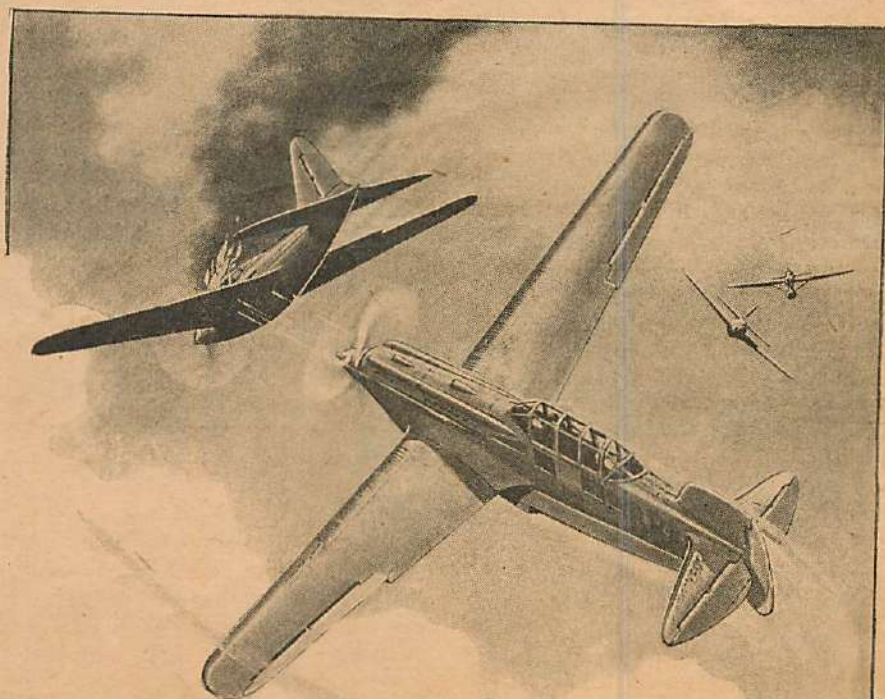
"I'm trying to make you get the feel of the thing, Bill," Larsen said, earnestly. "I'm trying to make you realize that there is some mysterious force working against me. That thing of burning me in effigy aboard a miniature viking boat is an example. There was no hint of where the thing came from or who did it. It gives me the creeps."

"Where were these beacons destroyed?" Bill asked.

"On one of the scenic routes on the west coast," Larsen said. "We run a triangular course around the Foloten Islands three times a week. The people who fly it are mostly tourists. The same thing happened on the route along the Hogne Fiord, farther south. Remember, when we fly those routes we fly between cliffs so steep that only goats can scale them. The Hogne Fiord is a typical Norwegian sea inlet between high mountains and among glaciers. Next year we're going to tap the sports and vacation sections with regular routes."

"Well, Nels," Bill said impatiently, "we seem to be getting nowhere at a tremendous rate of speed! What about the two ships that were lost entirely?"

"That was on the Midnight Sun Airway," Larsen said. "It runs from Christheim to Moldevaag. Both the ships disappeared on the leg from Bergholm to Moldevaag. We only operate that leg



Again the green ship came under his guns—

from the middle of July to the middle of August. That is a tourist route, also. It is the most northerly air line in the world. Most of the visitors to Finnmark want to see the spectacle of continuous daytime for twenty-four hours."

"Then," Bill said, "your trouble has occurred mostly on the tourist routes on the northwest coast."

"Mostly," Larsen said. "Except for the sabotage that occurred here at Solo. Two ships we intended putting on the Midnight Sun Route were destroyed by fire."

"It seems to me," Bill said, "that some one doesn't want you to be flying ships over the northwest coast of Finnmark. Why?"

"It narrows down to that," Nels said. "Maybe you'd like to talk to the divisional manager of the Midnight Sun Route. He happens to be here in Solo at the present time."

"Is he on the field now?" Bill asked.

"I'll find out," Larsen answered. He picked up a telephone and spoke into the mouthpiece. In a few minutes he said, "Ask him to come to my office, will you, please?"

"What does this divisional manager think about things?" Bill asked. "Is he a good man?"

"He's quite as puzzled as I am," Nels answered. "He knows that country up north better than any man except the native Lapps. He ought to; he licked it twenty years ago."

"Licked it?" Bill asked.

"He was an instructor in the lighter-than-air service of the imperial German navy," Larsen said. "He took a couple of cadets up for an instruction flight in a nineteen-thousand-cubic-foot free balloon. One of the cadets dropped a forty-pound bag of sand over the side and a northerly storm caught them that took them into the region where an occasional hundred-mile-an-hour wind occurs."

"They were way up on the tip of Finnmark, almost over the Arctic Ocean, when they managed to get down. They got some food and stores from a Russian destroyer that had been wrecked there the same winter. Two of them—Von Boett, the divisional manager, and Plass, one of the cadets—managed to survive until they could fight their way out the next summer."

"That's interesting," Bill said. "How did Von Boett happen to come back up here?"

"Both he and Plass came back about the time I came here to develop the air lines," Larsen said. "They stayed in aviation after the War. They came back here because they liked it."

"A murderer," Bill said, "always returns to the scene of his crime."

"Eh, what's that?" Larsen asked, startled.

"Nothing," Bill said. "I was thinking out loud. You found no trace of the two ships that were lost up there?"

"Not a thing," Larsen said. "We thought some wreckage would be washed ashore, but nothing has appeared as yet."

"You got an unlimited permit from the government to allow me to work on this thing with you?" Bill asked in a moment.

"Certainly," Larsen answered. "There won't be any trouble from that angle."

"The officials of your company knew I was coming, of course?"

"Yes."

"And you told this divisional manager, Von Boett?"

"Ye-es," Larsen said slowly. "But I didn't tell him just why you were coming."

"O. K.," Bill said as a knock sounded on the door and a thickset man with slightly graying hair, a purplish complexion, and small, piglike eyes, came into the room.

"Ah, Franz," Larsen said. "This is Mr. Barnes, Bill Barnes. Mr. Franz Von Boett, Bill. I've just been telling Bill about the trouble we've had, Franz."

"It is very bad, Mr. Barnes," Von Boett said in broken English.

"Do you have any ideas about it?" Bill asked Von Boett, watching the man carefully.

"No," Von Boett said. "I only know what has happened. This is a strange country, Mr. Barnes. Those frozen wastes to the north hold secrets they will never reveal."

"Mr. Larsen told me you were blown up there in a free balloon during the War," Bill said.

For an instant Von Boett's pig eyes searched Bill's face. Then he smiled. "I do not like to think of that," he said. "It was a terrible experience. We nearly went mad and we nearly died."

"One of the cadets with you didn't survive?" Bill asked.

"He went mad and wandered away in the darkness," Von Boett said. "We could not find him again. But I do not like to talk about those terrible months."

"I can't say that I blame you," Bill said easily. "What puzzles me is that you ever wanted to go back into that section to work."

"Sometimes it puzzles me, too," Von Boett said with a laugh. "Something irresistible drew me when I learned that an air line was to be opened up there. Young Plass and I had been working together in aviation since the War. We decided it would be interesting to go back."

"What about the pilots you've been using up there?" Bill asked, abruptly changing the subject. "Were the men piloting the two ships that disappeared dependable men?"

"Oh, absolutely," Von Boett said. "Mr. Larsen will tell you that. They were two of our best men."

"And you never found any trace of

the planes, the pilots, or the passengers?" Bill asked.

"Young Plass thinks they came back one night," Von Boett said, his purple face working strangely.

"Thinks they came back!" Larsen exclaimed.

"He says he heard them and could see them dimly, high in the air at night. It was near midnight and the sun was down near the horizon. A sort of dim twilight had fallen that threw long shadows across the ground. He says they circled the field and then disappeared into the haze to the north. Young Plass has strange hallucinations at times." Von Boett dropped his eyes and stared at the floor.

"Why didn't you tell me this?" Larsen demanded.

"What was the use?" Von Boett shrugged. "I thought it was just another of his hallucinations. I didn't want to worry you about it."

"How many pilots do you have up there now?" Bill asked quickly.

"Just Plass and another German named Richter," Larsen said. "We will have two more men soon before the season closes."

"Young Plass is a good pilot," Von Boett said. "So was Richter."

"They're both flying that leg each day?" Bill asked, and went on before Von Boett could speak: "That's pretty risky. They don't get any real rest."

"It's only a short leg," Larsen protested.

"O. K.," Bill said, and he rose from his chair and stretched. "I've got to get some sleep. I didn't get too much last night, and hardly any at all the night before. I'd like to talk to you again before you go north, Mr. Von Boett. When do you expect to leave?"

"To-morrow morning," Von Boett said.

"By plane?" Bill asked.

"Yes, sir," Von Boett answered.

They shook hands and Von Boett waddled out of the room. The moment the door closed behind him a lightning-like transition took place in Bill Barnes. He changed from a sleepy-eyed, smiling individual to a man of dynamic force.

"Quick, Larsen!" he said. "What is the schedule on that leg from Christheim to Moldevaag? Is there another flight this afternoon? Find out for me fast or you're going to lose another ship!"

"There is no regular schedule on that leg now. They each make a round trip every day, according to the number of passengers to be carried."

"Get on your telephone," Bill half shouted, "and find out where Richter is now. Didn't you notice that Von Boett used the past tense when he spoke about Richter? He said, 'So was Richter.' Something, unless we stop it, is going to happen to Richter. And watch Von Boett. There is something up in that

north country he and young Plass want. And they're willing to kill men to get it!"

Larsen stared at Bill as though he thought he had gone mad. Then he leaped for a telephone. Five minutes later he said to Bill, as quietly as he could manage, "Richter is scheduled to leave Christheim for Moldevaag in about two hours. Shall I tell them to hold him there?"

"No," Bill said in a moment. "Don't interrupt Von Boett's plans. Let him go on as though he was going to make the flight. Get your hangars and tell them to roll out the Lancer. Watch Von Boett, but don't let him know you're watching him. I'm going to Christheim as fast as I can get there. You'd better come with me, Larsen."

IX—TEN AGAINST ONE!

A HALF HOUR LATER Bill Barnes and Nels Larsen stood in front of the two whirling disks that were the props of the Silver Lancer. Martin, Miles, McCoy and Neely were swarming over the gleaming ship, making a last-minute inspection. Bill was giving Shorty Hass-further instructions.

"Let 'em all sleep for a couple of hours," Bill said. "Then follow me. You'll have to handle the transport, Shorty. Take Henderson in with you to relieve you and handle the one-pounder. Red, Bev and Cy in their Snorters and Sandy in the Eaglet to form a convoy. Don't let Sandy hook onto the transport. You may need him outside at any moment and won't have time to get him away if you have to fight."

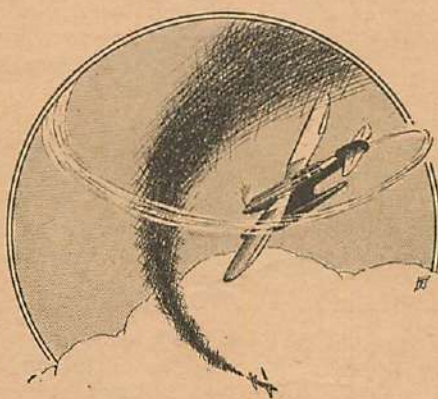
"I'm going to fly overland to Havenger and then follow the coast line north to Christheim. You'd better follow the same route. If I should land before you get into the air, I'll leave some one who understands English in the Lancer to pick up any messages from you. You want to keep your eyes open. Tell the men to be careful about using their guns. Don't use them unless you have to. But if you have to use them, you know what to do. If you're attacked it will probably be by some more of those same green fighters."

"Who is behind this thing, Bill?" Shorty asked.

"A German who found something valuable inside the arctic circle when he was blown up there in a free balloon during the War," Bill said. "He didn't know how to get it out until Nels began to develop the Midnight Sun Route of the Finmark airways. He's dangerous, and he's desperate now. I'll meet you at Christheim."

As Nels Larsen climbed into the after cockpit of the Lancer and connected his ear phones, he spoke to Bill. "This is quite a ship," he said. "I've read a lot about it."

"It has to be," Bill said grimly. "Do



Red circled down after the flaming fighter.

you know how to work that swivel gun back there?"

"I think so," Larsen said.

"You just swing your chair around and lift the gun into position," Bill said. "There are spare drums of ammunition in a rack on the starboard side."

"Right," Nels said. "I hope I don't have to use it. How many guns do you have up there?"

"Two .50-caliber machine guns, a 30mm cannon that fires through the prop shaft, and four twenty-five-pound bombs in the bomb bay," Bill said, grinning. "Grab your hat, we're going."

"O. K.," Larsen said.

Bill released his brakes and gunned the twin Diesels. The big ship picked up momentum fast as it skimmed down the hard-surfaced runway into the wind. The airport of solid rock faded away, and the city of Solo disappeared beneath the starboard wing as Bill banked the big ship around and took it upward in tight spirals.

"Bill!" Nels Larsen shouted into his telephone as Bill leveled off. "I just saw a couple of mechanics rolling Von Boett's ship out on the apron. Do you want to wait and see where he is going?"

"He's going to the same place we are, only we're going there faster," Bill said. He fed the snarling Diesels fuel as he rammed open his throttles. "How much altitude do we need to get over the mountains?"

"Ten thousand feet to be safe at some points," Larsen said. "You need nine thousand to get over the Snohoetten in the Dovre Fjeld."

The red-tiled roofs of the city of Solo, lying between the cliffs and the shining water, faded away behind them as Holmenkolmer, the headquarters of Finmark's ski jumping flashed under their wings.

Deep valleys, with tiny farms hanging on their sides, followed the river beneath them to the sea. Farm girls in brightly colored jackets tended the herds of cows and goats high in the mountains. Here and there, perched precariously on the sides of the fiord's cliffs, stood sod-roofed

huts where the girls lived, making cheese and butter for the coming winter. Elaborately carved *stabburs* dotted each farm for the storage of the yearly harvests of cereals, cheeses, cured meats, bread and cakes.

"Your people are certainly self-sufficient, Nels," Bill said into the intercockpit telephone.

"They're like your Lancer," Nels smiled. "They have to be!"

Great ice plateaus and enormous U-shaped valleys that were carved out by the vanished glaciers of the ice age spread out interminably below them as they climbed to get above the Snohoetten of the Dovre Fjeld.

"Those glaciers look as though they had been there forever," Bill said to Larsen. "It would be a tough place to try to find a landing."

"We have to use ships that won't have to hunt for a landing," Larsen said. "Just follow the fiord below you, Bill. It will take you to Havenger."

"Listen, Nels," Bill said. "Would you mind taking the controls and taking us in. I'm so sleepy I can hardly hold my eyes open, and I may need to be awake to-night."

"Right, Bill," Larsen said. "I've got 'em."

Bill's head fell forward on his chest an instant later and his arms dangled at his side. He was sound asleep within a minute after Larsen took the controls.

Larsen held the Lancer at a steady speed of three hundred miles an hour while he checked and rechecked the instruments before him. Then he opened the throttle a notch and watched the air-speed indicator climb to three fifty as the powerful ship glided through the air without any additional effort.

"What a ship!" he said aloud. "I wish I had a half dozen of these over here."

Then his eyes flew wide open. He sat up in his swivel seat with a start. The far-away roar of airplane motors crept into his ears. He thumbed the dull, evening sun that was slipping toward the horizon, but could see nothing. He looked up and back and probed the air all around him. He cocked his head to the right and then to the left and listened.

"Perhaps the rest of Bill's men are catching up to us," he said to himself. Then decided it had been less than an hour since they had left Solo.

He cocked his ears again and decided the roar seemed to come from the north on his starboard side. The sound was certainly growing louder and coming closer. He knew he had better awaken Bill. He started to speak into the telephone and stopped. He wanted to let him sleep until he set the ship down at Havenger.

And while he hesitated it happened! Two V formations of rugged little

green fighters dived out of a wisp of fleecy clouds a thousand feet overhead, their engines screaming. Larsen gasped in horror and shouted Bill's name into the telephone as white streams of tracers danced through the air toward him.

As Bill opened his eyes Nels threw the control column forward and sent the Lancer into a vertical dive with the throttles wide.

"I've got her!" Bill roared in his telephone as he wrapped his hand around the stick. Larsen released the controls as a storm of bullets drove into the tail of the Lancer.

"Break out that flexible gun!" Bill shouted. "I'm coming back up in a loop."

Larsen whirled his chair around and pulled the .30-caliber Browning toward him. He ran the gun across its track as large drops of perspiration ran into his eyes. He held the palms of his hands against his ears and gulped like a fish to lessen the pressure on his eardrums as the Lancer continued to plunge toward the great wastes of ice below.

The two V formations of five planes each tried to stay on the tail of the Lancer as Bill shook himself awake. He held the nose of the big ship down and down and down. Then Bill jammed the stick even farther forward and the Lancer came over on its back in an inverted loop. He centered the controls and rolled right side up as the ten green planes dived over him.

Opening the throttles wide again he stuck the nose up in an abrupt climbing turn until it almost stalled. Again he kicked his rudder, and the earth rolled out from underneath him as he swung back on his original course.

Then one of the green ships was on his tail again. He heard the *tat-tat-tat* of its machine guns, followed by the fire of another and another. He could feel the Lancer tremble as bullets crashed into its tail assembly. He pulled the stick back and went upward in a desperate zoom.

"They're fast babies, Nels," he said into his telephone. "I can't make up my mind whether to give them what they've asked for or get on to Christheim."

"They'll come after you, won't they, Bill?" Larsen said, his voice rasping. "You'd better run away from them until your men get here. They're determined to stop you."

"Is Von Boett's ship among them?" Bill asked.

"No," Larsen said. "They're closing in again, Bill."

"Let 'em have it!" Bill roared through clenched teeth.

The ten ships were coming at them from every direction, spread out in a semicircle. Bill gunned the Lancer for a moment to pull away from them.

Then he whipped up and back in a flashing chandelle.

The Lancer, with its terrific speed and maneuverability, was up and over and diving back head-on at the ten green ships with the wild fury and abandon of one of Nels Larsen's ancestors gone berserk. They dived and zoomed and skidded to get out of his flaming path. His fingers were fastened down hard on his gun trips. He raked a green ship that came under his sights with a withering fire that brought the pilot up in his seat with his arms flailing the air. The ship slipped off to the right, stuck its nose down and began a fluttering descent to the cold earth below.

Bill gunned his engine again and came over on the tail of the last plane. His line of tracer smoke curled above the head of the pilot. His bullets crashed into the fuselage and climbed forward to the engine block. Little wisps of smoke curled out from the engine housing.

As he zoomed upward he heard the chatter of Larsen's swivel gun. He glanced back over his shoulder and saw that Larsen's face was dripping with perspiration—and his light-blue eyes were as cold and hard as the great glaciers below them.

Suddenly the air seemed to be choked with slashing, roaring green biplanes. They were like vultures circling to settle on their prey. But Bill could feel that they were afraid of him.

"They've heard about that little contest over the North Sea," he said grimly. The eight ships came darting in like wasps about a man who has disturbed their nest. They were everywhere, charging in from all angles, their guns screaming lead.

Bill eased the throttles of the Lancer open another notch and took it through the air with the speed and fury of a flaming meteor. He saw his bullets tracing designs on the sides of the green ships, but his speed was too great for accurate shooting.

He knew that the Lancer was taking a terrible beating. It was being riddled from wing tip to wing tip by the guns of the green ships. But he fought on, his face tense and terrible in its absolute concentration. He whipped the Lancer up and down, skidded and side-slipped, zoomed and dived to avoid the streams of death that were aimed at him.

When he had another ship under his hair sights he switched to his 30mm cannon and literally blew the ship out of the air. His aim was deadly now in spite of the terrific speed of his maneuvers.

Four of the remaining green ships began to circle him, trying to get him within the vortex of their fire and at the same time keep out of range of his cannon. The other three ships joined them as they began to tighten the circle.

Each time he tried to break out of the circle there would be two or three planes in his path to cut him off and force him back. Bullets drummed all around the two cockpits of the Lancer, but Bill and Larsen seemed to bear charmed lives.

Bill's breath was coming in quick, agonized gasps now. His hand was wrapped around the control column like a band of steel. He was using all of his natural ability as a flier, plus the speed and maneuverability of the Lancer, to keep those seven ships from carving a death's head on the sides of the two cockpits.

In another instant he got another green ship under his sights and tore the head of the pilot from his body with his cannon. At the same moment Larsen caught a ship that was diving in from above with a stream from his .30-caliber gun. The shimmering prop of the green ship screamed in protest as the bullets tore into it and cut it to bits. The nose of the green plane dropped and it plummeted toward the great, icy chasm below.

"We can't keep this up forever, Bill," Larsen gasped into his telephone. "They'll get us in a couple of minutes."

"Hold it, Nels," Bill said. "I think they've had almost enough. If they peel off and run we can follow them back to their base and your troubles will be over."

"They'll be over if I stop one of those bullets, too," Nels said into the telephone, but he laughed as he said it.

"There are only five of them left," Bill said. "They want to get both of us out of the way."

Then the green ships were on them again, their guns spewing fire and lead and death. Bill waited until they were almost on him. He held his fire until he had another ship dead under his sights. His finger came down on the trigger of his 30mm gun. He fired a burst of five shots as he threw the throttle of the Lancer wide and moved away at terrific speed. He saw the green biplane become one great ball of black smoke and orange flame. As he yanked the stick back into his stomach to zoom above the other four ships he saw the ball of black smoke disintegrate. The explosive shells he had poured into the biplane had taken it apart with a finality that was appalling. What had been a ship with a living man at the controls was now a broken mass of tangled steel and a shattered body.

The pilots of those green ships thought some flaming monster from another world had fallen among them as Bill came back at them. His blue eyes were gleaming with a mad recklessness as he attacked with a last burst of fury. He was cursing steadily as he took his rage out on those green biplanes. He literally tore one of them to bits with both his machine guns vomiting death.

And that was enough!

The last three pulled out of the fight simultaneously and stuck their ships down in vertical power dives. The faces of the pilots were white and fear-stricken as they glanced back over their shoulders. They were sure that they had encountered something that was not human as they poured soup into their engines with but one thought in mind: escape.

Bill jammed the stick of the Lancer forward with but one thought in his own mind at that moment: to wipe out all the pilots of those murderous green ships.

But as the nose of the Lancer dropped, one of the twin Diesels began to suck and miss. Bill hauled the stick back with a curse as he switched to another tank. But both of his motors began to cough now, and for an instant fear brought the hair up on Bill's neck at the base of his skull. He looked over the side and saw that great chasm of yawning ice below him.

Then he switched to a small emergency tank that was his last resort. "They punctured one of my tanks," he said into the telephone as he jazzed his throttles.

In another instant the twin Diesels caught again and took up their full-throated roar. But the three green biplanes were mere specks in the distance now.

"I'd have to let 'em go, anyway," Bill said to Larsen. "I'll have to use what fuel we have to climb so we can glide into Havenger. Can you get me some fuel there for my Diesels?"

"I can get you anything you want," Larsen gasped. "What a fight, Bill! What a fight!"

"Close your overhead hatch and turn on your oxygen," Bill said. "I'm going up to about thirty thousand and glide in from there. I don't like the idea of having to sit down on those glaciers."

X—VICTORY

BILL threw the key on his radio panel and began to chant Shorty's call letters into his microphone after they had started their long glide above the steep fiords of the west coast.

"O. K., Bill. Shorty answering," came back to him a moment later. "We're just tuning up our ships. We'll be leaving here in about fifteen minutes. Any orders?"

"Just keep your eyes open," Bill said. "I'll wait for you at Christheim unless something develops that takes me on north. If it does, you follow me to Moldevaag. I've got to lay over in Havenger for a short time to refuel and have one of my tanks patched up."

"What's the matter with it, Bill?" Shorty asked quickly. "Did you run into more trouble?"

"Ten of those green biplanes," Bill



An anti-aircraft gun barked below him, and the Lancer bounced—
as a wisp of white smoke appeared in the air—

growled. "They almost shot our buttons off. I don't think you'll have any trouble after that, but keep your eyes open. I'm signing off."

Bill slapped the Lancer down on the harbor of the port city of Havenger and taxied toward the landing ramp. From the docks rose the characteristic aroma that is a part of Finmark: a blend of fresh-cut lumber and the drying fish of the curing works. The ships along the green-mossed wharf piles, with the tides of the north Atlantic slapping against

their stalwart sides, were waiting to go forth with copper, wood pulp and lumber, and the various products of the fishing industry.

Off to the west the July sun was sinking to the edge of the horizon in a soft glow of rose light that cast no shadows. In another few hours, disappearing from sight for only a short time, it would begin its rise again. They were on the outskirts of the land of the midnight sun.

"You'd better get in touch with your

airport at Christheim," Bill said to Larsen. "Get that pilot, Richter, himself. Tell him to delay his take-off until he sights us over Christheim. Tell him to use glasses, as we want to stay high enough to be out of sight and sound of the ground. Tell him we'll stay above him on his leg to Moldevaag. But don't alarm him. Tell him to be ready to open his motors wide if anything happens. We'll be there in about an hour and a half."

"Right, Bill," Larsen said. "You think Von Boett is really going after him?"

"I do," Bill said. "He doesn't want any pilots up in that territory except Plass. Von Boett is about to make his big coup."

"Coup?" Larsen said.

"Hell's bells, Nels!" Bill grinned. "I don't know what he's trying to do. But I know he's stationed all those green fighters up there to take something out of the country. What it is, I don't know. He's desperate now because he knows his back is against the wall. He knows that if we don't stop him we'll find out his secret. It's something illegal or he wouldn't be willing to risk murder to execute his plans. That's all I know. You've got to take it for what it's worth."

That flight up the west coast of Finmark to the land of the midnight sun was a thing that impressed itself on Bill's mind vividly. The land below them was a rock-bound plateau, furred with aromatic pines, that met the sea in cliffs over which streamed the silver ribbons of a thousand waterfalls. The sea reached back into the land, sometimes for hundreds of miles, with green fiords into which the swift waters rushed with high-flung spray and incessant thunder.

Salt spume, weird, circling sea birds and the white sails of fishing smacks drifting out of the carmine sunset mingled together to make it a land such as he had never seen before. Barren mountains, rising in a barrier to the east, were gleaming with ice on their tops. Surging through the narrow, ice-gouged valleys were snow-fed streams alive with leaping salmon. There were no railroads, no automobile roads, and most of the isolated fishing hamlets had no means of communication except by the sea.

All along the coast an island fence known as the Skjaergaard protected the coastwise navigation from the sea. This was the route Nels Larsen's men had been flying into the land of the midnight sun.

In the wintertime the country was covered with a mantle of ice and snow, but now the steep green cliffs that lined the fiords were covered with sweet-brier, dwarf birch and summer berries.

"It's strange land," Bill said to Larsen. "I begin to understand your feeling about it. Only such a land as this could have developed men with the

hardiness and self-reliance of the vikings."

"They were barbarians then, Bill," Larsen said. "But things have changed."

"Things have changed," Bill said as he threw his radio key and tried to pick up Shorty again.

"We're just above Havenger, Bill," Shorty said in a moment.

"Hike up your speed," Bill said. "I may need you soon. I'll be away from Christheim before you reach there. Follow the lighthouse air beacons along the coast. If I call for you, come as fast as you can. It will be daylight all the time, you know. You'll have to get down to two or three hundred feet at times. Take it easy."

A half hour later Bill circled above the city of Christheim, the great fishing center for the northern seas. The waters of the splendid harbor sparkled dully under the dim light of the sun.

Bill circled until he saw a big Sikorsky S-43 amphibian rise from the harbor before he stuck his nose on the first beacon on the run to Moldevaag. The sun was sinking slowly toward the horizon, leaving the world a place of dim twilight as he took a position above the fast Sikorsky. His eyes were narrow slits now as he probed the sky all about him and strained to catch the first hint of an alien motor.

He took a position high enough above the Sikorsky so that he could not be seen in the dim haze of the midnight sun. The night was like nothing he had ever seen before. It had become a part of the day and seemed to stretch on and on forever into a vast void that knew no end. He could understand that vague uneasiness with which Nels Larsen had approached the job of developing the air lines of Finmark. There was something uncanny and weird about a day that went on and on for weeks at a time.

Bill's nerves were screaming as he endeavored to keep the big Sikorsky underneath him in the dim, ghostlike haze. One instant he could see its running lights and the next they would vanish.

Then, as though they had been tossed into the air by some invisible hand, a half dozen or more green ghosts appeared from nowhere to surround the fast amphibian! They came out of the ghostly twilight and took a position around the transport without a sound to indicate their coming. One instant the big Sikorsky S-43 was alone, and the next they were there.

It was only when Bill heard the *tat-tat-tat* of their machine guns and saw fire spew out along their engine housing that he could believe his eyes.

"Try to contact Richter and tell him to hold his course for Moldevaag," Bill roared at Larsen. "Use the master tuning control. They're trying to force him to land."

Then Bill stuck the nose of the Lancer down and went plummeting toward the three green ships that were firing their guns across the bow of the Sikorsky to force the pilot down. This time, he thought, I have the element of surprise with me. His face was a grim mask of ferocity as he thought further that the pilots of those six ships were endangering the lives of not only Richter, but all the passengers he was carrying.

His finger clamped down on his electric trigger as he got the green biplane that was riding above the nose of the Sikorsky under his sights. Fire and smoke lashed out of the nozzles of his machine guns as the pilot of the green ship looked back up over his shoulder. The powerful .50-caliber bullets from Bill's guns drove into the fuselage of the biplane just behind the pilot's head and crept forward. The face became a battered mass of red as the bullets drove into it.

The green ship zoomed upward and yawed wildly as Bill pushed his throttles open and hung the Lancer on its props. Another green ship came whirling around in a vertical bank. Bill could see the fire dancing from the two guns mounted along the engine housing. At the same instant he heard the flexible gun in the rear of the Lancer begin to chatter and saw another green ship skid out of range of its bullets like a fiddler crab.

Then Bill and the Lancer became the same flaming meteor he had been before as he drove those green ships away from the Sikorsky and gave it an opportunity to disappear into the haze ahead.

"You got Richter?" Bill said into the intercockpit phone.

"Right," Larsen said. "He says he'll take it on through. Aren't you afraid one or two of those ships will slip away and get to him?"

"I am," Bill said. "Deathly afraid. But the five that are left are forming a stepped-up column behind us now. They're going to gang us all at one time before they go after the Sikorsky again. When they get close enough, turn your gun on them. They'll try to close in above us and I'll come up fast and over and let the whole column have both guns while we're inverted. Let me know when they come. The longer they stall the better it will be for Richter. I'm going to contact Shorty and tell him we need him."

"Here they come, Bill!" Larsen screamed a minute later.

Bill waited until he could hear Larsen's gun chattering and could feel the drum of enemy bullets in his tail assembly before he opened his throttles and flashed upward to hang the Lancer on its props until he brought it over on its back. Then he let the nose drop and stuck it on the first of the speeding green column. The green ships

skidded and crabbed and slipped to get out of range of his deadly aim. As they tried to re-form he flipped the Lancer over and was among them again, like a fighting cock striking out to left and right with its sharpened spurs.

Bill was tired now, so tired that his mind and muscles would not coordinate in their usual way. His face was white and strained and his eyes were two red slits of fire.

"I'm not good for much longer, Nels," he said into the intercockpit phone as he sped away from the killing green ships. "Keep your eyes open for the transport and the rest of my men. I'm going to need them. I—" his voice trailed off into a mere whisper.

He flipped his radio key and chanted, "B. B. calling S. N. I. . . . B. B. calling S. N. I."

"You'll have to hurry, Shorty," he said a moment later. "I'm worn out. Here's my position."

"We'll be there in a couple of minutes," Shorty said. "Hang on, Bill!"

Bill went around and around those five green ships for the next couple of minutes, firing burst after burst and eluding their vicious charges as best he could with the Lancer's speed.

When he heard the roar of the twin Diesels in two of his Snorters he seemed to take a new lease on life. He reversed his direction with a dazzling chandelle and started back toward the little formation of green ships. Cy Hawkins and Red Gleason fell in on each side of him, their eyes glittering as they sped into battle.

The skies above the Lunsen Fiord became a thundering, snarling madhouse of flaming guns and roaring motors again. Larsen's eyes were popping out of his head at the fury of the attack of the two Snorters. Planes were whipped and rolled like feathers in a hurricane. It was a vicious duel to the death, with five planes against three.

Cy Hawkins singled out a green ship as they broke formation. In an instant they were locked in a terrific fight, each stabbing and feinting for an advantage. It did not seem that two human beings could live through even a minute of such furious combat. The earth spun around and around in a dizzy circle as they maneuvered to get in a fatal burst of fire.

Then, as Sandy came speeding into the fight followed by Bev Bates and the flying fortress that was the carrier transport, the five green ships flipped their tails in the air and tried to run away. But Bill's men were on them and had them almost at their mercy, when Bill threw his radio switch and roared orders into the microphone.

"Calling all planes. . . . Calling all planes. . . . Calling all planes," he chanted. "Let 'em go! Come on back and fall into formation around the trans-

port. Red and Cy to starboard; Bev and Sandy to port. I'll be a little above and in front of you, Shorty. We want those ships to lead us back to their base. It can't be far from here. I'll stay on their tails and give you your speed and course from time to time. I'll keep 'em in sight with my infra-red telescope."

Bill pulled up the long, rectangular metal case partly sunk in his instrument panel and pivoted it sideways to position over the center of his panel. He glued his eyes to the eyepiece and adjusted the lenses.

"What the hell is that, Bill?" Larsen wanted to know.

"It's a black-light telescope," Bill said. "It's what you need over here with your low ceilings. It projects an invisible beam of infra-red rays which is capable of piercing the thickest fog bank or cloud formation. It is possible to pick out the boundary lights and runway on a field where there is zero visibility."

"We're passing over Moldevaag now, Larsen," Bill went on. "The Sikorsky is down and being trundled over to the gangplank with hand lines. She's safe. Those green ships are keeping right on north. We'll stay on their tails. They figured on losing us in this hazy night visibility." He threw his radio switch and spoke to his men for a moment.

When he again looked through his telescope his whole body tensed. For a moment he could not believe what he saw ahead of him. The five green ships were being joined by a half dozen others that were coming up out of the valley of a fiord. Then Bill sighted the row of hangars, the two radio masts jutting into the air and the long, narrow landing field.

"There are more green planes coming up out of the floor of the valley," he said to his men. "They're all spiraling up to get altitude. I'm going to nose down and drop a couple of bombs on the three bombers that are warming up down there. We'll never be able to handle them if they get into the air. They look as though they mounted cannons and three or four machine guns each. All of you get some altitude and play it safe when they attack. This is their base. Now finish your job! I'm going down!"

Bill jammed the stick of the Lancer forward and nosed it down until he had only a thousand feet between him, the row of hangars and the three twin-motored bombers lined up on the apron. He reached for a switch and turned it to make the four twenty-five-pound bombs in the belly of the Lancer ready for release.

He was only a thousand feet above the little airport in the fiord as he took his sights. An anti-aircraft gun barked below him, and the Lancer bounced as a wisp of white smoke appeared in the air on his left. He brought the Lancer

around in a dazzling Immelmann to spoil their aim as the three Snorters and the Eaglet tossed their tails in the air and dived on the eleven green biplanes that were speeding toward them.

Bill saw four of the green ships above peel off and dive toward him. He was conscious of a terrific pressure on him as he nosed the Lancer down again and reached for the bomb-release lever.

As the four green ships came roaring down on his tail, Bill yanked the stick back and came up on his back and down again, directly over the twin-motored bombers below him. His bomb sights were directly on them when he pulled the release lever.

Two grayish darts sped out of the bottom of the Lancer, their blunt noses taking a true course for their target.

The Lancer bounced again as they drove into the huddled bombers. The earth whirled under Bill's wing tip as he banked around vertically and came back to drop the last of his bombs. As those last two carriers of death exploded, debris that was made up of men's bodies, steel, wood and fabric spewed in every direction. Black smoke welled out of the gas tanks of the battle cruisers that had been bristling with machine guns.

"You just destroyed Von Boett's plane down there!" Larsen screamed in his ear. "You were right! This is where he was coming!"

Five thousand feet above the Lancer the air had become deafening and bewildering. Bill could just see the terrific fight that was going on. Tracer smoke, white and yellow, rose in the dull haze of the midnight sun as the three Snorters, the Eaglet and the carrier transport fought for their lives.

Bill knew it was midnight now because of the strange way the sun hung on the horizon and because of the long shadows across the top of the earth.

Bill went above his men and said to Larsen, "Watch those men of mine!"

They saw young Sandy whip his Eaglet through the air with the reckless abandon of a veteran fighter. He was here and there and everywhere, darting in and out of the frantic struggle as green planes skidded crazily around him. They saw a green ship go over on its side, its rudder biting into the air, to swing in a tight circle. And they saw young Sandy come around behind it and cut it in two with his bullets as it straightened out. The pilot jerked upward in his cockpit, then collapsed over the stick as the ship plunged into a spin and started its journey toward the dark-blue waters of the fiord below.

They saw the five machine guns and the rapid-firer in the transport pouring lead into any green ship they could get within range of their deadly aim.

They saw Cy Hawkins and Red Gleason riding their ships as though they

were a part of them, fainting, jabbing, leading the green ships into false moves and then pouncing with as little mercy as a cat on a mouse.

They saw that staid, brown-eyed Bostonian with the Harvard accent and cultured voice, Bev Bates, tearing through the roaring heavens. They saw him come over in a snap roll and charge into the fight like a man gone mad.

And as suddenly as the heavens had become a bedlam of men seeking the death of their enemies it became quiet again. They were aware that machine guns were no longer making the night hideous with their noises. A mile to the west raced the five remaining green biplanes. On their tails were the three Snorters and the Eaglet, with the transport roaring behind. Bill threw his switch and roared, "Red, Bev, Cy, Sandy, Shorty! Come out of it. Let 'em go. We're going to make a landing on the field below. Shorty, I want you to go in first with all your fixed guns on the hangars—Red and Cy on each side of you. Snap into it! We still have a job to do!"

"What flying, and what fighting, Bill!" Larsen said.

Bill swung around in his seat. His face was suffused with pride. "They'll do," he said. "They'll take anything apart that wants to be taken apart. We've got to get down and get the answer to this, Nels. Watch them take

their ships in on that little strip of land."

They watched them, and Nels Larsen was still shaking his head when Bill sat the Lancer down beside them. The hangars and buildings around them were a shambles. There was no sign of opposition from the men who stood, with their arms raised, before the hangars.

One of them called out to Nels Larsen in his native language.

Larsen answered him. "Von Boett is badly wounded," Larsen said to Bill. "He wants to talk to you."

They found the pig-eyed Von Boett lying on a sofa in what served as an administration building. His mottled face was white now, and any one could have told that he hadn't long to live.

"You win, Barnes," he said. "Somehow I knew you would."

"What did you find up here in 1917, Von Boett?" Bill asked him.

"Gold!" Von Boett said, and his face twisted. "Millions and tens of millions in gold. It was in the hold of a Russian destroyer that had been wrecked in this fiord, evidently trying to get away from a storm. All of her crew were dead. We survived, living on the stores we found on her. We took the gold out and put it in a cache that no one could find. Giest wanted to report it to the authorities if we got out alive. We had to kill him to keep his mouth shut."

"We couldn't think of any way to

get it out of here after the War. We wanted it all for ourselves. Then, when Finnmark began to develop the Midnight Sun Airline we knew it would be found. So we got jobs with them."

"Last summer I managed to get a couple of million dollars out of here. With it I bought the planes, equipment and men I've used to fight you, Barnes. We forced down two planes on the Midnight Sun Airline. The passengers are still captives here. We haven't hurt them. We thought we could force Larsen to close up this leg if he had a couple of disasters. Then we planned on using our planes to take all of the gold out of here before the end of the short summer—"

But Franz Von Boett never spoke again. He choked horribly for a moment. Then his body shook convulsively and he was dead.

"Who gets this gold, Bill?" Larsen wanted to know. "I've heard a tale of the emperor sending out hundreds of millions in gold. It was abandoned and never found again."

"I don't know who gets the bulk of it," Bill said. "But I'm going to get enough of it to pay for the Snorter I lost and the money it cost me to come over here."

"Oh, I'll guarantee that, Bill," Larsen said. "I always pay when a fellow comes to help me in his Sunday pants. I'm glad you had 'em on, Bill!"

GETTING INTO AVIATION

(Continued from page 29)

jobs at present with some of the largest air lines. Airplane-only mechanics are not much in demand for air-line work, as major overhauling of the modern liners is frequently done at the factory.

At leisurely little airports a green, eager boy may fast-talk himself into a job helping a mechanic, but he gets paid little and the training and experience he gets are of doubtful value, depending, of course, on the ability of the mechanic as teacher, the nature of work performed, and so on.

Two of the biggest manufacturing companies have informed us that their skilled workers are recruited mostly from men in similar trades and from men trained in military or commercial aviation schools. Very few are from helpers who have learned on the job. Untrained men have only a slight chance of getting jobs at all. However, a few factories are turning more toward the apprentice system, and hire a limited number of green boys (not younger than 18) and pay them low wages plus instruction, or in at least one case we know of charge the apprentice a small amount while he is learning. (Lists of factories and their addresses may be obtained by writing the bureau of air commerce.)

What kind of training is ordinarily necessary to get a skilled job? Well, in maintenance, if you expect to work in a big base where work is specialized, you may be able to get on the pay roll with knowledge of only one kind of job. For engine work, special airplane-engine training is necessary for a good job. Opportunity for learning on the job depends on the policy of the company. Green men are hired and taught only when school-trained men are not available, and it is harder to learn on the job. In addition to engine work, jobs requiring training different from that obtainable in any other occupation are aircraft sheet-metal work, rigging, propeller care, and instrument repair. In contrast, a high-class machinist from any trade may transfer quite easily to airplane maintenance base work.

FOR maintenance jobs at the medium-sized airports, where work is not so specialized, you would need to be proficient in all phases of maintenance. If you worked without the supervision of a licensed mechanic you would have to hold department-of-commerce licenses as airplane or engine mechanic, or both.

To get a license as an airplane-engine mechanic you must be 18 or over; pass

detailed theoretical and practical examinations in engine maintenance, repair, inspection and overhaul; pass examinations on Aeronautics Bulletin No. 7 (Air Commerce Regulations) and Bulletin No. 7-H (Alterations and Repairs to Licensed Aircraft); and have had two years' practical experience on internal-combustion engines, of which one year must be on aircraft engines.

To get an airplane mechanic's license you would have to have at least one year's actual experience in building, maintaining or repairing aircraft; pass a practical and theoretical examination on aircraft structure, rigging, maintenance, inspection, repair and overhaul; and pass the same examination on Bulletins No. 7 and 7-H. (These may be obtained free from the bureau of air commerce.)

To get a job in manufacturing work, broader training is necessary in the small plants than in the large ones. Training suitable for maintenance mechanics fits a man for some factory jobs, such as final assembly. Detail assembly often requires higher skill and a knowledge of blue prints, and many mechanics' courses do not cover this work. Some of the longer courses do.

A considerable amount of the skilled factory work requires machine-shop ex-

perience, and many of these workers are drawn from other trades and from schools giving machinists' training. Men from similar trades can be broken in easily on certain other types of work—for instance, electrical and radio installation.

There are also various skilled jobs in factory work which are so few in num-



Official Photo, U. S. Army Air Corps.

Army transport of the type used for parachute training.

ber that schools do not prepare for them, and the factories train these men. And there are some unskilled jobs which do not pay very much and from which there is little hope of promotion unless one gets training off the job. Taking one of these jobs might enable a boy to study in a night school (schools are often located near factories) and prepare himself for higher-paid work. But helpers' jobs are hard to get, because so many boys are trying to do just that.

Among the jobs in manufacturing, for which special aviation training is almost always required, are aircraft sheet-metal work, aircraft welding, airplane mechanics (including rigging), and engine mechanics. That's why you'll find aviation schools giving special courses in these branches and comprehensive "master" courses including most or all of them.

What about schools, cost of courses, and time to complete?

A recent survey by the bureau of air commerce showed that the average length of engine mechanics' courses is 43 weeks, and the average cost of tuition \$181; for airplane mechanics', 42 weeks and \$180. Obviously, among the schools questioned were some which give rather sketchy courses, confined to imparting barely enough information and experience to pass the theoretical and practical tests for licenses.

THE top-notch aviation schools offer thorough courses in combined airplane and engine mechanics, which prepare for both maintenance and manufacturing jobs. Included are courses in engines (theory and practice); airplane assembly (repair and rigging); aircraft instruments (theory and practice); propellers; metallurgy, sheet-metal work and welding; theory of mechanics; elementary aerodynamics; mechanical drawing; some radio work; and meteorology. A more

elaborate course is available which also includes study of air transportation, foremanship, machine-shop practice, parachutes, and other subjects.

Tuition for these thorough courses at the best schools is from about \$600 on up to \$1,300, sometimes including (in the higher-priced courses) from 20 to 50 hours of flight training. The time required is from one to two years. Less thorough courses may be had in wide variety at various less expensive prices. Schools gladly send details at the drop of a postal card. Write to the Bureau of Air Commerce, Washington, D. C., for its aviation ground-school list.

In addition to the general courses, special courses in one phase of work may be had. These vary greatly in thoroughness and price. A course in sheet-metal work requires about three months and at the best schools costs about \$200. Under present conditions a graduate would be sure of a job immediately. A welding course at a good school costs about \$100. Welders are in demand at present, especially on the west coast, but not as much as sheet-metal workers. Instrument service and repair courses cost varying amounts up to about \$300, depending on the length and quality of the course. Openings for such men are relatively few, because factories do not need them. But a big air-line company informs us that there is a demand for more such men at present.

Now we come to the military schools, where Uncle Sam feeds you, pays you, and trains you to boot.

The Air Corps Technical School is at Chanute Field, Rantoul, Ill. The courses given and the time required to complete are: airplane mechanic's, 36 weeks; aircraft armorer's, 24 weeks; radio mechanic's and operator's, 28 weeks; aircraft machinist's, 24 weeks; aircraft welder's and sheet-metal worker's, 24 weeks; parachute rigger's, 8 weeks; photographic course, 36 weeks; airplane instrument inspection and maintenance course, 8 weeks; air corps supply and technical clerk's course, 20 weeks. Graduates of the courses which prepare for the kinds of work done in commercial maintenance and manufacturing operations stand high with employers. Many graduates choose, of course, to remain permanently in the air corps.

Enlistment in the air corps for three years is required. Enlistment is open to men from 18 to 35, who are United States citizens or applicants for citizenship, and can pass a moderately rigid physical examination. High-school work is not required for enlistment, but high-school graduation or "its equivalent" is required for admittance to the technical-school courses. Each year of training or experience in work similar to that for which a course prepares counts as a year of high school. This experience can be obtained in the air corps before going

to the school, and "grammar-school-only" men can frequently get to the school within three years, provided they have intelligence and learn arithmetic through decimals, ratio, proportion and square root.

If you already have high-school or equivalent training and want to go immediately to the technical school, you can write directly to The Commandant, Air Corps Technical School, Rantoul, Ill., for information and blanks. There is usually a considerable waiting list for enlistment at the school, and when your turn finally came you'd pay your own way to Rantoul.

You might get in quicker by enlisting in the air corps for service at any field and then taking your chances on being sent in the regular quota from your field. Right now is a good time to follow this method, for the air corps, between March 1 and July 1, 1937, is increasing its enlisted personnel from about 16,000 to 17,784. Apply at any army recruiting station or write for information to Chief of the Air Corps, Washington, D. C. In the past about 700 men a year were trained at Chanute, but with commercial business drawing off trained men, and a 2,300-plane air corps in the offing, the number may be considerably larger in the future.

Privates in the air corps get \$21 a month, uniforms, food, lodging and medical attention. They also become eligible to take out government life insurance.



Official Photo, U. S. Army Air Corps.

Air corps parachute riggers at the Air Corps Technical School prove how good they are—by jumping.

If you choose to remain in the air corps, the pay, to which is always added uniforms, food and lodging (or a cash allowance) and medical attention, is not unattractive. Base pay runs from \$21 to \$126. As a rated mechanic, base pay is never less than \$72 a month. Minimum for a mechanic on flying orders is \$108. Promotions, plus extra pay for reenlistments, plus 50 per cent when on flying duty, may put you up to around \$200 to \$250 a month. If you stay in for 30 years you retire with a sizable portion of your pay for life.

In the April issue of AIR TRAILS, in connection with eligibility for enlisted flight training, we outlined the requirements for enlisting in the navy, possibil-

ity of assignment to aviation-training courses, pay, promotions, and so on. So we won't repeat that here. The main difference to remember in comparing the army and navy possibilities is that in the army you can enlist specifically for the air corps, and even directly at Chanute Field. In the navy you enlist for "general service" and compete with thousands of other "gobs" for assignment to aviation. But in the army an enlisted man cannot get flight training in grade. He does have preference over civilian applicants for appointment as a flying cadet at Randolph Field, provided he is qualified as outlined in the March issue of AIR TRAILS.

When he finishes training and his active duty as a reserve officer, he goes back to civil life or else enlists in the air corps again, to serve as an enlisted pilot. That is, unless he is extremely lucky and gets one of the few regular commissions. But in the navy an enlisted man of exceptional ability may get flight training without having any college work at all.

So much for the ways to get training for nonengineering jobs. What about training for the engineering jobs, where opportunity for advancement to big positions is best?

AVIATION ENGINEERS may be roughly divided into aeronautical engineers, and air-line engineers, though that classification is very loose and not all engineers in aviation work can be fitted into it.

Aeronautical engineers, though generally trained rather broadly, are specialists on the job. Some concentrate on load and stress analysis, some on design problems, some on materials, some on patent research, and others on special projects in various divisions and subdivisions of engineering work. A good engineer digs at his specialty, but also keeps abreast of general developments so he'll be in line for executive positions where he would direct and correlate work of various specialists.

In addition to the deep thinkers and slide-rule fiends in the engineering department, there is the production engineer, who works at increasing the general efficiency of the plant by better coordination of the departments, improved fabrication methods, and so on.

Air-line engineers specialize in such work as developing and improving navigational aids, including radio and instruments; in airport design, lighting and general equipment; in solution of maintenance and inspection problems; and in general improvement of air-line efficiency on the technical side.

Training for the better factory engineering positions invariably involves a four-year course (or its equivalent) in engineering, with aeronautical engineering as the major interest. Postgraduate

work may be advisable, as aeronautical engineering is one of the most difficult of studies. It certainly will be unless your university or school is one of the best. In this connection it may be said that some universities which are not prepared to do so give degrees in aeronautical engineering. In fact, bad aeronautical engineers have been turned out in such numbers by poor schools that the eager young man, falsely led to believe he is an aeronautical engineer, has become something of a comical figure in the industry. The standing of the school counts for as much as the degree. You may get a list from the bureau of air commerce giving addresses of all universities and other schools giving aeronautical training, but you should take steps to find out which are the really good schools. The opinion of a prospective employer would not be amiss. Or you may write and ask the Engineering Council for Professional Development, Washington, D. C., for its list of approved schools.

THE COST of getting a technical education varies so much between different colleges and depends so much on availability of scholarships and self-help, residence of student, and so on, that we will make no estimates along that line. Especially since information from various institutions is easily obtainable.

Several strictly aeronautical schools give technical courses, and some of them command high esteem in the industry. Here are brief descriptions of some of the courses offered:

A nine-months' post-graduate course in air-line work for men who have already graduated from an accredited engineering college. Includes practical and theoretical work in airplane design, assembly and maintenance; in metals fabrication; in engines; in communications equipment and practice; in instruments; principles of air transportation, and other subjects. Tuition \$600.

A two-year course for men who already have two years of college-engineering work. This is designated to fit men for factory or air-line work, and includes courses in airplane design and construction; overhaul and installation of motors; building; installation; maintenance of radio and instrument equipment; and other subjects. The same course may be had with advanced navigational aids, air-line principles, and airport design substituted for airplane design. Tuition, about \$700 a year.

A two-year course open to high-school graduates, which attempts to crowd a four-year course into about 22 months of intensive work. Omits "nonessential" cultural subjects. It is aimed at both air-line and factory work. Tuition, about \$500 per year.

In selecting an engineering school it is a good idea to choose one close to a

manufacturing center. Your training and opportunities are likely to be better there. For instance, it is rumored that one of the largest manufacturing companies in the country gives preference and better chances for advancement to engineers trained in a certain near-by school in which it takes a special and somewhat advisory interest.

The material division of the air corps, in cooperation with the University of Cincinnati and Antioch College, has worked out a scheme whereby certain employees of the division may work part of the time at Wright Field and spend approximately equal periods taking college-engineering courses. In this way those who show sufficient promise may become aeronautical engineers and pay their own way. The value of such a close connection with the material division is obvious. None except civil-service employees may study under this arrangement.

Next month we will give you details about getting aviation jobs in civil service. We will also give you information about opportunities, pay and promotions.

Exaggerations

(Continued from page 39)

onto the "S" hook when he takes it off the winder.

And after the flight the builder usually consoles himself by doubling the duration, since he's convinced the rubber was only half wound. No one has ever been cruel enough to count the turns and inform him that his half-wound motor was practically fully wound.

Estimation of glide ratios or sinking speed gives rise to some wild stories. No self-respecting modeler will admit that his ship has a glide ratio of anything less than ten or fifteen to one. But it is interesting to watch how quickly the last foot of altitude disappears when the model nears the ground. This brings estimates of glide ratios into the same category as the large fish which got away. But never bring this fact to the builder's attention or you will lose a friend.

A story we heard the other day shows how fertile the modeler's mind really is in concocting stories. Discussing the widespread popularity of gas models, some one wondered if the descendants of the present crop of gas modelers will be born with two large fingers especially suitable for cranking gas motors. And too, these descendants might be able to run through all sorts of obstacles never taking their eyes off the model flying directly overhead. They should have remarkable tree-climbing ability. And the set-up would be ideal if nature could equip them with a sort of telescoping arm that could be extended to lift the model out of the top branches.

STREAMLINED AMPHIBIAN

(Continued from page 60)

The wing is mounted in the top, hull notch, the resulting break in outline being molded with plastic wood or wood filler.

Shape the tip floats from scrap balsa and mount on bamboo struts.

PAINTING

Coat the entire model with clear varnish, white shellac, or clear dope to fill the pores. Sand lightly where possible before brushing the top coats. The paints, black and white, are schemed as shown by the photo.

Cut two props from scraps, paint aluminum, and attach with pins so that they are free to turn.

The windows are painted white and trimmed with black.

MATERIALS

- 1 block $9 \times 2 \frac{3}{4} \times 1 \frac{1}{2}$ "
- 2 blocks $2 \frac{1}{2} \times 1$ " sq.
- 2 blocks $1 \frac{1}{8} \times 1 \frac{1}{2}$ " sq.
- 1 $\frac{1}{8} \times 2 \times 5$ " sheet balsa.
- 1 $\frac{3}{8} \times 2 \frac{1}{2} \times 13$ " sheet balsa.
- 1 $\frac{1}{4} \times 3 \times 3$ " sheet balsa
- 1 pair $\frac{3}{4}$ " wheels
- 1 $\frac{1}{4}$ " wheel
- $\frac{1}{2}$ oz. cement
- 1 oz. clear varnish, dope, or white shellac
- white and black lacquers, or dopes.

Modern Motors

(Continued from page 33)

In particular, was already overburdened with things to remember, it was apparent that this would have to be removed. So they devised the boost control.

Fundamentally, the automatic boost control consists of a servo-cylinder and piston which operate an auxiliary throttle lever and are controlled by aneroid pressure. A battery of aneroid capsules is connected to a piston valve. An increase or decrease in the rated boost pressure will collapse or expand the capsules, the movement of which causes the piston valve to admit air to one side or the other of the servo-piston, which controls the auxiliary throttle and limits the power output to the maximum desired.

In the single-stage type of supercharger such as this, the servo-piston is pneumatically operated, use being made of the difference in pressure which exists between the supercharger inlet and the delivery pipes. Some superchargers use oil for operating the servo-piston, the oil being taken from the main engine lubricating system.

We should, of course, explain here, for

the benefit of those who are not clear on the function of the supercharger, that the device is used to supply the engine with the explosive mixture under pressure. It should be apparent to the reader that an engine which relies on air for its fuel mixture will find "breathing" difficult at high altitudes, just as does the pilot who is flying the plane.

At sea level the atmosphere has a pressure of 14.7 lbs. per sq. in. At 5,000 ft. this pressure drops to approximately 12.13 lbs. per sq. in., and at 10,000 ft. it drops to approximately 10 lbs. Thus, we must see that after the piston has forced the mixture into a compressed condition at a height of say, 10,000 ft., the final pressure will be much lower than it was near the ground. If, for instance, the atmospheric pressure at 20,000 ft. drops to about one half the air pressure at sea level, it will be seen that the engine will develop only half its rated horse power. So, to make up for this loss of air pressure, some artificial means had to be devised to force the mixture to the cylinders at normal atmospheric pressure.

Early ideas included forms of blowers usually worked by a turbine system off the exhaust. They tried various types of pumps, plunger, rotary piston and centrifugal. These pumps could also be worked by ordinary mechanical means. There were many difficulties to be faced and overcome. In the exhaust-turbine drive there was a possibility of

weakening the impeller blades by the high temperature to which they were exposed, combined with the high stresses as the result of centrifugal force. Then again the use of a turbine drive brought up the possibility of creating serious back pressure on the exhaust, which would cut down the power considerably.

However, the designers realized that if the atmospheric pressure at high altitudes was lessened, it in turn reduced resistance to the plane, and that the power that could drive a plane at 250 m.p.h. at sea level would drive it much faster at 20,000, and faster still at 30,000 ft., if they could devise some way to maintain that power at that altitude. They kept on working on the supercharger idea, and to-day it is an accepted device on all high-power engines.

The army air corps has standardized, in a general way, on 2 types of superchargers: pressure type and suction type. The only difference between the 2 is the relative position of the carburetor to the supercharger. In the suction system the carburetor is set at the opening of the supercharger, while in the pressure system it is placed between the supercharger and the intake valve. Our supercharger illustration is that of the suction type.

Now we are beginning to discover what improvements have been necessary to produce 1,000 horse power in an airplane engine. New high-tensile steels, lighter and stronger alloys, and more

WOULD YOU LIKE TO WIN \$10 CASH AND \$10 WORTH OF KITS OR SUPPLIES FREE

All you have to do is find the greatest number of words in the letters

Number the words from 1 up. Put each on a separate line. Do not use names or proper nouns.

Send in your entry with an order for \$1 or more, not later than July 31, 1937.

The decision of the judges will be final. In case of tie, duplicate prizes will be awarded.

The winner receives \$10 cash and \$10 worth of any kits or supplies in the Imperial line, including, if desired, a BROWN JR. GAS MOTOR.

Whether you win the Grand Prize or not, your entry entitles you to free membership in the Imperial Club, with free Club Pin—altogether with our regular Free offer. THE SIMPLEST CONTEST YOU EVER ENTERED!

EVERYBODY WINS!

24-HOUR SERVICE :: SEND 2c POSTAGE FOR CATALOG

18" Balsa 1/16x1/16, 100, 5c 1/16x3/16, 35 for 5c 1/16x3/16, 18, 5c 1/16x1/2, 15 for 5c 3/32x3/32, 30, 5c 3/32x1/2, 30 for 5c 1/8x1/8, 12 for 5c 3/16x1/8, 10 for 5c 3/16x3/16, 8, 5c 3/16x1/2, 6 for 5c 3/16x3/4, 3 for 5c 3/16x1, 2 for 5c 1/4x1/4, 6 for 10c 1/4x1/2, 8 for 10c 1/4x3/4, 8 for 10c 3/32x1/2, 7 for 10c 3/32x1, 6 for 10c 3/16x1/2, 3 for 9c 3/16x1, 3 for 10c 3 sheets or 36" lengths, double above prices; add 1c packing charge for 36" lengths.	TISSUE, AA All col., doz. 19c Silver, .50, 5c Superfine, wh. 5c WHEELS per pr. Brh Bls Celu 1/4 .01 .03 3/4 .02 .04 .05 1 1/4 .03 .05 .07 1 3/4 .04 .08 .10 1 7/8 .07 .10 .16 3 .15 .30 PINE WHLS., pr. 3/4 4c; 1" 6c 1 1/2 8c; 1 3/4 12c NOSE BLOCKS Both sides alike 1x2x15c 2x2x12c 3x2x15c 3x3x28c 3x3x310c INSIGNIA 24 and stripes 5c WASHERS 1 doz. 3/4 or 1 1/4 1c THRU BEARINGS Small, .0002, 10c Large, .0002, 15c RUBBER 1/4x1/425 ft. 5c 1/8x1/820 ft. 5c 1/4 flat18 ft. 5c 3/16 flat 12 ft. 5c Skein50c	RUBBER LUBRICANT Large bottle 10c PROPELLER BLOCKS 1/2x 3/4x 5 8-5c 1/2x 3/4x 6 6-5c 3/4x1 x 7 4-5c 3/4x1 x 8 3-5c 3/4x1 1/2x10 5-5c 3/4x1 1/2x12 3-5c 1 x1 1/2x12 4-5c 1 x1 1/2x15 6-5c SHEET ALUM. 1/16x12x361c 1/16x12x481c 1/16x12x721c 1/16x12x961c 1/16x12x1201c 1/16x12x1441c 1/16x12x1681c 1/16x12x1921c 1/16x12x2161c 1/16x12x2401c 1/16x12x2641c 1/16x12x2881c 1/16x12x3121c 1/16x12x3361c 1/16x12x3601c 1/16x12x3841c 1/16x12x4081c 1/16x12x4321c 1/16x12x4561c 1/16x12x4801c 1/16x12x5041c 1/16x12x5281c 1/16x12x5521c 1/16x12x5761c 1/16x12x6001c 1/16x12x6241c 1/16x12x6481c 1/16x12x6721c 1/16x12x6961c 1/16x12x7201c 1/16x12x7441c 1/16x12x7681c 1/16x12x7921c 1/16x12x8161c 1/16x12x8401c 1/16x12x8641c 1/16x12x8881c 1/16x12x9121c 1/16x12x9361c 1/16x12x9601c 1/16x12x9841c 1/16x12x10081c 1/16x12x10321c 1/16x12x10561c 1/16x12x10801c 1/16x12x11041c 1/16x12x11281c 1/16x12x11521c 1/16x12x11761c 1/16x12x12001c 1/16x12x12241c 1/16x12x12481c 1/16x12x12721c 1/16x12x12961c 1/16x12x13201c 1/16x12x13441c 1/16x12x13681c 1/16x12x13921c 1/16x12x14161c 1/16x12x14401c 1/16x12x14641c 1/16x12x14881c 1/16x12x15121c 1/16x12x15361c 1/16x12x15601c 1/16x12x15841c 1/16x12x16081c 1/16x12x16321c 1/16x12x16561c 1/16x12x16801c 1/16x12x17041c 1/16x12x17281c 1/16x12x17521c 1/16x12x17761c 1/16x12x18001c 1/16x12x18241c 1/16x12x18481c 1/16x12x18721c 1/16x12x18961c 1/16x12x19201c 1/16x12x19441c 1/16x12x19681c 1/16x12x19921c 1/16x12x20161c 1/16x12x20401c 1/16x12x20641c 1/16x12x20881c 1/16x12x21121c 1/16x12x21361c 1/16x12x21601c 1/16x12x21841c 1/16x12x22081c 1/16x12x22321c 1/16x12x22561c 1/16x12x22801c 1/16x12x23041c 1/16x12x23281c 1/16x12x23521c 1/16x12x23761c 1/16x12x24001c 1/16x12x24241c 1/16x12x24481c 1/16x12x24721c 1/16x12x24961c 1/16x12x25201c 1/16x12x25441c 1/16x12x25681c 1/16x12x25921c 1/16x12x26161c 1/16x12x26401c 1/16x12x26641c 1/16x12x26881c 1/16x12x27121c 1/16x12x27361c 1/16x12x27601c 1/16x12x27841c 1/16x12x28081c 1/16x12x28321c 1/16x12x28561c 1/16x12x28801c 1/16x12x29041c 1/16x12x29281c 1/16x12x29521c 1/16x12x29761c 1/16x12x30001c 1/16x12x30241c 1/16x12x30481c 1/16x12x30721c 1/16x12x30961c 1/16x12x31201c 1/16x12x31441c 1/16x12x31681c 1/16x12x31921c 1/16x12x32161c 1/16x12x32401c 1/16x12x32641c 1/16x12x32881c 1/16x12x33121c 1/16x12x33361c 1/16x12x33601c 1/16x12x33841c 1/16x12x34081c 1/16x12x34321c 1/16x12x34561c 1/16x12x34801c 1/16x12x35041c 1/16x12x35281c 1/16x12x35521c 1/16x12x35761c 1/16x12x36001c 1/16x12x36241c 1/16x12x36481c 1/16x12x36721c 1/16x12x36961c 1/16x12x37201c 1/16x12x37441c 1/16x12x37681c 1/16x12x37921c 1/16x12x38161c 1/16x12x38401c 1/16x12x38641c 1/16x12x38881c 1/16x12x39121c 1/16x12x39361c 1/16x12x39601c 1/16x12x39841c 1/16x12x40081c 1/16x12x40321c 1/16x12x40561c 1/16x12x40801c 1/16x12x41041c 1/16x12x41281c 1/16x12x41521c 1/16x12x41761c 1/16x12x42001c 1/16x12x42241c 1/16x12x42481c 1/16x12x42721c 1/16x12x42961c 1/16x12x43201c 1/16x12x43441c 1/16x12x43681c 1/16x12x43921c 1/16x12x44161c 1/16x12x44401c 1/16x12x44641c 1/16x12x44881c 1/16x12x45121c 1/16x12x45361c 1/16x12x45601c 1/16x12x45841c 1/16x12x46081c 1/16x12x46321c 1/16x12x46561c 1/16x12x46801c 1/16x12x47041c 1/16x12x47281c 1/16x12x47521c 1/16x12x47761c 1/16x12x48001c 1/16x12x48241c 1/16x12x48481c 1/16x12x48721c 1/16x12x48961c 1/16x12x49201c 1/16x12x49441c 1/16x12x49681c 1/16x12x49921c 1/16x12x50161c 1/16x12x50401c 1/16x12x50641c 1/16x12x50881c 1/16x12x51121c 1/16x12x51361c 1/16x12x51601c 1/16x12x51841c 1/16x12x52081c 1/16x12x52321c 1/16x12x52561c 1/16x12x52801c 1/16x12x53041c 1/16x12x53281c 1/16x12x53521c 1/16x12x53761c 1/16x12x54001c 1/16x12x54241c 1/16x12x54481c 1/16x12x54721c 1/16x12x54961c 1/16x12x55201c 1/16x12x55441c 1/16x12x55681c 1/16x12x55921c 1/16x12x56161c 1/16x12x56401c 1/16x12x56641c 1/16x12x56881c 1/16x12x57121c 1/16x12x57361c 1/16x12x57601c 1/16x12x57841c 1/16x12x58081c 1/16x12x58321c 1/16x12x58561c 1/16x12x58801c 1/16x12x59041c 1/16x12x59281c 1/16x12x59521c 1/16x12x59761c 1/16x12x60001c 1/16x12x60241c 1/16x12x60481c 1/16x12x60721c 1/16x12x60961c 1/16x12x61201c 1/16x12x61441c 1/16x12x61681c 1/16x12x61921c 1/16x12x62161c 1/16x12x62401c 1/16x12x62641c 1/16x12x62881c 1/16x12x63121c 1/16x12x63361c 1/16x12x63601c 1/16x12x63841c 1/16x12x64081c 1/16x12x64321c 1/16x12x64561c 1/16x12x64801c 1/16x12x65041c 1/16x12x65281c 1/16x12x65521c 1/16x12x65761c 1/16x12x66001c 1/16x12x66241c 1/16x12x66481c 1/16x12x66721c 1/16x12x66961c 1/16x12x67201c 1/16x12x67441c 1/16x12x67681c 1/16x12x67921c 1/16x12x68161c 1/16x12x68401c 1/16x12x68641c 1/16x12x68881c 1/16x12x69121c 1/16x12x69361c 1/16x12x69601c 1/16x12x69841c 1/16x12x70081c 1/16x12x70321c 1/16x12x70561c 1/16x12x70801c 1/16x12x71041c 1/16x12x71281c 1/16x12x71521c 1/16x12x71761c 1/16x12x72001c 1/16x12x72241c 1/16x12x72481c 1/16x12x72721c 1/16x12x72961c 1/16x12x73201c 1/16x12x73441c 1/16x12x73681c 1/16x12x73921c 1/16x12x74161c 1/16x12x74401c 1/16x12x74641c 1/16x12x74881c 1/16x12x75121c 1/16x12x75361c 1/16x12x75601c 1/16x12x75841c 1/16x12x76081c 1/16x12x76321c 1/16x12x76561c 1/16x12x76801c 1/16x12x77041c 1/16x12x77281c 1/16x12x77521c 1/16x12x77761c 1/16x12x78001c 1/16x12x78241c 1/16x12x78481c 1/16x12x78721c 1/16x12x78961c 1/16x12x79201c 1/16x12x79441c 1/16x12x79681c 1/16x12x79921c 1/16x12x80161c 1/16x12x80401c 1/16x12x80641c 1/16x12x80881c 1/16x12x81121c 1/16x12x81361c 1/16x12x81601c 1/16x12x81841c 1/16x12x82081c 1/16x12x82321c 1/16x12x82561c 1/16x12x82801c 1/16x12x83041c 1/16x12x83281c 1/16x12x83521c 1/16x12x83761c 1/16x12x84001c 1/16x12x84241c 1/16x12x84481c 1/16x12x84721c 1/16x12x84961c 1/16x12x85201c 1/16x12x85441c 1/16x12x85681c 1/16x12x85921c 1/16x12x86161c 1/16x12x86401c 1/16x12x86641c 1/16x12x86881c 1/16x12x87121c 1/16x12x87361c 1/16x12x87601c 1/16x12x87841c 1/16x12x88081c 1/16x12x88321c 1/16x12x88561c 1/16x12x88801c 1/16x12x89041c 1/16x12x89281c 1/16x12x89521c 1/16x12x89761c 1/16x12x90001c 1/16x12x90241c 1/16x12x90481c 1/16x12x90721c 1/16x12x90961c 1/16x12x91201c 1/16x12x91441c 1/16x12x91681c 1/16x12x91921c 1/16x12x92161c 1/16x12x92401c 1/16x12x92641c 1/16x12x92881c 1/16x12x93121c 1/16x12x93361c 1/16x12x93601c 1/16x12x93841c 1/16x12x94081c 1/16x12x94321c 1/16x12x94561c 1/16x12x94801c 1/16x12x95041c 1/16x12x95281c 1/16x12x95521c 1/16x12x95761c 1/16x12x96001c 1/16x12x96241c 1/16x12x96481c 1/16x12x96721c 1/16x12x96961c 1/16x12x97201c 1/16x12x97441c 1/16x12x97681c 1/16x12x97921c 1/16x12x98161c 1/16x12x98401c 1/16x12x98641c 1/16x12x98881c 1/16x12x99121c 1/16x12x99361c 1/16x12x99601c 1/16x12x99841c 1/16x12x100081c 1/16x12x100321c 1/16x12x100561c 1/16x12x100801c 1/16x12x101041c 1/16x12x101281c 1/16x12x101521c 1/16x12x101761c 1/16x12x102001c 1/16x12x102241c 1/16x12x102481c 1/16x12x102721c 1/16x12x102961c 1/16x12x103201c 1/16x12x103441c 1/16x12x103681c 1/16x12x103921c 1/16x12x104161c 1/16x12x104401c 1/16x12x104641c 1/16x12x104881c 1/16x12x105121c 1/16x12x105361c 1/16x12x105601c 1/16x12x105841c 1/16x12x106081c 1/16x12x106321c 1/16x12x106561c 1/16x12x106801c 1/16x12x107041c 1/16x12x107281c 1/16x12x107521c 1/16x12x107761c 1/16x12x108001c 1/16x12x108241c 1/16x12x108481c 1/16x12x108721c 1/16x12x108961c 1/16x12x109201c 1/16x12x109441c 1/16x12x109681c 1/16x12x109921c 1/16x12x110161c 1/16x12x110401c 1/16x12x110641c 1/16x12x110881c 1/16x12x111121c 1/16x12x111361c 1/16x12x111601c 1/16x12x111841c 1/16x12x112081c 1/16x12x112321c 1/16x12x112561c 1/16x12x112801c 1/16x12x113041c 1/16x12x113281c 1/16x12x113521c 1/16x12x113761c 1/16x12x114001c 1/16x12x114241c 1/16x12x114481c 1/16x12x114721c 1/16x12x114961c 1/16x12x115201c 1/16x12x115441c 1/16x12x115681c 1/16x12x115921c 1/16x12x116161c 1/16x12x116401c 1/16x12x116641c 1/16x12x116881c 1/16x12x117121c 1/16x12x117361c 1/16x12x117601c 1/16x12x117841c 1/16x12x118081c 1/16x12x118321c 1/16x12x118561c 1/16x12x118801c 1/16x12x119041c 1/16x12x119281c 1/16x12x119521c 1/16x12x119761c 1/16x12x120001c 1/16x12x120241c 1/16x12x120481c 1/16x12x120721c 1/16x12x120961c 1/16x12x121201c 1/1
--	---	---

scientific means of testing parts and discovering hidden flaws have all contributed to the improvement and power of the engine. The steel propeller, with its greater strength and more scientific design, has also played a big part in enabling the designer to boost the r.p.m.

Probably the greatest problem the designers had to tackle when they undertook to increase the horse power and crank-shaft speeds of their engines was that of cooling. In the great fight of power versus weight, they knew that once they increased the speed of the moving parts they had to provide for extra cooling agencies.

During the War, aircraft engines were going crazy with r.p.m. speeds of about 1,400. To-day 2,600 is nearer the general mark, and the cooling and lubrication problems have increased accordingly.

First came the old bugaboo, the exhaust valve. This has always been a big problem, particularly in air-cooled engines. Racing at terrific speeds, burning new high anti-knock fuels, the exhaust valves were under a continual hosing of intense heat and flame that hissed through the exhaust port. The designers had to take care of 2 phases of cooling on this point alone. The valve seat had to be designed to stand this heat, and the valve stems also had to be given special attention. The valve seats went through several phases until they selected the tulip type with a thick rim, which appears to be generally adopted everywhere. They increased the size of the valve also, which helps in diffusing the heat.

The stem-cooling problem was somewhat more difficult, but to-day most high-power aero engines use what is known as the salt-cooled valve stem. In this we find the valve stem hollowed out and the space partially filled with a mixture of fusible salts. The salts generally used are composed of metallic sodium and sodium chloride. For this reason this type of valve has become known as the sodium valve.

The research into valve cooling has been carried on for years, and the subject would fill many such articles of this length. It also includes research into suitable metals for the valve seats and certain oil-lubrication systems which appear very complicated when expressed in words or type.

How important all this cooling means in high-speed engines can perhaps be best explained by studying the British Schneider Cup winner of 1929, which used the Rolls-Royce "R" racing-type engine. It will be remembered that this plane was the usual low-wing racing seaplane. To assure complete cooling in every part of this high-speed motor the designers first used 2 full-sized radiators built into the metal wing. In this way they took care of the water-cooling problem of the engine. The oil tank was located in the fin and a special network of oil-cooling tubes were built into the sides of the fuselage.

In the Macchi-Castoldi racer this system was further improved by placing the oil tanks in the nose of the fuselage and running the heated oil through a series of oil radiators mounted on the upper surfaces of the floats. The water-radiation system was carried in wing radiators and then through smaller radiator surfaces mounted on the fronts of the floats, around the float struts, and even in a generous-sized section of the rear portion of the fuselage.

To-day most of these cooling features first used in racing planes have been adapted to high-power engines used on air transport and military planes. The oil radiator is a standard feature on most heavy-duty aero engines, while the water-cooling system has seen the shift of the radiator from the forward portion of the nose to the wings, or in special tunnels set under the engine.

In this country, where the air-cooled radial has held top position, the problem of air cooling high-power engines has had to be tackled from many angles. With the increase in size, number of cylinders and, of late, the double-row vogue

coming in, the cooling question has been the one that has given the designers the most worry.

As we pointed out 2 months ago, air-cooling a radial was much harder than cooling a whirling rotary. The front sides of the cylinders got all the benefit of the air stream. As a matter of fact, back in 1932 the army engineers were of an opinion that the air-cooled engine had reached its peak with 600 h.p. and were seriously considering a new drive for a good water- or chemical-cooled Vee-type engine. It was admitted then that to increase the size of the radial by adding another row of cylinders was impractical because they could see no way of cooling the rear bank.

However, that was 5 years ago. Now the designers are chuckling at their old fears, for a simple cowl costing less than \$25 to build solved all their problems. This was the national-advisory-committee-for-aeronautics cowl, which added about 30 per cent to the effective horse power of airplanes in flight. This cowl, which looks like a large metal bowl with an opening in the center for the prop shaft to protrude through, appears on first glance to effectively cover the whole engine. However, owing to its efficient design, enough air came through the opening in the front to suitably cool the engine. Not only did it improve the cooling of the engine by properly distributing air around the cylinders, but it added speed to the plane.

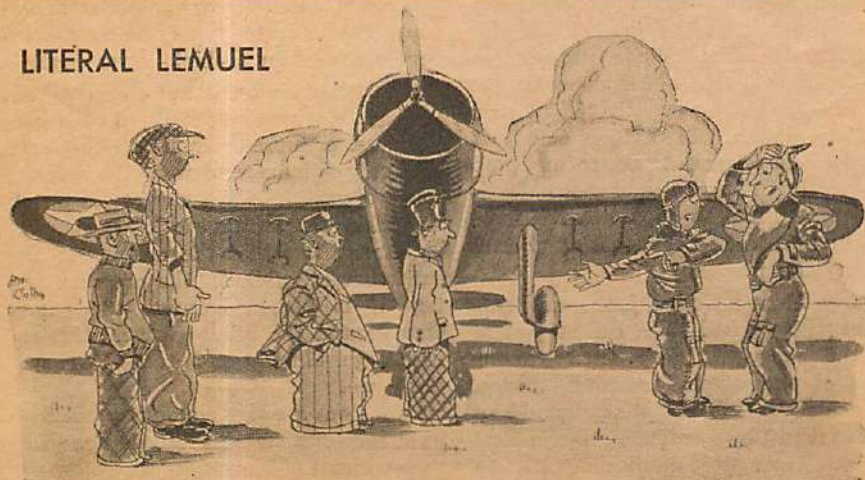
For instance, a ship with a maximum speed of 118 m.p.h., using an uncowed motor, was fitted with this N. A. C. A. cowl and taken into the air. Under the same weather conditions, and with the engine running at the same r.p.m., this top speed was increased to 137 m.p.h.

With the coming of even more powerful engines and the double-row radial, the cowl was further improved by the use of metal flaps that could be opened or closed at will by the pilot. These flaps were adjustable from the cockpit and controlled the quantity of air passing through the engine.

How much further we can go with this air-cooled radial is not yet known. For years now they have been sounding the death knell of the radial, but as the months and years go by new problems come up and are overcome. To-day we have air-cooled radials developing nearly 1,500 h.p. which come off the production lines like automobiles. The 1,000 h.p. engine is here to stay.

Mr. Roy Fedden, a noted aircraft-engine expert, recently gave a lecture in London before a critical audience of aircraft manufacturers, in which he hinted that within 5 years 1,000 h.p. radials will be commonplace and that 12-cylinder, air-cooled, horizontally opposed engines will soon be available that will give 1,550 h.p.

LITERAL LEMUEL



"How do ya get the bums in the bumrack?"

AIR PROGRESS

(Continued from page 7)

new Fairey Battle Junior, a small edition of the earlier type Battle bomber, is said to be the fastest single-engine bomber in the world. The actual speed has not been divulged. Another Koolhoven fighter, the F.K.52, powered with a Bristol Mercury, does 230 m.p.h. at 14,000 feet. It is listed as a two-seater fighter.

Germany recently launched a new high-speed airplane rescue ship named the *Hans Rolshoven* at Hamburg. The Scottish Aircraft and Engineering Co. of London, which is building the Burnelli planes under license, is also building a new troop carrier, a bomber-fighter and a torpedo carrier. They will be known as the Clyde ships.

RACING AND MISCELLANEOUS

The proposed Lindbergh Transatlantic Air Race is getting very little attention in this country, although it has been reported that Dick Merrill and Captain

Lewis A. Yancey are planning to make an entry. It appears that the original rules have been revised and the race will be held over the month of August; that is to say, an entrant may start at any time during that month, and his time will be checked from New York to Paris.

The rule that bars single-engine ships has kept many American pilots out, so they are grooming their mounts for the annual speed races, which will be held in Cleveland in September. Michel Detroyat, last year's great winner, plans to return, along with several other noted foreign racing stars.

An international glider competition will be staged at Wasserkuppe, Germany, by the Aero-Club von Deutschland from July 4th-18th. It is believed that several American glider pilots will go across to take part.

The German Junkers works are working on a new 4-crank-shaft Diesel of

2,000 h.p. with a specific weight of less than 1.1 lb. per horse power.

Because he believed there was an unjustifiable delay in the delivery of military aircraft, M. Pierre Cot, the French air minister, has decided to requisition the Morane Saulnier aircraft factory. The British air ministry is considering a plan to give aeronautical instruction in public schools, in addition to the usual O. T. C. training.

The failure of undercarriages and their accessories, such as brakes, wheels and tires, has been responsible for 25 per cent of all air-line accidents, according to a recent report made by the bureau of air commerce. Pilot and personnel error was blamed for 37.5 per cent of the accidents. Bad weather comprised a negligible per cent.

Believe it or not, but the new Douglas D.C.3. requires 5,300 ft. of wiring to connect up the various electric circuits carried in the noted transport.

DEAR HARRY—

(Continued from page 30)

The *Sunstreak* dives again, levels out and points its nose at the sky. Up it goes in a vertical climb, reaches its limit and falls off into a sideslip.

Norwood whistles in amazement. "I agree with you. The boy is a born flier or he would have crashed before now. But his recklessness is due to bring about the end of his career. He'll never land that plane and live."

Sterling is bringing his ship in low over the field. He banks sharply, wing tip seeming almost to scrape the ground, shoots the powerful plane into a wild zoom and circles the field.

"He's going to land," Norwood's voice is low, tense.

The little speed plane is dipping, darting down to the airport. It starts to level out, traveling at meteoric speed, then climbs away with a wide-open motor as Sterling decides on another landing attempt.

"Lost his nerve that time," Norwood says.

The second trial. Sterling dives and skims over the field—lower and lower. The wheels touch. The ship rebounds into the air and again thunders away to height and safety.

Third attempt. The plane bears down on the field in a long, slanting dive, sinks slowly to the earth, makes contact with wheels and tailskid, decreases its terrific speed and comes to a stop.

Norwood and those about him are petrified.

"A three-pointer!" Norwood exclaims. "He's down safe!"

The racing plane turns, taxis up to the hangars.

"Sterling," Norwood begins, "I want to say—"

The pilot of the racer climbs out of the cockpit and whips off helmet and goggles to expose a merrily smiling face—but not the face of Steve Sterling—that of Speed Spaulding!

"What—what?" Norwood stammers, but no more need be recorded.

Well, you're, of course, wondering how I worked the big surprise. Here's how.

While talking to Speed Spaulding I thought of the idea of disguising him in my clothes and having him fly the *Sunstreak* racer, mainly to give Norwood a thrill. As soon as I put the idea up to Spaulding he fell in line with great enthusiasm.

The rest you know. Dressed in my flying outfit with my helmet and goggles concealing his face, Speed fooled even the mechanics. And then he put on the air show, purposely pretending that a green hand was on the stick.

Boy, oh, boy! Ten years from now they'll still be talking of the joke Spaulding and I pulled off to-day. And ten years from now Norwood's face will still turn a delicate pink when I remind him of it.

Presto!

We will at this point change scene and subject.

Remember the episode of the aviation

club described in my second-last letter? You recollect how I brought over a transport plane for the aviation club to inspect and the Crosbyites replaced the transport with a light plane, thus putting me in a very embarrassing position and enabling them to have a laugh at my expense.

Well, ever since then I have been waiting for a chance to pull something on Crosby and his followers. Of course, I have no real grudge against them. But I do yearn to have a laugh at *their* expense before my air-school days come to a close.

My opportunity comes—and I seize it before it can get away.

An air meet is to be held at a neighboring airport and Norwood is invited to send over some of his advanced students to show what they can do in the line of stunt flying.

At the noon hour Norwood informs the students of this invitation and asks who would like to go. Crosby and three of his pals volunteer.

It happens that I am not present at the time Norwood makes the announcement, but upon hearing of it decide that I would like to go and stunt, also. Looking up Crosby I inform him that he and his three friends will have company in the form of myself, when they go forth to show their stunting skill.

"What!" howls Crosby. "We'll stay home rather than be seen with you. Norwood ought to know better than to let you go to the meet. I suppose you'll

pull off some wild flying and break your fool neck."

"So?" I say. "Well, Crosby, if you and your pals feel that way about it you can go to the meet alone. I won't force myself on you."

Which serves to soothe Crosby. And on the appointed day he and his three henchmen fly away to the air meet. It is left to me to journey there as a lowly motorist in a borrowed flivver.

Ambling about the airport after my arrival I locate the four Crosby planes. They are standing on the line, apart from the rest, ready for action when their time comes, which, according to the program will be in about an hour.

Going back to my car I put on a mechanic's coverall. Later, when most of the crowd of spectators is down at the other end of the airport watching spot landings I visit three of the Crosby ships, removing from the engine of each enough vital parts to insure their complete inability to fly. Any one noticing me, of course, takes it for granted that I am a mechanic working on the ships.

Returning to my car again I remove the mechanic's outfit, drive out of the airport and cache the engine parts in a ditch some distance away from the airport grounds. Safe and sure, that's me.

Back at the airport I climb into the fourth Crosby ship, the only one that is in condition to fly. And I am just in time.

"Event No. 3!" comes the roar of the program announcer's voice over the

loudspeakers. "Stunt flying by four student pilots from Skyways Air School."

Even as I push the starter I see the four Crosbyites hastening to their planes. They look up in surprise as my motor roars into life.

Instantly, Crosby recognizes me. He yells to the other three and they all begin to run.

I open the throttle in a hurry. The ship rolls down the field and into the air. And right then and there I give the crowd and myself a thrill that is not on the program.

My motor is cold. It coughs, misses, and spits like nobody's business. I am losing height fast. I dive, jazzing the throttle. The motor picks up—fails—picks up again. The wheels hit the earth an awful whack. The plane bounces—and what a bounce!

The packed grand stands are looming up dead ahead. I must not crash into them! I bank around, almost slipping into the ground—to find a hangar in front of me!

Desperate, I essay a suicidal climbing turn—get away from the hangar—and almost go into a spin. But the motor is running steadily now, warming rapidly.

Wiping a gallon of sweat from my brow I look down. The Crosbyites are working like busy bees on the motors of the three remaining ships.

I cut my throttle and the amplified

voice of the program announcer blasts to my ears.

"—seems that three of the Skyways Air School planes won't start, folks. But anyway one pilot has taken off, so we'll probably see some stunting."

And they will!

I cut loose with every stunt I know, do everything but turn the ship inside out. Dives, loops, spins, sideslips, barrel rolls, falling leafs, I perform 'em all. Finally I am finished and glide down to a landing in the center of the field.

Over my idling motor I again hear the announcer's voice.

"Folks, the exhibition is over—and what an exhibition! I think you'll all agree with me when I say that Skyways Air School turns out mighty fine fliers."

Oh, my. Does Steve Sterling blush behind his goggles at this praise. So overcome is he that he almost fails to perceive the oncoming rush of four furious Crosbyites—four bloodthirsty tigers with a single thought—the destruction of that same Steve Sterling.

I gun the motor and speed into a quick take-off. From a safe altitude I look and laugh down upon the four raging figures that stare up at me and shake futile fists. A happy moment, truly.

Well, that's the story. Keep a sharp lookout for my next letter. I'll be writing another before long (provided the murderous Crosbyites don't tear me limb from limb). And so—

Yours,

STEVE.

AERIAL PHOTOGRAPHY with a MINIATURE CAMERA

(Continued from page 22)



This photo, taken from a sport plane, accentuates the buildings and shadows.

Although the fine-grain films may be used, the supersensitive varieties are to be preferred because of their greater

speed. An exposure of $1/200$ of a second at $f:4.5$ using a K 2 filter in bright sunlight will—with the proper development—give a very nice negative full of detail. The shutter speed given will stop any motion when flying at an altitude of from 600 to 1000 feet on a smooth day.

Infra-red film may also be used, but lenses of large aperture are needed. Exposures of about $1/50$ to $1/100$ of a second at $f:2$ will be necessary when using the Wratten A filter and photographing in bright sunlight. This film is desirable when very long distance is to be photographed. The speed of infra-red sensitive film may be increased from three to four times by hypersensitizing. In order to accomplish this, a four per cent solution of ammonia is prepared—four parts of twenty-eight per cent ammonia to one hundred parts of water. The film is bathed in this solution for one minute and then dried very quickly, preferably with an electric fan. These operations should be carried out in total darkness. The temperature of this solution should not exceed fifty degrees Fahrenheit.

The type of plane is not of very much importance, although one affording a clear view of the ground should be used if you have any choice. The accompanying photographs were taken from a two-passenger Taylor "Cub" monoplane. This plane is ideally suited to this type of photography, since it allows an unobstructed view of the ground, is easily handled, has a landing speed of about twenty-five miles per hour, and can be set down in a "two-by-four" lot—a great advantage in case of an emergency when flying close to the ground.

The following is the technical data for the accompanying photographs:

Camera—Leica Model D

Lens—Elmar $f:3.5$

Filter—Leitz #2

Film—E. K. Super X

Exposure— $1/200$ sec. $f:4.5$

Developer—Champlin #7

Altitude—800 ft.

Visibility—30-40 miles

Ceiling—unlimited

Barometer—30.65

FIRE DIVE

(Continued from page 25)

pulled out. The red fire disappeared. The pilot waved his hand to the crowd.

A spectator collapsed in his seat.

"It was only a stunt. Oh, well, I knew it all the time."

The whole crowd sat weakly down again and watched the second stunt plane dive through the air with a similar torrent of fiery red belching from its engine.

And that was the end of the exhibition.

Dave Rainier, striding across the field with his partner, Bert Dayton, found the boy standing where he had left him. He noticed nothing wrong.

"It's O. K., Art. You're hired as the Air Aces' chief and only greaseball. You can begin by putting the ships to bed for the night."

The Air Aces moved on to a new location, to another and another. No scarcity of engagements existed for them. Their exhibition was favorably known to promoters of all sorts of outdoor gatherings. It was a show that could be depended upon to thrill the most indifferent crowd.

Art Weldon did his work thoroughly and well. The Air Aces came to feel implicit confidence in their new mechanic.

But they found him difficult to talk to.

"S'funny," Bert Dayton confided to Dave, "the boy looks like the friendly sort, but he seems afraid to talk."

Dave scratched his head.

"I know." He laughed. "If Art wasn't so young I'd think he had a deep, dark past."

Bert Dayton tried hard to gain the boy's confidence. He explained to him the details of the apparatus on the two planes; the formula of the chemicals used for smoke making, the way they fed from tanks under the forward cowl into the hot exhaust manifold, where they created a partial combustion. The smoke thus formed, he showed, was blown out of the long exhaust pipe under the fuselage.

Art displayed greatest interest in the method of producing the final stunt, where the plane seemed to be afire.

Dayton pointed to the exhaust manifold.

"That's done a little differently. We open these ports on the manifold and feed in first a chemical that produces black smoke. When the black smoke is pouring out of the ports in good shape we inject a chemical that makes a harmless 'red fire.' The red fire sweeps back over the fuselage. From the ground it looks as though the ship is going down in flames."

Art smiled, a nervous smile.

"The first time I saw the stunt I

thought the ship was really going down in flames."

He did not smile at all when, a week later, Bert Dayton made the suggestion he go up on one of the exhibition flights.

"Why not come along? You'll enjoy it. Throwing those smoke streams across the sky is a thrill, believe me."

The boy remained silent momentarily.

"Maybe you don't like to fly."

That brought results.

"Don't like to fly!" Art exclaimed, and looked up at the blue majesty of the sky.

Dayton laughed.

"O. K., skybird. This afternoon we'll hit the air trails."

The Air Aces were almost ready to leave the ground when Art came running and pulled himself into the front cockpit of Bert's plane. Seconds later the engine exhausted at full throttle and they were off.

"The boy's a natural!" Dayton found himself saying as he flung his ship through the stunts. Engine blasting, wires straining, they thundered down in awesome power dives, whipped into vertical banks, sideslipped with screaming wires, throwing their smoke streams all over the sky. Through it all, Art sat easily in his cockpit. Now and again he looked overside at the ground, turned to watch the vapor torrent pouring from the rear of the plane. When he turned thus his pilot caught a grin of pure delight.

"Does that boy," Bert said to himself quite unnecessarily, "like flying?"

Came the grand finale.

Dave Rainier's ship had flown low to lay the colored smoke screen over the crowd. When he returned to the heights Dayton "tipped over" his plane and let it fall, putting it through wild maneuvers that seemed uncontrolled to the spectators below.

"Here comes the black smoke!" Bert yelled to Art, throttling down and turning a valve. He ducked in the cockpit to escape the sooty vapor.

The dirty, black smoke poured from the engine. A few seconds and Dayton turned another valve. The dark smoke intermixed with fiery red. He closed the first valve and opened the second wide. The red fire enveloped the entire fuselage, streaming away behind like a river of flame.

The control stick jerked under Dayton's hand.

Startled, he saw it move backward, and the plane leveled out with wings bending under the strain. The stick moved to one side and the ship sideslipped, sideslipped at terrific speed toward the earth!

Coming to life, he gripped the stick and straightened up in his seat. Ahead,

through the red fire, he could see Art bent over in his seat gripping his stick. The boy had seized control of the plane!

"Let go of the controls!" Bert roared.

Art turned a face transformed by terror.

"The fire!"

Dayton, his mind in a turmoil, whipped glances at the engine, the fuselage, the wings. There was no fire; at least, only the harmless brand.

"Drop that stick!" he bellowed.

The earth was near, leaping up with incredible swiftness. Desperate, Bert wrapped both hands about his control stick and fought the pressure exerted by the terror-stricken boy in front. He managed to bring the stick to center. The plane leveled.

A flick of his hand shut off the red-fire valve—and immediately the stick was free of pressure.

Dayton made a fast landing, his partner's ship close behind. Rainier leaped from the cockpit and came running.

"What happened up there? I thought you were going to crash."

Dayton was almost speechless with rage.

"Weldon," he yelled, "grabbed the controls and nearly crashed us!"

Followed a hectic session. Bert Dayton stormed at the boy. Dave Rainier tried to find out what it was all about. And Art himself remained tight-lipped.

"Listen, Art," Rainier was pleading. "You must have had some reason for going wild up there."

Dayton's anger had subsided. The crushed look of the boy was enough to cool him down.

"Come on, tell us. What was it?"

"It was the fire," Art said finally, his voice low. "The red fire. I knew it was harmless, but it scared me. I lost my head."

"So that's it!" Bert could not keep the biting sarcasm out of his voice. "The red fire frightened you."

Dave Rainier said nothing, eyeing the boy with a puzzled expression.

Bert Dayton was all for firing Art immediately. The partners talked it over in the privacy of a hangar.

"I like the boy. You know that. But he's a menace. If harmless red fire scares him, what would real danger do? I wouldn't step into a plane with him again for all the cash in the mint."

Rainier demurred.

"I like the boy, too. And I can't believe he's such a coward. There's something—something— If we keep him on long enough, maybe I can figure it out."

Dayton gave in.

"O. K. Have it your own way. But

if you ever take that boy up in a plane again—"

His partner smiled oddly.

"Y'know, that's just what I'm planning to do."

Things went on as usual for a time. The Air Aces continued to thrill the public. Art Weldon continued to keep their ships in first-class order. He seemed to find solace in work, was at the planes day and night—checking, repairing, cleaning.

"Don't you ever go hunting for amusement?" Dave Rainier asked once.

Art frowned over a rocker arm.

"No—no; not any more."

Rainier walked away, his brain busy. Another piece was fitted to the puzzle he strove to complete. So the boy did not look for amusement like a normal boy—not any more. Why? There was some definite reason. When that reason was found—

Overriding his partner's opposition, he invited the boy to go up with him on ordinary stunting exhibitions. Invariably Art rode through them with perfect calm. It was, then, Dave concluded, only the idea of fire that terrified him. Another step forward.

The three were standing beside the planes one day when Rainier made his final play.

"I want you"—he looked straight at Art—"to ride with me to-day when we put on the fire dive."

The boy flinched, went pale.

Bert Dayton burst out.

"You're crazy, Dave! If you take him up you'll be playing with death. He'll freeze on the controls."

"He won't freeze the controls this time," Rainier said calmly. "I've disconnected the controls in the cockpit where he'll sit."

Then he addressed the boy.

"How about it? I'll put you in the rear cockpit. The red fire won't be so thick there."

"And how," Dayton broke in, "are you going to control the red fire? The valves are in the rear pit."

His partner was still looking at the boy.

"Art is going to work the valves. If his unreasoning fear gets the best of him he can turn off the red fire."

"And now, Art, will you go up with me?"

The boy's face worked visibly.

"I—I—I'll do it!"

The skies turned leaden that afternoon just before they took off. Bert Dayton scanned them with a frown.

"I'm not superstitious, Dave, but I wish you'd put off this experiment. I heard once that most crashes occur on dark days."

Rainier laughed heartily.

"No, you're not superstitious, Bert, old boy. Not much."

"You're going to take him up just the same?"

"Right."

The two planes bored into the sky and began the show, hurtling through each succeeding maneuver with increasing speed, as planes and pilots warmed to their work. Stunt after stunt went off with precision and completeness. Surprisingly soon, it seemed, they were ready for the climax.

Dave Rainier let his ship nose down. He turned in the cockpit, pushing up his goggles to observe the boy better.

"All right on the black smoke," he called cheerily.

Art turned the valve and the sooty cloud came pouring from the exhaust manifold.

"Now the red fire."

Art was as white as the white smoke they had lately thrown across the sky. But his hand moved to the valve. The red fire gushed forth, rushed back with the slip stream, whirled over him. He sat there, face contorted with terror, holding himself under control by violent effort.

Rainier turned back.

Boom!

The flame of an explosion leaped out of the engine—struck him full in the face. His eyes! They were blinded! Frantically he strove to open the seared lids in spite of the pain. Through a red haze he saw the broken exhaust manifold, shattered by the explosion. Flames, real flames, spewed forth. They ignited the cowl fabric.

He fumbled for the switch, killed the engine. But the fabric continued to burn fiercely. The ship was falling. All but blinded, he could not control it.

The flames—they had reached his cockpit—they were blazing over him! He worked the control stick, tried to sideslip the ship to the earth. Impossible. He could not even see the earth.

His parachute. Last chance. But the straps were burning! He beat at them, but they were already charred. The chute was useless.

Desperate, he turned his back to the flames. The boy! He had forgotten him. Through the red haze he saw him sitting there in the rear cockpit, frozen with fear at sight of the fire.

"Jump—while you can!" Rainier yelled.

Art seemed to awaken from a trance.

"I won't leave you!"

He jumped up in his cockpit, pulled himself over the windshield onto the top of the fuselage. Flames gushed over him. He came on in spite of them,

threw himself into the front cockpit, grabbed the stick.

The wires screamed. A terrific sideslip blew the fire away to one side. Grimly he held the ship in the sideslip until the rising earth seemed near enough to touch.

A horrified crowd saw the blazing plane strike earth heavily at high speed, lurch wildly and roll to a stop. They saw two blackened figures emerge, one supporting the other. The airport crash truck raced to the scene. And pandemonium reigned.

But it was quiet next morning in the white, enameled hospital room. Dave Rainier lay there in the bed, all but concealed by bandages, with eyes red-rimmed but otherwise uninjured. Bert Dayton sat beside him—and both looked at the boy who stood at the foot of the bed.

"So you thought this boy was a coward," Rainier said slowly to his partner.

Dayton stirred uneasily.

"Don't rub it in. I've apologized about four times already."

Art tried to change the subject.

"I got the chemical tanks out of the wreck and tested the stuff. The red-fire solution was mixed too strong. That's why it exploded."

Rainier continued to gaze at the boy.

"I see. We won't let it happen again."

Then he smiled.

"And now let's have the story. We know you've mastered your fear of fire. Tell us how it got hold of you in the first place."

"It happened at Sharon Airport," Art seemed a different person as he talked. His old taciturnity was gone—gone forever. "I had taken up a ship with a bad engine. Shouldn't have done it, of course. But I had just got my license and couldn't wait to get in some flying. The engine back-fired, setting the ship afire. With no chute, I had to sideslip down in flames. The fire got to me—burned the hair from my head."

Dave nodded.

"Knew there was something odd about the color of your hair."

"Yes," Art went on, "it grew out with a sort of burned-yellow color. Always reminded me of the fire—though I didn't need any reminder. The memory haunted me. Fire of any kind terrified me. I tried to fight the fear, but couldn't seem to master it."

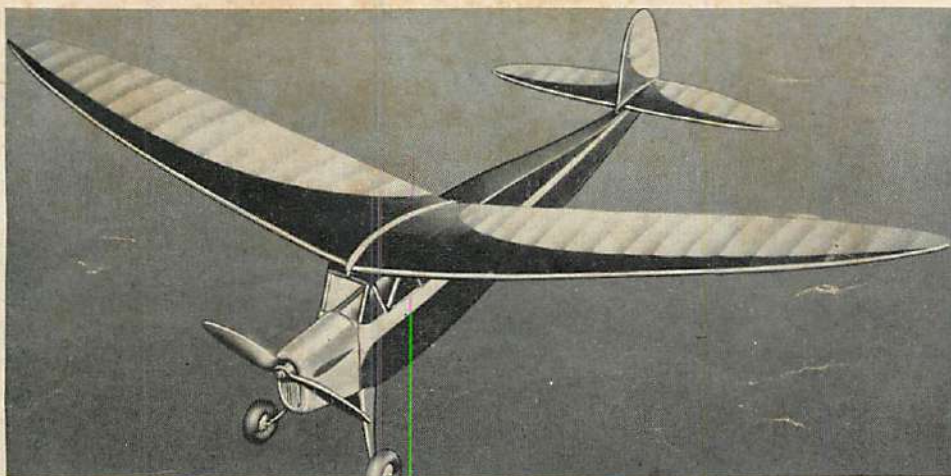
He paused.

"And yet," Rainier said gravely, "when our ship caught fire you conquered your fear, fought your way through the flames, and saved my life."

Art looked down uncomfortably.

"Boy," Dave Rainier said, "you're a man."

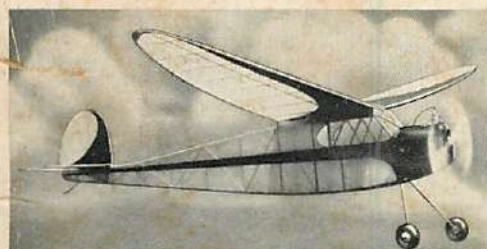
YOUR COMET DEALER "goes to you" with an IMPRESSIVE LINE-UP of COMET MODELS!



The COMET CLIPPER GAS MODEL

A natural-born winner—still leading them all! Piling up new triumphs in competition every week! Features: removable power unit integral with landing gear; wing and tail group separates in event of collision; steep climb and flat glide; easy to build because difficult parts are finished; 6 ft. wingspan. Build and fly this champion of them all!
Kit No. T7—Comet Clipper, including Comet Automatic Timer.....**\$4.95**
Comet Clipper Kit with air wheels.....\$6.50
Postage 25c; none if ordered from dealer.

Three NEW SENSATIONS — at your dealers!



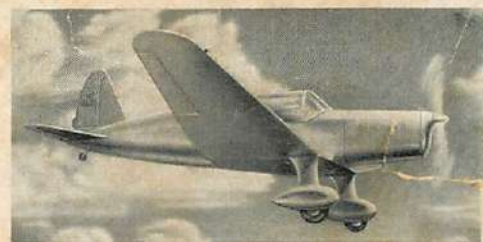
CLIPPER, JR.

Here's something new, different, sensational! The rubber-powered Comet Clipper, Jr., scaled right down from the Comet Clipper! Engine roar gadget, high climb, flat glide; 36" elliptical wing detaches in event of collision. Kit contains imitation gas motor, motor roar device, wheels, cement, tissue, finished propeller; metal cylinder flanges, sharply printed Balsa, plenty of rubber. And just look at that price—only.....**\$1.00**
complete! Kit No. P5
Postage 15c; none if ordered from dealer.



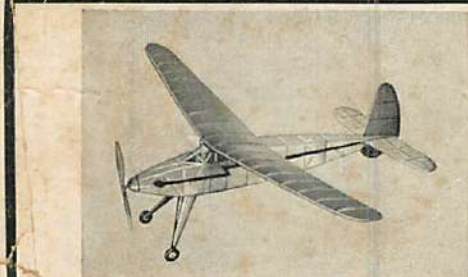
CLODHOPPER II

Designed by Jim Cahill, Captain of 1938 Lord Wakefield Team. Winner of many American and world competitions. 47 1/2" wingspan, 32" long. This kit has Jim Cahill's approval—it's a marvel of completeness. Kit No. P7. Complete kit only.....**\$1.00**
Postage 15c; none if ordered from dealer.



AERONEER

A big 40 1/2" wingspan model of a dashing sport plane! Exact scale, 1 1/4"-1'. New motor roar device; movable controls, shock-absorbing wheels. A remarkably complete kit, and a sensational value at only.....**\$1.00**
Postage 15c; none if ordered from dealer. Kit No. P6



2 NEW "BIG" MODELS—only 25c EACH

32" PHANTOM FURY—Here's a "honey"—a big 32" model of a plane that has everything! Another of those sensational values only Comet can offer! Kit No. E24—complete kit **25c**
only

Postage 15c; none if ordered from dealer.



30" BREWSTER SCOUT BOMBER—A snappy eye-fel—an authentic model of a remarkable fighting plane. Complete kit. Highest quality Balsa and other materials. Kit No. E23 **25c**
only

Postage 15c; none if ordered from dealer.

COMET MODEL AIRPLANE & SUPPLY COMPANY

2509 West Cermak Road, CHICAGO. Dept. MN4, Eastern Branch: 688 Broadway, NEW YORK

COMET maintains distributors in many cities throughout the United States and other parts of the world. Foreign distributors include: F. P. Sweeten, Blackpool, England; E. J. Hyams and Son, Wellington, C. I., New Zealand. PACIFIC COAST DISTRIBUTORS: Edw. Kapitanoff, 4649 Prospect Ave., Los Angeles, Calif.; Smalley Paint and Paper Co., 5300 Ballard Ave., Seattle, Wash.

The BEST CEMENT for MODEL BUILDING



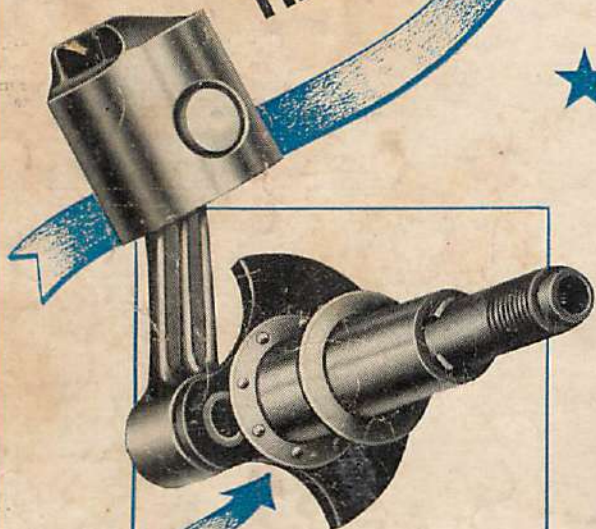
There's a saying among model builders: "If it carries the Comet trade-mark, it's the best!" That's especially true of the famous COMET CEMENT—the best cement ever made for model builders and general use. Boy, how it sticks—helps you build strong, sturdy models that will stand up. Around the house, you'll find dozens of uses for this great cement. It will stick to china, leather, glass. Packed in attractive, colorful self-seal tubes and priced at **5c and 10c** only

Get your Comet Cement from your Co dealer—look for the display!

ONLY MOTOR ever to run 400 HOURS WIDE OPEN!

and still going strong
without replacing a part*

HERE'S
THE REASON



Ball Bearing Thrust Bearings—

Eliminate drag! Increase power! Positive lubrication for longer life!

New High Dome Mono-Steel Piston—

Develops more power than any other piston made!

Crankshaft—

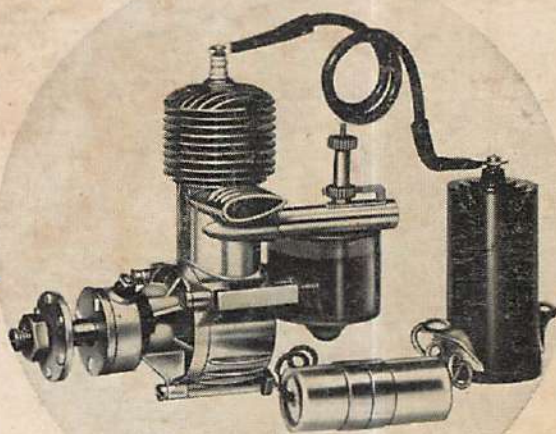
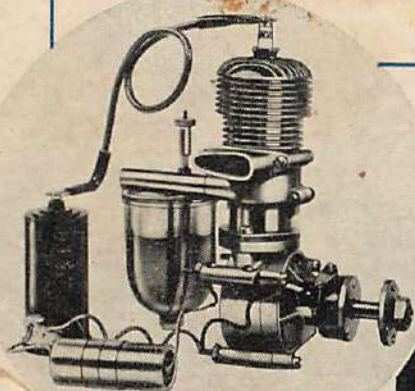
Only miniature motor with fully counter-balanced one-piece crankshaft and tubular crank pin!

Connecting Rod—

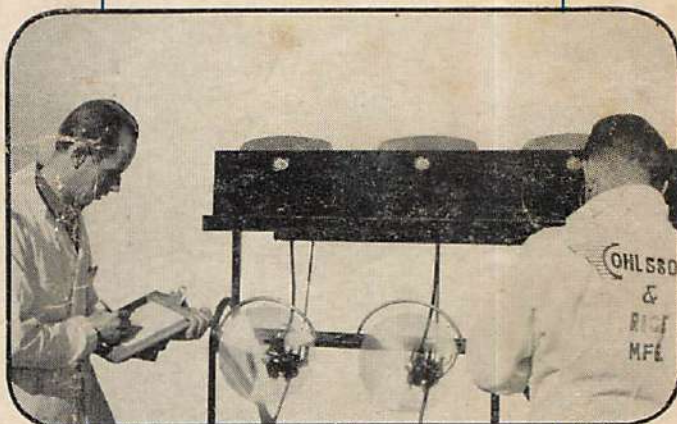
Dural with Ohralloy bushings! Another exclusive Ohlsson feature!

FAMOUS OHLSSON GOLD SEAL—

—"World's Finest Miniature Motor." At your dealer's... **\$1850**



OHLSSON "23"—most sensational light-weight motor on the market. At **\$1650** your dealer's. Only.....



Surpassing every known record for durability and performance, this Ohlsson "23" is being subjected to the most gruelling test ever required of a miniature gasoline motor, as it continues past the 400 hour mark without replacement of a single part! * Send for detailed literature today!

Dealers -- New Ohlsson Demonstration Display Stand. Write today for particulars on how to obtain one of these handsome sales aids.



Ohlsson
Miniatures

630 NORTH ALVARADO ST.
LOS ANGELES, CALIF.

*Spark plugs replaced when necessary.

ESTER, R.B.
P.O. BOX 3
FOREST, ONT. CAN.
9099