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BILL BARNES AIR TRAILS

JANUARY
1937

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ROCKET SHIPS

by ALLAN FINN



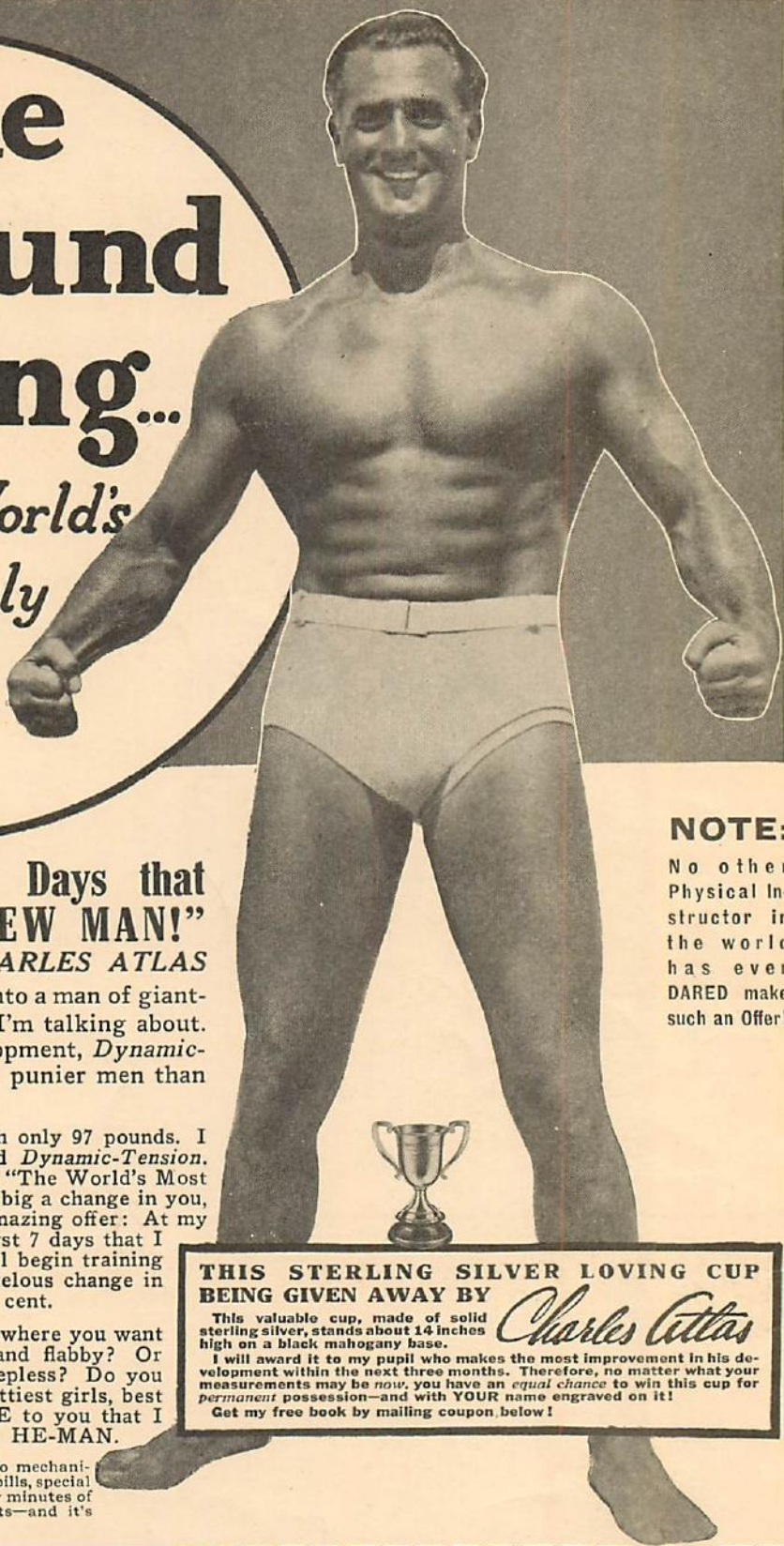
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Volume VII
No. 4

January
1937

BILL BARNES AIR TRAILS

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A STREET & SMITH PUBLICATION

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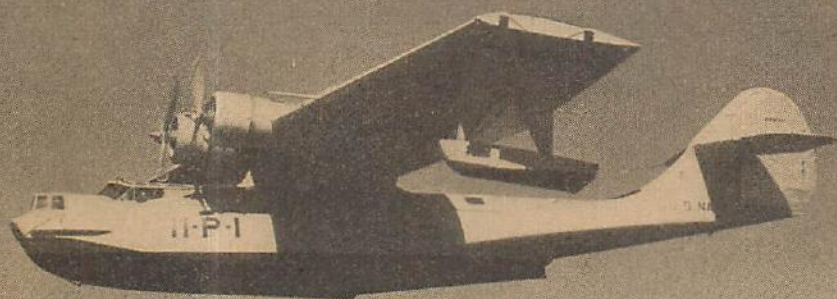
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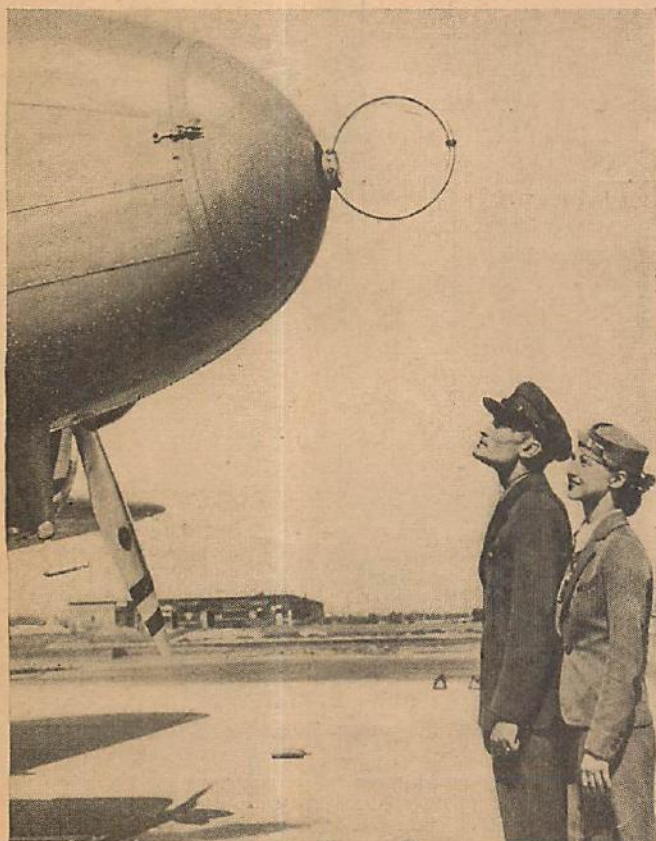
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This Winged World



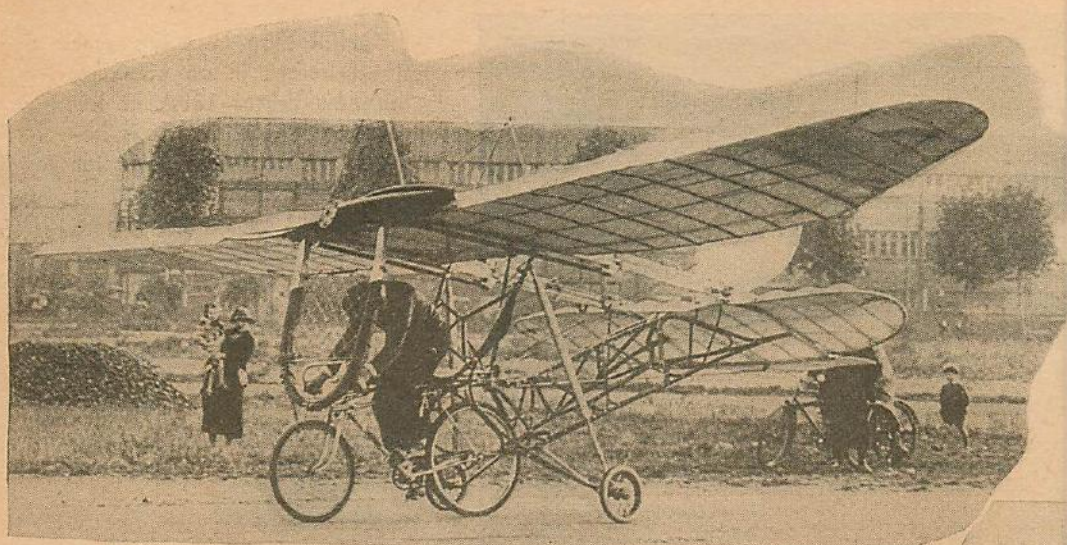
PARADE of the west-coast Aircraft Base Force on Navy Day included this new Consolidated XP3Y-1 of the 11th Patrol Squadron and three Hall PH-1s of the 9th.



RING in its nose with which to lead this UAL Boeing home by directional radio beam is electrically "shielded," preventing rain or snow static interference.

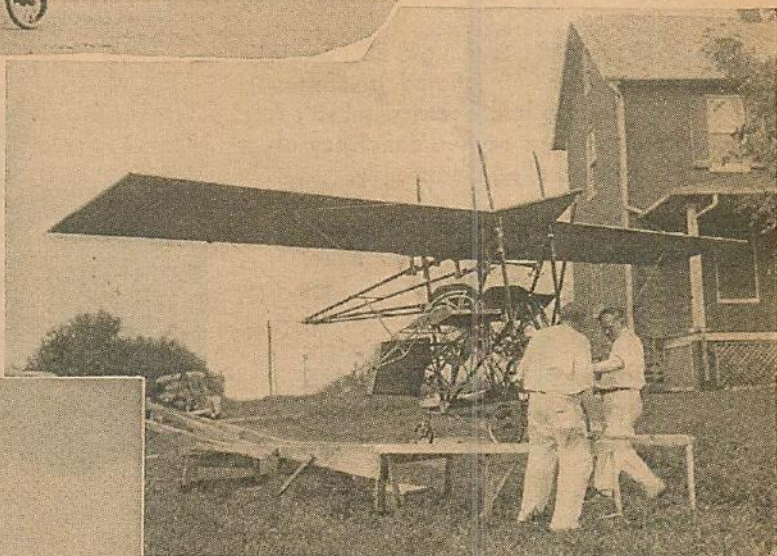
NO TIGERS allowed, says UAL pilot Al Fosgate, so Dorothy Lamour has to leave her cub behind. TWA will now carry pets, however, in the baggage compartment—if tame!





MAN-FLIGHT, cherished dream of humans since earliest history, still lures inventors. At left, new French contraption taxis experimentally in patent test. It's the creation of Francois Baudot, former Bleriot engineer, which should mean something.

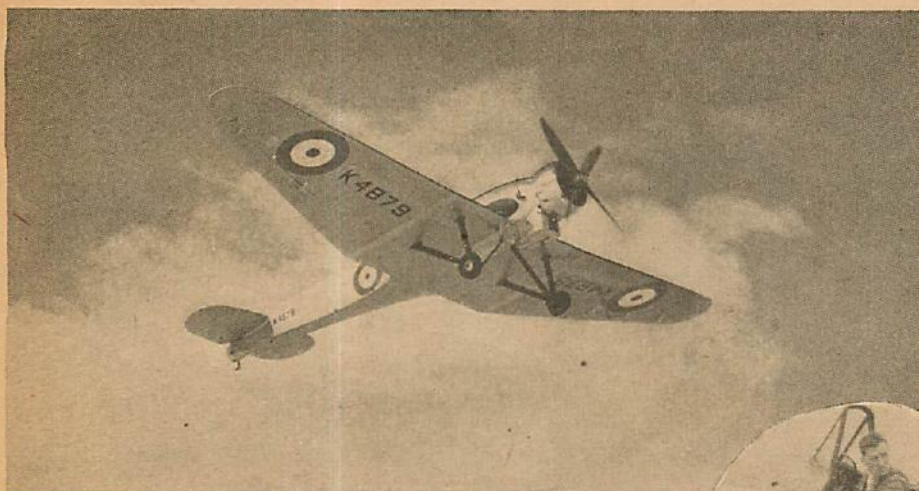
RUNWAY take-off failed to launch this recent American attempt at pedal-power flight, but the inventors, J. Carl Bauer and Lewis Hueber, will try again—despite mathematical theory that man is not strong enough to fly his own weight.



FLYING AUTO has emerged as finished product after several years of development by the Pitcairn Autogiro Co. Rear surfaces are fixed, direct control being maintained by tilting the rotor. Engine—a 90 h.p. Pobjoy radial—is behind cabin; one drive shaft runs back to the tail wheel and another forward between the two seats to the prop. Geared extension from prop shaft turns rotor for 150-ft. take-off run. Top speed is 90 m.p.h., minimum 20.

FOLDING its vanes, the roadable autogiro drives through the street under rear-wheel power, after steep landing in a small Washington park, for delivery to Bureau of Air Commerce.

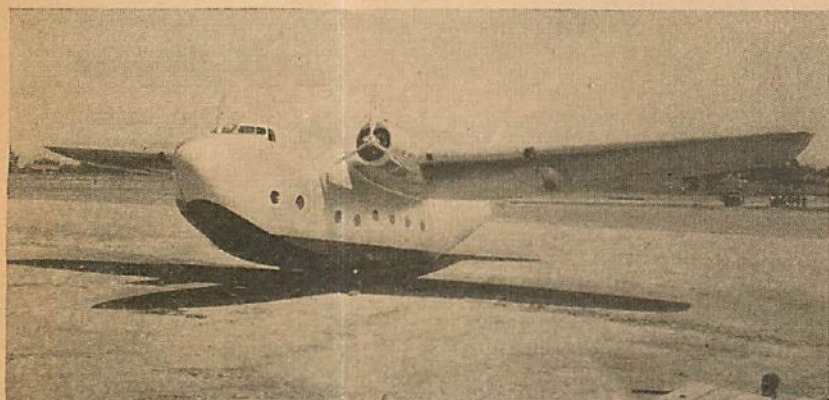
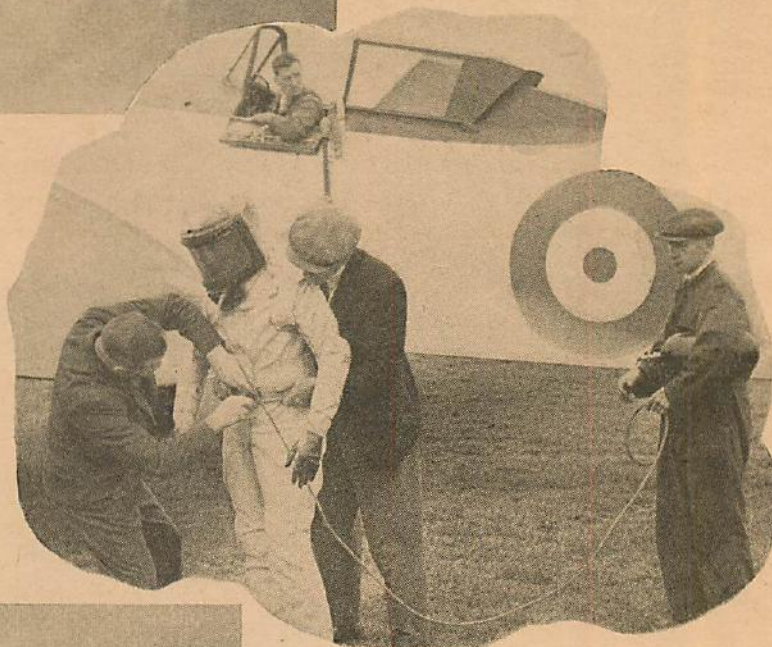




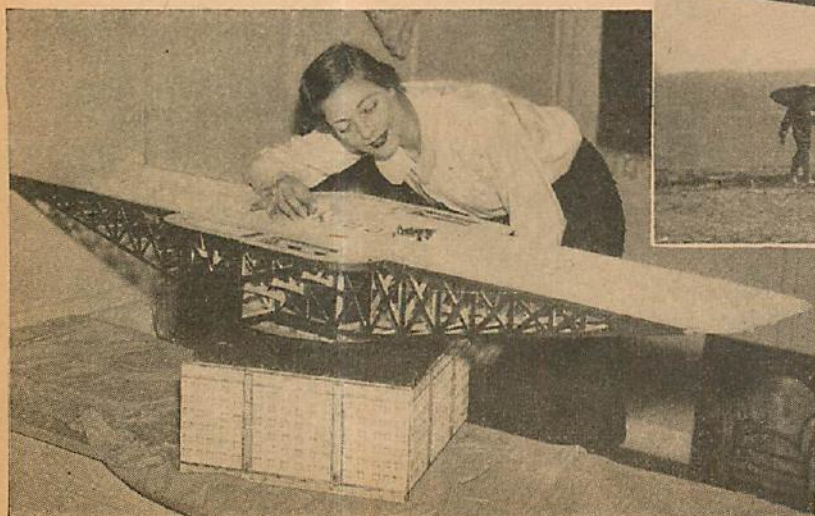
HIGHER than man has ever flown before in an airplane, the new Bristol 138A at left reached 49,967 ft. It is believed the largest single-seater ever built; light construction is all-wood except for engine mounting and cowl. Another photo, with data, appears on page 31.

DIVING upward into thin air, Pilot Swain wore a rubber suit inflated to life-sustaining pressure and electrically heated. He reported that oxygen deficiency almost resulted disastrously.

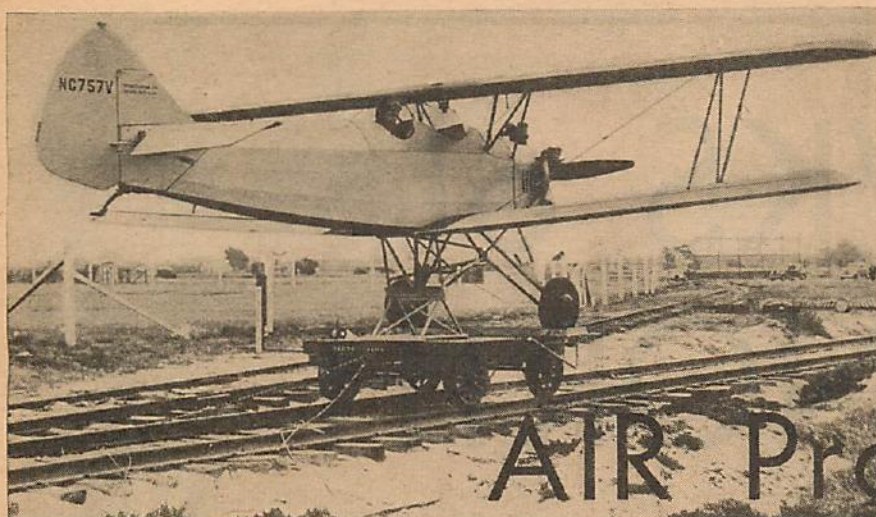
DOUGLAS DF, first pictured last month, has 32-passenger range of 1,500 miles, 12-passenger range of 3,300 miles. Engines are 1,000 h.p. Wright Cyclones; span is 95 ft., length 70, empty weight 16,000 lbs., gross 28,500, top speed 185 m.p.h., cruising 167. Side floats fold into wing.



AMBULANCE plane below is conventional Russian plane converted to hospital service by the ingenious method of A. T. Lingart whereby three streamlined stretcher cases, in which patients are placed, are attached below fuselage and wings.



CITY AIRPORT atop large building, rotatable to permit landings and take-offs into the wind, is the plan envisioned by Capt. Charles Frobisher in this model exhibited in London.



A summary of aviation news

AIR Progress

Bill Wheatley's Consolidated Fleet take-off from rail truck under propeller power points way to similar land launchings of boats and other heavy planes.

Air Forces

Overshadowing all other recent aeronautical developments, the huge world rearmament race dramatically holds the aviation spotlight to-day. League of Nations reports show that total arms expenditures for 1935 were over 9 billion dollars, more than a billion above 1934, and for 1936 will undoubtedly be much greater. Growing air forces accounted for part of the increase.

Germany, whose rearmament is believed to have given impetus to the scramble for war strength, is still an unknown factor, but an American observer, Major Lester D. Gardner, states that among German aircraft factories he visited, two combined larger space and more employees than all the U. S. plants put together.

France announced that the government will take over all plants making war planes and engines, which means most of the French factories. First step was the merger of the Breguet, Nieuport, and Morane-Saulnier firms. Next was a plan to increase her large force by half and assure at least 1,000 modern first-line fighting planes.

Britain's program went ahead (*AIR TRAILS*, October) with some home criticism that it wasn't going fast enough. Perhaps as a result, it was unofficially stated that Britain might buy 700 U. S.-made war planes, besides those from her own hard-pressed industry. An additional order for 300 was given to the Canadian Boeing plant. Canada will enlarge her force, and Australia may buy U. S. planes. Brazil is buying 30 Stearman trainers.

Russia is still leading in numbers. Her success in parachuting large groups of soldiers—latest feat, 5,200 dropped behind “enemy” lines—leads Gardner to predict that the next war—if and when it comes—will be fought by “air armies.”

As a foretaste of future aerial warfare, hundreds were killed by bombs in the Rebel attack on Madrid.

Flights and Performances

The fastest flight ever made across the Atlantic was flown by Capt. James A. Mollison from Newfoundland direct to London in 13h 17m. Including flying time from New York north, he made the trip—his third North Atlantic crossing—in 19h 58m. His plane was the famed Bellanca Flash.

Added disrepute was gained for long-distance races by the failure of the French Aero Club's 13,629-mile Paris-

Saigon (French Indo-China) dash. Only three planes, two Caudron bi-motored Goelands and a bi-motored Breguet Fulgur, were entered; Maurice Arnoux's Goeland crashed in India, Leon Challe's Goeland quit at the Persian Gulf, and Michel Detroyat's Fulgur quit in Arabia. Usual air-mail service went through regularly.

Jean Batten, in her Percival Gull, set a new England-Australia solo mark of 5 days, 21h 3m, and despite official frowns continued solo across the Tasman Sea to New Zealand in 10h 30m record time, becoming the first woman to complete the entire route.

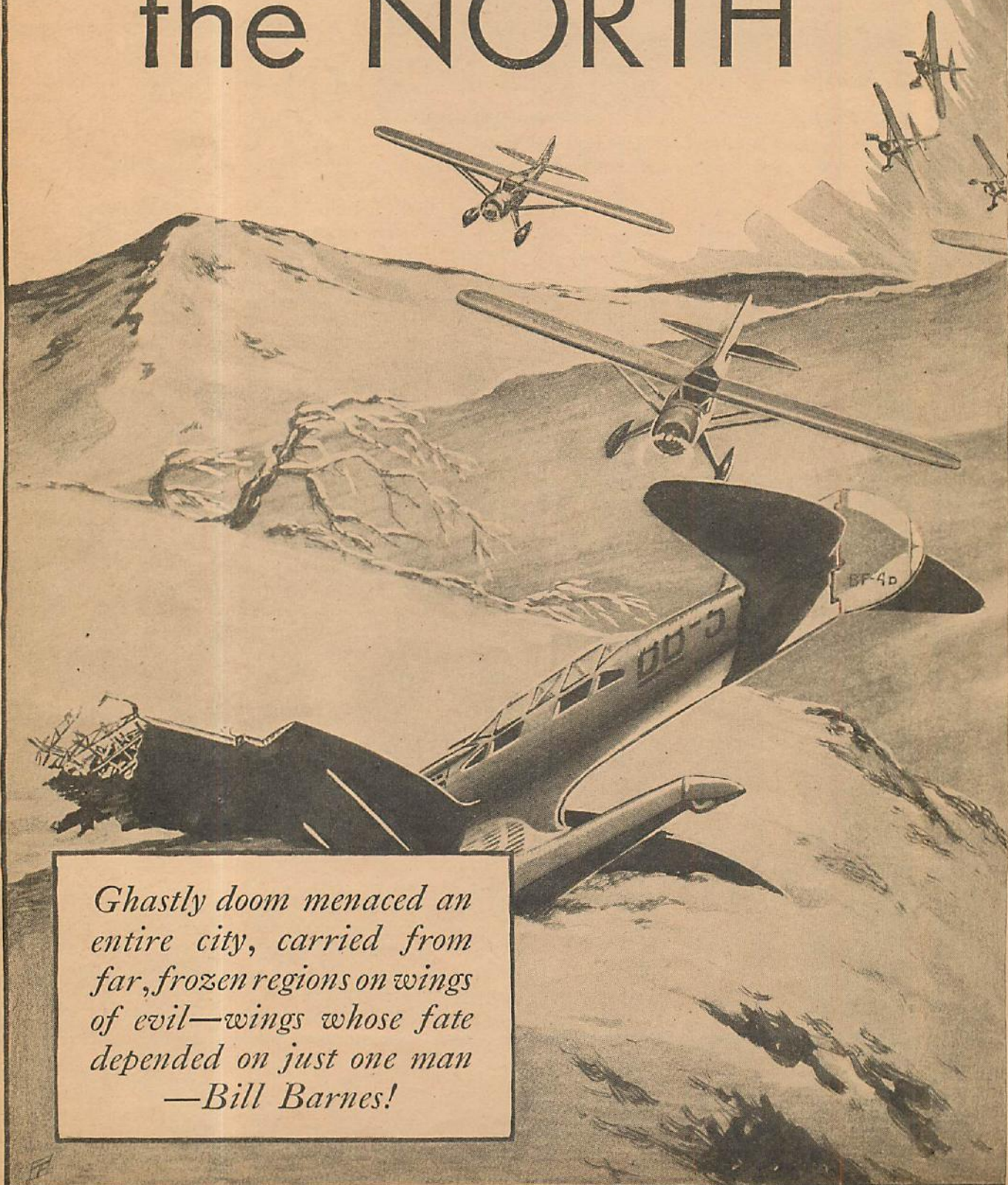
In the U. S., Lt. John M. Sterling won the army's annual Mitchell Trophy 100-mile speed race with a record 217.546 m.p.h. in a Consolidated PB-2 pursuit. Engines are deliberately restrained to avoid burning out; in a previous 1-mile speed dash, a PB-2A was clocked at 251.74 m.p.h. average. . . . Wind-booted, the American Airlines Douglas *District of Columbia* averaged 260 m.p.h. for a record passenger Chicago-Newark 776-mile hop of 2h 39m 20s. . . . A new New York-Boston intercity record of 50½m for 190 miles was set by John Shobe's 285 h.p. Beechcraft.

Transport

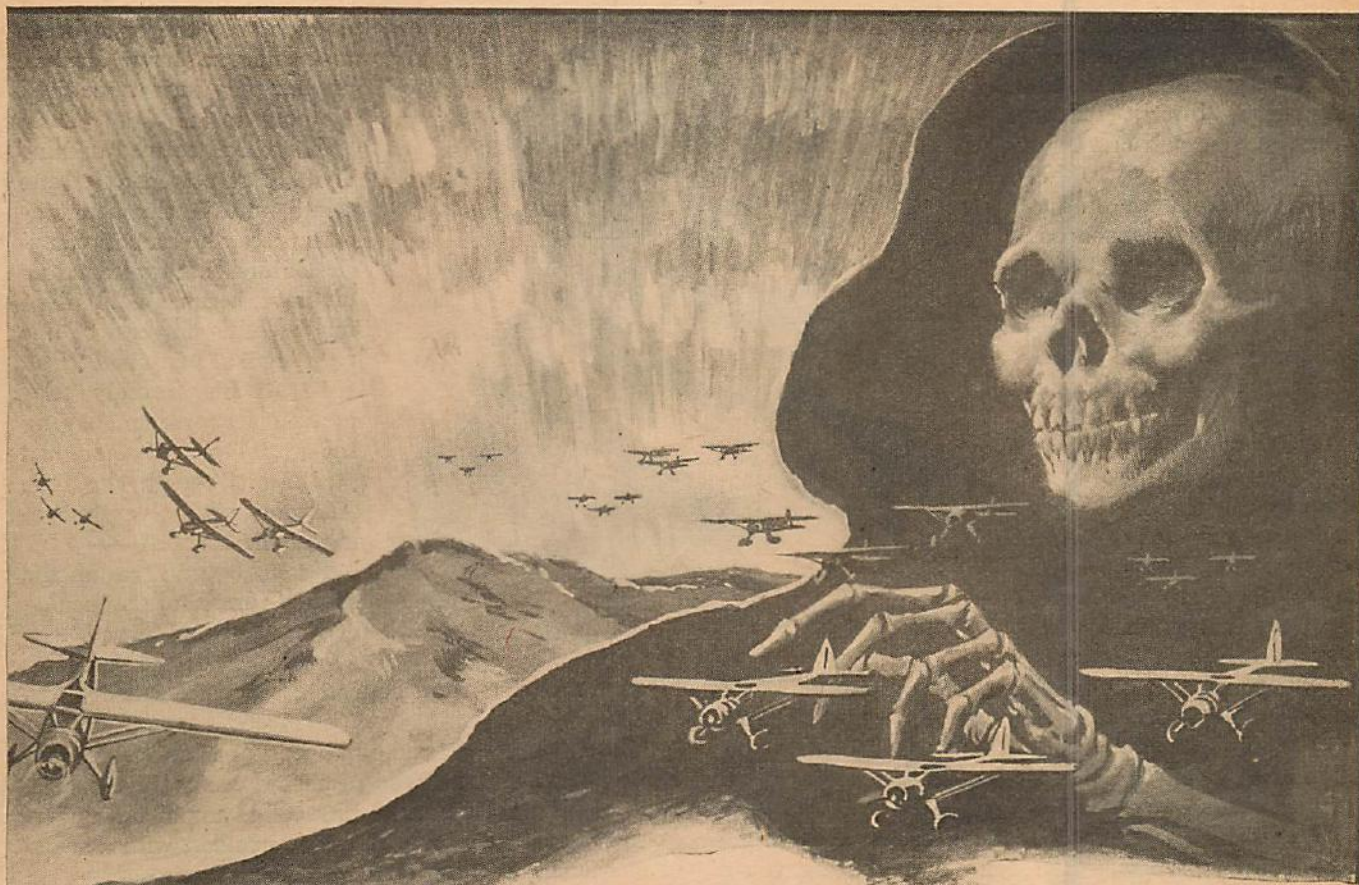
The round-the-world passenger race between three reporters was won by H. R. Ekins of the Scripps-Howard newspapers in 18 days 14h 56m. All started from New York on the dirigible *Hindenburg's* ninth return flight, but Ekins took the lead in Europe by chartering a plane to Athens while his rivals held to regular scheduled air-line flights. He made an additional gain by catching the *Hawaii Clipper* in Manila after a special hop from Borneo, and securing passage on it, although it was still in mail-carrying service; his rivals followed on the *China Clipper's* first regular east-bound passenger run, arriving in New York some 6 days later. Ekins circled the world at the average speed of 55 m.p.h.

Canada plans to start 6-hour transcontinental service from Montreal to Vancouver next summer. . . . Boeing is building six “Clippers” for Pan-American's Pacific route, to be the biggest yet: gross weight, 82,000 lbs., span 152 ft., length 109, height 28, carrying more than 60 day passengers, 40 at night. . . . Martin is building a million-dollar 44-passenger 4,000-mile transport job for Russia.

HAWKS of the NORTH



*Ghastly doom menaced an
entire city, carried from
far, frozen regions on wings
of evil—wings whose fate
depended on just one man
—Bill Barnes!*



A Great Bill Barnes Novel of Thrilling Air Adventure

by George L. Eaton

WITH the half light of the November dawn came fog, eddying up from the sullen waters of the Atlantic to be whipped by moaning winds over the bleak New Jersey coast and inland. It came, a wall of quiet grayness, creeping across the flying field toward the knot of squat factory buildings that made up the small Cobbs Aviation Co. It stole onward, slowly, inevitably, moving closer and closer to the motionless figure of Paul "Jinx" Gerbano, the Cobbs test pilot, as he stood on the apron in front of Hangar 2. Its ghostly feelers probed out to touch and encircle him, and terror was on his gaunt face.

He took a step back, instinctively retreating. But the fog closed in, grew thicker, damper, until Gerbano could no longer see the concrete beneath his feet; until the line of hangars behind him dimmed and vanished; until he knew that there was no escape from the fog—as there had been no escaping it two years ago, when the first disaster had happened.

He remembered it clearly—too clearly—that dawn in 1934. He saw himself again in the pilot's seat of the giant tri-motor, with the fog crowding in. Behind him, in the cabin, were passengers, ten of them; most of them asleep, none of them realizing the horror that was to

come. The fuel was dwindling. The co-pilot was feverishly working over a radio, long since disabled.

Then—the gasoline was gone. The three motors cut out. The transport went nosing down. The awful wait. The fog—fog—fog— The flashing vision of trees ahead—of a hill. The frantic kick of the rudder. The breakneck speed. Then—the crash!

That should have been the end—but it wasn't. He lived—lived to hear the news that only he had escaped with his life, that the others, all the others, had died. The fear was born in him then—the fear of fog. And steadily it grew worse, after his discharge from the air line and the search for work.

But there was no work for a crash pilot. Twice he went to distant States and obtained low-paying flying jobs. And twice, as if a hidden force had been lying in wait, fog came—blinding, terrifying fog—and unavoidable accidents followed.

The news of these accidents spread, and each was linked with the first. He became known to the public, to the trade at large, as "Jinx" Gerbano, the tough-luck guy, the hoodooed pilot. His already shaken nerve cracked. Things went from bad to worse. He was barely able to eke out an existence for his young wife

and himself in the awful days that followed. It was then that, unexpectedly, his old flying friend, "Shorty" Hass-further, sought him out.

Just four weeks ago to the day, the veteran ace of the famous Bill Barnes squadron had walked into his house and said: "I've been looking all over for you, Paul. I heard you'd had some tough breaks. How're things now?"

Gerbano told him about everything—about the fog.

Shorty shrugged. "You gotta snap out of it. You can't let a thing like that get you down. Hell, you were one of the best pilots in the business. Still are, as far as I'm concerned. If I didn't think so, I wouldn't be here— You think you can handle a crate like you used to?"

The fear gripped Gerbano, but he said: "Yes. If there isn't any—any—"

Shorty scowled. "Forget that fog business. I've got all the faith in the world in you. I'm offering you a chance to get back into big time—a job."

"A job—flying?"

"Testing. There's just one thing. You gotta keep your lip buttoned. Now listen—"

"There's a bird with a one-horse airplane factory over in Jersey. Name of Richard Cobbs. Aeronautical engineer and lousy with brains—but no dough. Bill's been working with him. Together they've designed a new attack bomber. Bill's putting up the dough, but keeping his end quiet. So far there's been no leak. The ship's almost finished.

"The navy's interested. Bill doesn't want any of us to do the testing. We need an experienced pilot who's out of the public eye. I thought of you. Bill isn't so sure you can handle it. But he left it up to me. I think you can. You want the job?"

Want it! He took it. And from the minute he climbed into the cockpit of the sleek Cobbs Commander his fear began to recede. The ship was a honey. He ran her through the first tests with his old-time ease and deftness. He felt on top again. He was on his way back!

All the hard tests had been completed—the T.V. dives, the speed, the acrobatics. The navy observers had been more than impressed with the plane. A large order seemed certain. Just one test remained—an unusual one—a flight five hundred



"Jinx" Gerbano

miles across the open ocean to contact a navy airplane carrier, then back to the field. Nothing to it.

There *had* seemed nothing to it. But now, as Gerbano stared into the churning, vaporous sea, the clammy tentacles of mist that trailed across his face became cold, dead fingers—the fingers of his passengers who had died. And all his fiercely suppressed fear came surging back. Thrice disaster had stalked through the fog. And now, on the very morning of the last test—

From behind came the sudden rumble of an opening door. Gerbano turned, saw a well of light beating

through the mists from Hangar 2. A voice called: "Mr. Gerbano?"

"Here, Gus," he said, and went back to enter the lighted hangar. The head mechanic was waiting inside. Back of him, poised on its retractable amphibian undercarriage, was the sleek Cobbs Commander, with a squad of mechanics working on her.

"The boss just phoned. Him and Barnes and the rest are on their way out. You reckon they'll pull the test in this soup?"

Gerbano avoided the man's eyes. He said steadily: "It'll clear."

But he didn't go outside again to see if it did. Instead, he went to the locker room and methodically changed into flying togs. He was there when Shorty came in.

"Hi!" Shorty said cheerfully. "Dirty weather."

Gerbano was bending over, fastening an ankle strap. He tried to make his voice sound casual. "Yeah. Test coming off?" The words stuck in his throat.

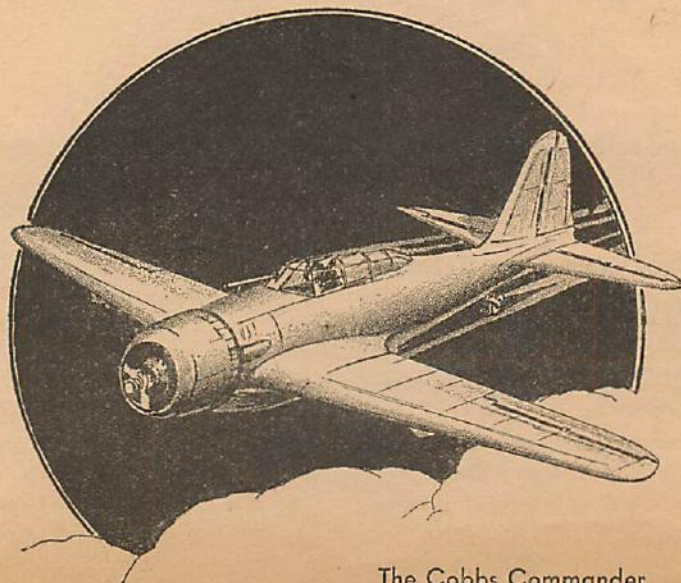
The grin left Shorty's face. He said quietly, "I forgot, Paul."

Gerbano straightened up. His eyes went to Shorty's. "I'm all right. I'll do the job. It's just that damn stuff. I remember things."

Shorty went over and clamped a hand on the other's shoulder. "Don't let it get you, fella. You can lick it. I know you can."

"Sure—sure I can."

Shorty started for the door. He said carelessly over his shoulder: "I'm going to see Bill. He's outside with the navy observers. Might be smart if we waited until this stuff cleared a bit, huh?"



The Cobbs Commander

THE STUFF had cleared considerably by



the time of the take-off. And Gerbano, snug in the forward cockpit of the Commander as she streaked eastward at three thousand feet, mentally thanked the understanding Shorty for having stalled for time. At that, *the take-off might have been delayed even longer* if the news hadn't suddenly come from the factory entrance that newspaper reporters were there, demanding admittance. Bill Barnes and Cobbs, furious that the secret of the new plane had finally leaked out, had ordered Gerbano to get away immediately.

He had, the sudden excitement alleviating his fear, until the attack bomber had zoomed through the layer of thinning fog and into the clear sunlight above. The effect of the bright sky, of the sun beating on the Commander's yellow wings, had brought a surge of confidence.

The fog now lay far below, a grayish carpet clinging to the Atlantic, over which the Commander was hur-

The plane was staggering. A second figure leaped free.



ting. Gerbano checked his charts and instruments, and then leaned back. He'd do the job now. He'd beat the jinx. He'd stay far way from that stuff downstairs. But always, through his thoughts, crawled the dread knowledge—three times before something had happened.

He kept his eyes on the sky ahead, forcing himself not to look down. It was because of this that he failed to see the biplane until the strange ship had zoomed up and come alongside.

He saw a man standing in the biplane's rear cockpit.

crouched down behind a boxlike object, vigorously turning a crank. And, lettered along the length of the plane's fuselage, was: SUPREME NEWS PICTURES, INC.

Newsreel men!

Gerbano's hand went to the throttle. That was something his employers didn't want—premature pictures of the Cobbs Commander.

The throttle went wide. The Commander's speed increased. The newsreel plane fell astern. In the rear-view mirror, Gerbano saw that the cameraman was still cranking.

**A torrent of fire
sprayed down, en-
gulfed the trans-
port—**

Angrily, Gerbano flung his ship to the right, to the left, in a zigzagging course to elude the camera lens. But he knew

that the damage had been done, the pictures taken.

Again he looked back. The newsreel ship was now far to the rear. Something was wrong. Its flight had become erratic. A wisp of black smoke whipped back from the biplane—tripled in intensity. A fringe of crimson came from the engine. Flames!

Gerbano reduced the throttle, banked. The other plane was staggering. The flames rose higher. A dark object fell away from the rear cockpit, parachute harness strapped to it. A second figure leaped free.

The Commander raced back, nearer. Gerbano saw a third man. He was half over the side of the front cockpit, signaling frantically. Then he jumped.

The biplane plunged, enveloped in fire. Gerbano circled. Down below, two white mushrooms had appeared—parachutes. But three men had jumped. Then he saw



a small black speck, still falling, disappear into the foggy air close to the ocean.

Gerbano's face was white. One 'chute hadn't opened. But those other two men—they would land in the ocean—hundreds of miles away from shore—from hope of rescue.

A decision had to be made—instantly. The two wouldn't last long in the water. He was the only one capable of rescuing them. Yet there was the secrecy of the Commander to maintain. That—stacked against two human lives.

There was only one answer. Gerbano closed the throttle, pushed the stick forward, dived. And the landing gear toiled down to an extended position.

The cowed nose of the Commander was aimed for the Atlantic—and the fog. Mistiness came into the air

as the altimeter needle spun. Bits of fog tore past the diving plane. Gerbano watched the air thicken.

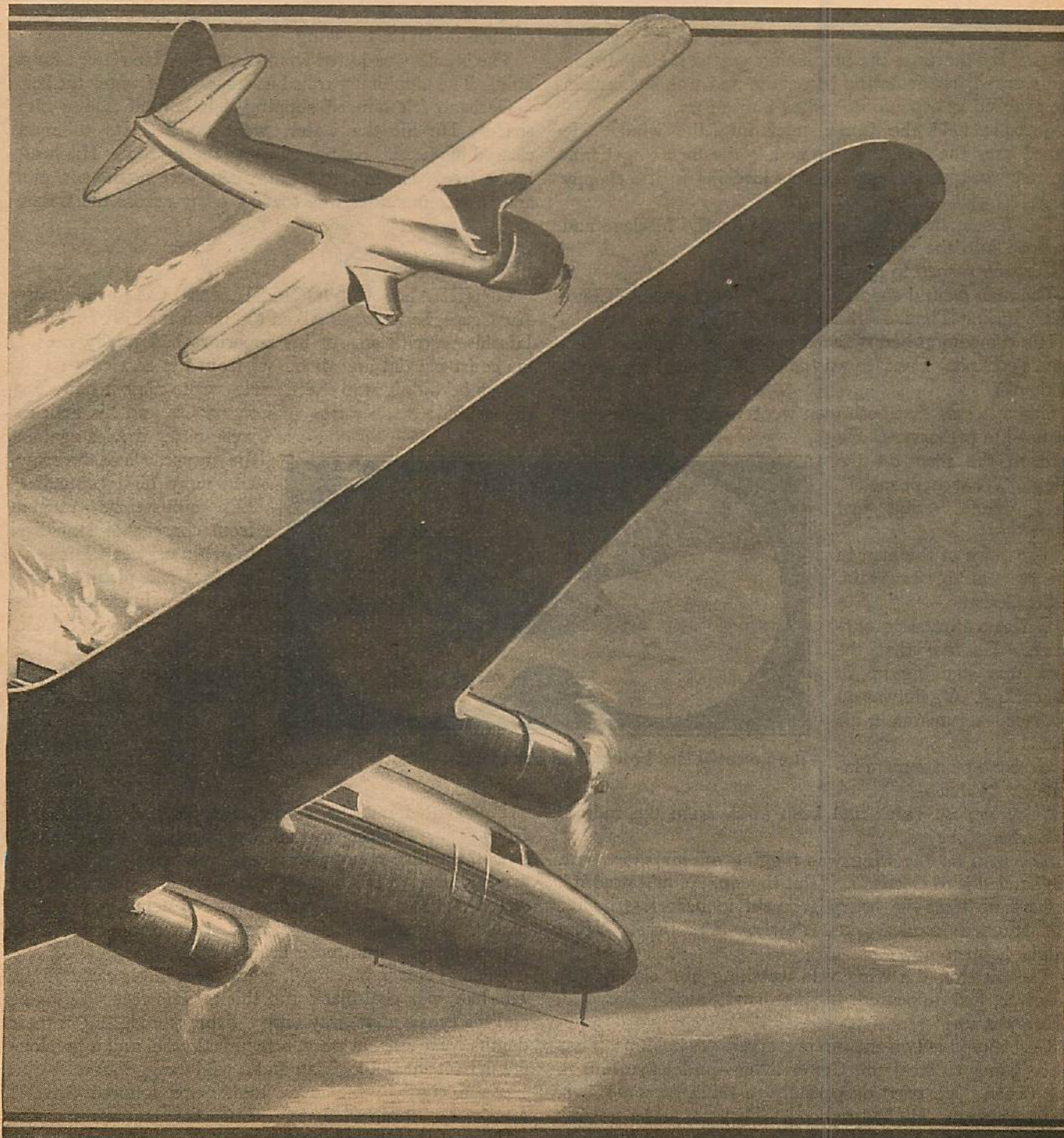
The fog had thinned since early morning, but it was still there. If he landed, would the jinx come back? Would he crack up?

Panic came. He yanked the stick into the pit of his stomach to jerk the Commander out of her dive and into a wild zoom. He couldn't do it. Something would happen if he did.

The attack bomber howled skyward. Gerbano saw the two figures in the parachutes, now dimmed by the fog. Leave those men to drown?

Badgered, wild-eyed, Gerbano fought himself, fought his fear back. Again he sent the Commander pelting down.

Then, and only then, did he remember the radio. He



switched it on, contacted the field, and jabbered out what had happened, what he intended to do, his position.

The radio operator said, "Stand by. I'll get Mr. Barnes—Mr. Cobbs—"

But by that time the Commander was again in the fog. Gerbano's fingers bit into the control column. Visibility grew worse—worse— He saw the water. He leveled off—and landed.

The plane bounced, lurched, then settled. He was down—successfully. Nothing had happened!

He swung the plane around as a parachuted figure dropped into the water on the port side. The amphibian roared across the intervening space. The man was pawing himself clear of the shroud lines and shouting.

Gerbano brought the plane alongside. The man crawled up on a pontoon, pulled himself erect, clinging for support. He shook the water from his eyes, gestured ahead.

The second jumper had come down a hundred yards beyond. Gerbano could barely see him in the swirling mists. By the time the amphibian got to him, the man had worked free from the parachute and was swimming. He grabbed at a pontoon, pulled himself up.

Gerbano held the Commander into the wind. He leaned over the coaming, shouted to the men to get into the rear cockpit. The plane was lurching in the choppy sea.

The first man nodded, scrambled up the fuselage and dropped into the rear pit.

Gerbano turned to him. "The third?"

The man behind shook his head. "He's gone. 'Chute didn't open. Thanks—thanks for picking us up."

His companion had crawled up on the wing near Gerbano's cockpit. His face was pale. He gasped out words of thanks.

Gerbano saw that both men were wearing heavy short coats—life preservers. He said to the man on the wing, "What happened?"

"I dunno. She just went—"

The voice of the man in the rear cockpit broke in. "Mr. Gerbano—"

Gerbano turned in surprise. He saw that the man was standing up in the cockpit. A grin was on his face—a gun was in his hand!

Gerbano stared incredulously. "What—"

"Get 'em up quick and keep away from the radio!"

Gerbano obeyed.

The man on the wing was tugging off his short coat. He handed it to Gerbano. "Put this on. You'll need it."

Gerbano took the heavy garment in nerveless hands. His stunned mind worked slowly. The jinx! What would happen now?

The man on the wing was watching him closely. A revolver had appeared in his hand, also. He said, "Hurry it up!"

Gerbano pulled on the life preserver. A holdup! They were going to steal the Commander—and leave him in the water. He tried desperately to think of some plan, some way out. He had radioed. They would be sending out ships from shore. Maybe if he stalled for time—

He said, "It was all a fake—the fire?"

"Yeah."

"But the third man—"

"Just a dummy to make the play look good. Now climb out on the other wing."

Gerbano hesitated. His gaze went from the man on the wing to his companion standing in the rear cockpit, and back again. They both were alert.

"Get out!"

Gerbano stepped up on the cockpit seat. He knew he hadn't a chance. But, if he could only get one of them. A wild plan came, born of sheer desperation.

He turned as if to step over the coaming and onto the other wing as directed. Then, suddenly, he whirled and threw himself clear of the cockpit and straight at the man standing on the opposite wing stub.

The gunman there had a split second's warning. He dropped flat. Gerbano's hurtling body passed over him, crashed down on the wing.

The breath was jolted from Gerbano. He clawed for a hold. The amphibian rolled as a mound of water hit her.

Gerbano felt himself slipping, felt himself falling into space. He hit the water, went under. Its coldness cleared his head. He pawed up to the surface. His head broke free. He saw that both men were in the cockpits and the Commander was roaring away across the water.

II—REPERCUSSIONS

GENERAL MURDOCK SILVER, late of the Army Air Corps, had always talked too much for his own good. His biting criticisms of his superiors had finally caused his court-martial and dismissal from the service.

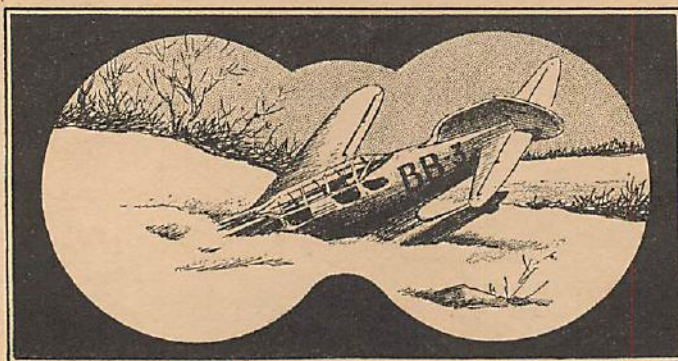
But he didn't stop there. He wrote almost daily for the Webb-Norton string of newspapers and his articles were bitter tirades against the graybeards of the army and navy high command. His accusations ranged from charges of stupidity to gross neglect. His sensational pen pictured Uncle Sam's inadequate defense against aerial attack. He vividly prophesied the coming of hordes of enemy bombers, winging across the Atlantic and the Pacific to slaughter the innocents in their beds and lay waste the land.

He pointed out the vulnerability of the key cities—New York, Washington and San Francisco. He showed how the entire country could be rendered helpless, her army and air force immobilized, by the wrecking of the water supplies, the transportation systems, the power plants. He pleaded for a unified air force, for more planes, more pilots, more brains.

General Silver was a tall, sparse man in his early fifties. His hair was coal-black and thick. His face was gaunt and his eyes a slate-gray with a flame smoldering in their depths. He was, at once, a fanatical rebel and a passionate patriot; a cool logician and a wild exaggerator.

As a civilian, the army higher-ups ignored Silver's attacks, or pretended to. And the public read his articles with skeptical tolerance.

(Turn to page 64)



The powerful lens brought the object close—Shorty's Snorter!

THE FLIER'S DICTIONARY

The sixteenth lesson in the technical terminology of the air. Save your files!

AERODYNAMICS

Four Forces Acting Upon A Plane in Flight

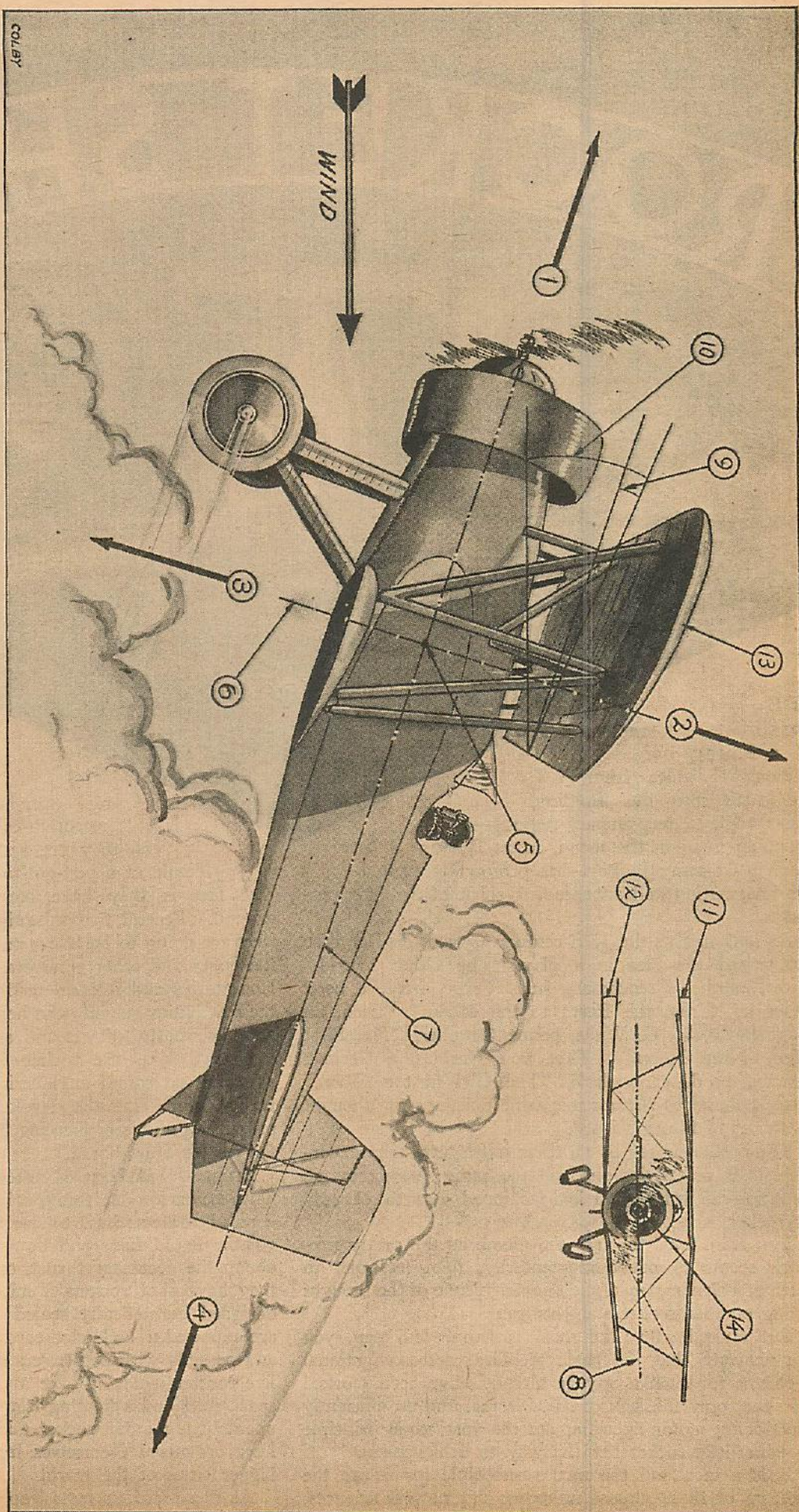
- 1 Force of Thrust Pulling Plane Forward
- 2 Force of Lift Pulling Plane Upward
- 3 Force of Gravity Pulling Plane Downward
- 4 Force of Drag Holding Plane Backward
- 5 Center of Gravity, Where All Forces Meet

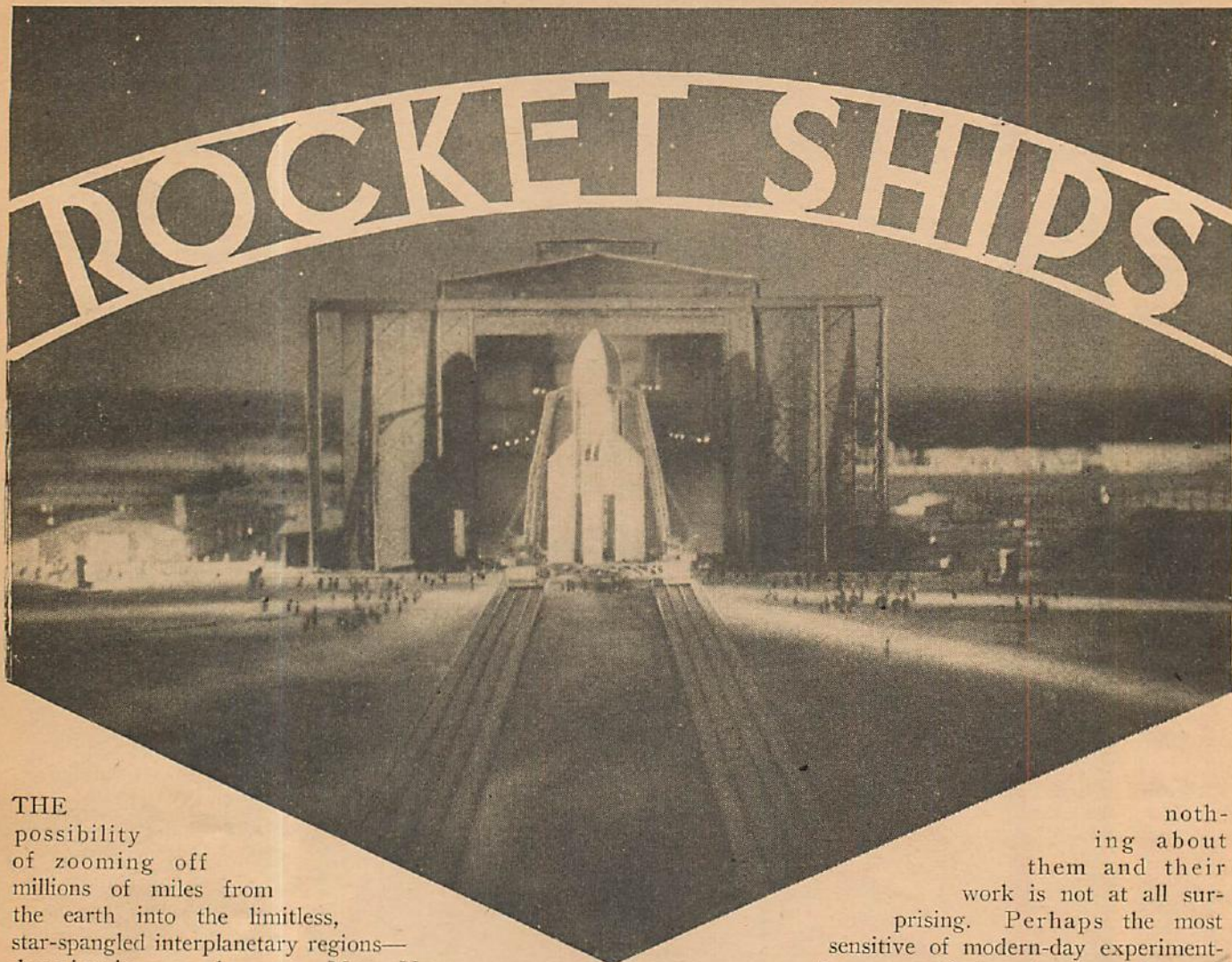
Three Axes About Which the Plane Turns in Flight

- 6 Vertical Axis, About Which the Plane Turns Directionally
- 7 Longitudinal Axis, About Which the Plane Rolls Laterally
- 8 Lateral Axis, About Which the Plane Pitches Longitudinally

Important Angles of the Airfoils in Flight

- 9 The Angle of Incidence Formed by the Chord of the Wing and the Line of Thrust.
- 10 The Angle of Attack Formed by the Chord of the Wing and the Direction Line of the Wind Flowing About It
- 11 The Angle of Cathedral Formed by the Droop of the Upper Wing and a Horizontal Line Across the Center Section
- 12 The Angle of Dihedral Formed by the Rise of the Wing or Wings from the Fuselage to the Tip as Compared with a Horizontal Line Through the Wing Roots or Across the Bottom of the Fuselage
- 13 Center of Pressure Along the Airfoil Where the Drag and Lift Forces Are Said To Be Acting
- 14 Center of Drag on a Plane in Flight Where the Distribution of Parasitic Resistance Is Centered





THE possibility of zooming off millions of miles from the earth into the limitless, star-spangled interplanetary regions—dropping in upon the moon, Mars, Venus, mayhap far-away Jupiter—has profoundly excited the imagination and adventurous spirit of man for centuries.

As long ago as the 17th century Cyrano de Bergerac dramatized the idea in a play, "The Other World." Later, another Frenchman, Jules Verne, wrote a book about it, "From the Earth to the Moon." Then, an Englishman, H. G. Wells, penned another, "The First Men in the Moon." Thea von Harbou, a German woman, produced a third, "The Girl in the Moon." And *Astounding Stories* magazine develops the thought in stories of future science.

The means chosen by all these extra-terrestrial excursionists is practically one and the same: a gigantesque variation of your good old-fashioned Fourth of July skyrocket.

You stare hard through the gloom as the pretty firework seems to pause momentarily, then plummet to earth in a sizzling tracery. The magnitude of the thought riding on that rocket staggers you.

But undoubtedly, like most earth-minded men, you are unaware that the basic technical and navigational problems for such a voyage already have been worked out; that only the lack of suitable fuel and an efficiently functioning motor operating on the very same principle as your little rocket bar the way to achievement.

It is a fact, and the men responsible for it are the creators of those almost unknown but newest sciences, astronautics and rocketry. That you have heard little or

nothing about them and their work is not at all surprising. Perhaps the most sensitive of modern-day experimenters, they are suffering the skepticism and ridicule of a you-got-to-show-me public.

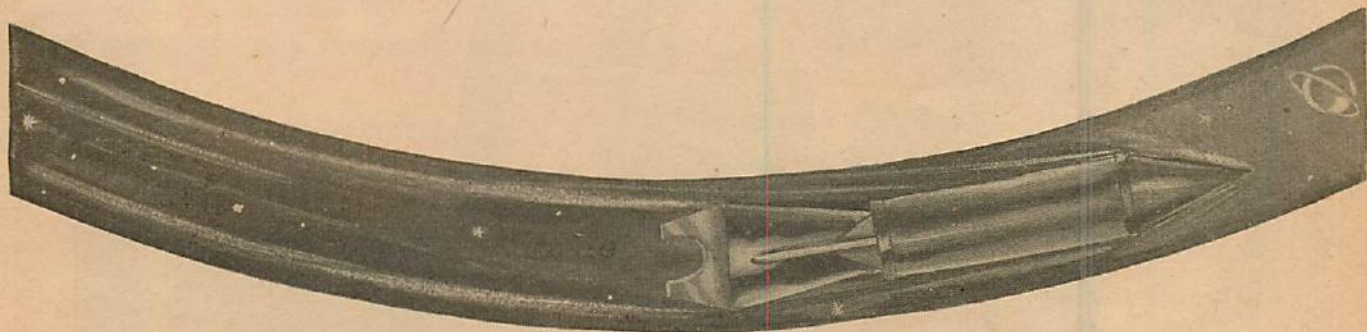
The fact is they have been virtually driven underground. Fearful that misguided housewives may think they are going to be blown to bits, the astronauts avoid the police and other annoyers by keeping close to cellar laboratories and isolated testing grounds. Occasionally their activities get into the newspapers in accounts compounded mostly of wit and sensationalism.

Nevertheless, the rocket makers have plugged on. Working on sound engineering principles, they are, in reality, pioneering the development of the only known propulsion means of piercing the vacuum regions beyond the earth's atmosphere.

Progress has been of necessity slow but substantial. They have, for one thing, solved the fundamental problems of rockets: how to use and control explosive and volatile liquid fuels and how to burn them properly to obtain the necessary thrust, or recoil, in take-off. Too, they have shot rockets a mile and a half straight up; designed hermetically sealed ocean rocket ships which are expected to be hurled across the Atlantic with freight and possibly with passengers during our lifetime; sent a live rooster whizzing over a river in India; worked out space suits and a floating island for interplanetary trips; operated a regular rocket mail service in Austria; and have organized themselves into societies which dot the bigger cities of the world.

As these curious facts leap at you, the thought arises at once: "Well, who are these rocket men? And when

*Will man penetrate interstellar space?
The answer lies in rocketry, the latest
and least known science of air conquest.*



The scene at the left
is from a German
motion picture, "The
Girl in the Moon."

by
Allan
Finn

did this thing start?" In truth, the astronauts have been experimenting for little more than a decade. In practical astronautics they are precisely where aviation pioneers were before the Kitty Hawk flights. The roots of their science, however, are thousands of years old.

The prototype of their rockets is the flaming arrow which the ancient Greeks shot at enemy ships in war. Called Greek fire, the arrow had a capsule at its head charged with pitch, sulphur, charcoal and salt. This capsule was ignited at its forward end and emitted a tongue of yellow flame.

In the 13th century the Chinese attempted to duplicate this fire. Finding salt scarce, they used saltpeter. Oxidizing the other ingredients, this chemical caused an explosion. The flame shot forward, all right, but it made the arrow a flaming boomerang, spiraling back to the bowman. The Chinese had accidentally stumbled upon the first cousin of gunpowder and the rocket. Igniting the charge from the rear, they used such rockets for the first time against the Mongols in the Battle of Pienking.

Introduction of rockets into Europe did not occur until 1405, when Konrad Kyeser von Eichstadt, a German military engineer, urged them as a war weapon. About the same time Joanes de Fontana, an Italian, designed rockets in the form of pigeons, fish and hares.

With an iron instead of a paper case, Sir William Congreve evolved in England a rocket which, fired from a specially fitted



Seven experimental rockets produced by a Czecho-Slovakian inventor, Ludvik Ocenasek, prepared for testing near Prague.



Shown before the tower at Roswell, N. M., where Dr. Robert H. Goddard, American rocket pioneer, is carrying on his experiments, are (left to right) A. W. Kisk, Harry F. Guggenheim, Dr. Goddard, Col. Charles Lindbergh, N. T. Ljungquist.

Dramatic night view of an iceboat, built by a Syracuse University student, which attained 75 m.p.h. under propulsion of rows of rockets attached to the sides.



ship, was used to bombard Boulogne, France, in 1805-06. Then in 1812, in the Battle of Leipzig, and afterward at Waterloo, Europe's first Field Rocket Brigade went into action. However, the rifled gun bore and the development of breech-loading, independent recoil and smokeless powder, coming in the 19th century, finally relegated the rocket to limbo. Revived during the World War, it was unsuccessful against airplanes.

England simultaneously developed the rocket as a peace-time instrument, introducing it in life-saving, which, except for pyrotechnics and signaling, is its chief use to-day. Attempts were made to build rocket-propelled airships, but these failed.

Until the beginning of this century, rocket experimentation was almost nil. In 1903—the year the airplane first rose for a few brief seconds—a Russian, Konstantin Ziolkovsky, working by rule of thumb, literally rocketed the rocket into its modern stride.

Ziolkovsky, credited with the first scientific theory on interplanetary travel, discovered that a rocket did not need air in flight, i. e., it could operate in a vacuum outside the stratosphere as easily as in the dense atmosphere close to the earth. Previously, it had been generally believed that rocket exhaust gases required something to "push" against. But Ziolkovsky showed that propulsion was not affected by the absence or presence of air, inasmuch as a rocket functioned in accordance with New

ton's Third Law: to every action there is an equal and opposite reaction.

With three notable exceptions, practically the whole world scoffed at the Russian's discovery. These were Dr. Robert H. Goddard, of the United States; Professor Herman Oberth, of Austria, and Robert Esnault-Pelterie, of France. Grasping the truth of his theory, they began experimenting with rockets at about the same time, unknown to each other.

Of the three, Dr. Goddard, a bald, stocky physicist of Clark University, Worcester, Massachusetts, is regarded by fellow astronauts to-day as the No. 1 pioneer researcher. He is the dean of rocketry.

A remarkably secretive man because of early public ridicule, he quietly began his experiments in 1907—the year the Wrights built an airplane able to fly 40 miles an hour for 100 miles. His tests took place at Worcester, Auburn and Fort Stevens, in the Bay State. Two years later, with a grant from the Smithsonian Institution, he pursued his research in a program for developing a rocket to take meteorological instruments aloft.

By 1919 he was ready to spring an epochal event in rocketry. In that year he published the results of his work in a paper entitled "A Method of Reaching Extreme Altitudes," which started the whole world tinkering at "flying needles." His article became the cornerstone of astronautics.

The danger of rocketry is unintentionally demonstrated in this unusual scene in Scotland—the explosion of a mail-carrying rocket designed by Gerhard Zucker, German experimenter.

for rockets, announcing that he was concentrating on development of combustion chambers and exhaust nozzles and flights.

Last January he broke a silence of sixteen years at the winter meeting of the American Association for the Advancement of Science in St. Louis to disclose that he had shot a weighty rocket a mile and a half upward at a speed of 700 miles an hour. Launched from a 60-foot tower, it was powered by gasoline and liquid oxygen, and guided by small fish-tail fins operated by a tiny gyroscope.

In March Dr. Goddard published his second paper, a ten-page affair, entitled "Liquid Propellant Rocket Development,"

which reviewed his research since 1919 and revealed that he was devoting himself to the problem of weight reduction in rocket motor building.

But while Dr. Goddard pioneered rocket theory, it was the Germans who took the lead in the practical field. Their starting point was in 1923. The ice was broken by a sensational



Kaye Don, British sportsman, finds that rocket propulsion is a good way of testing model hull shapes for a high-speed motor boat.

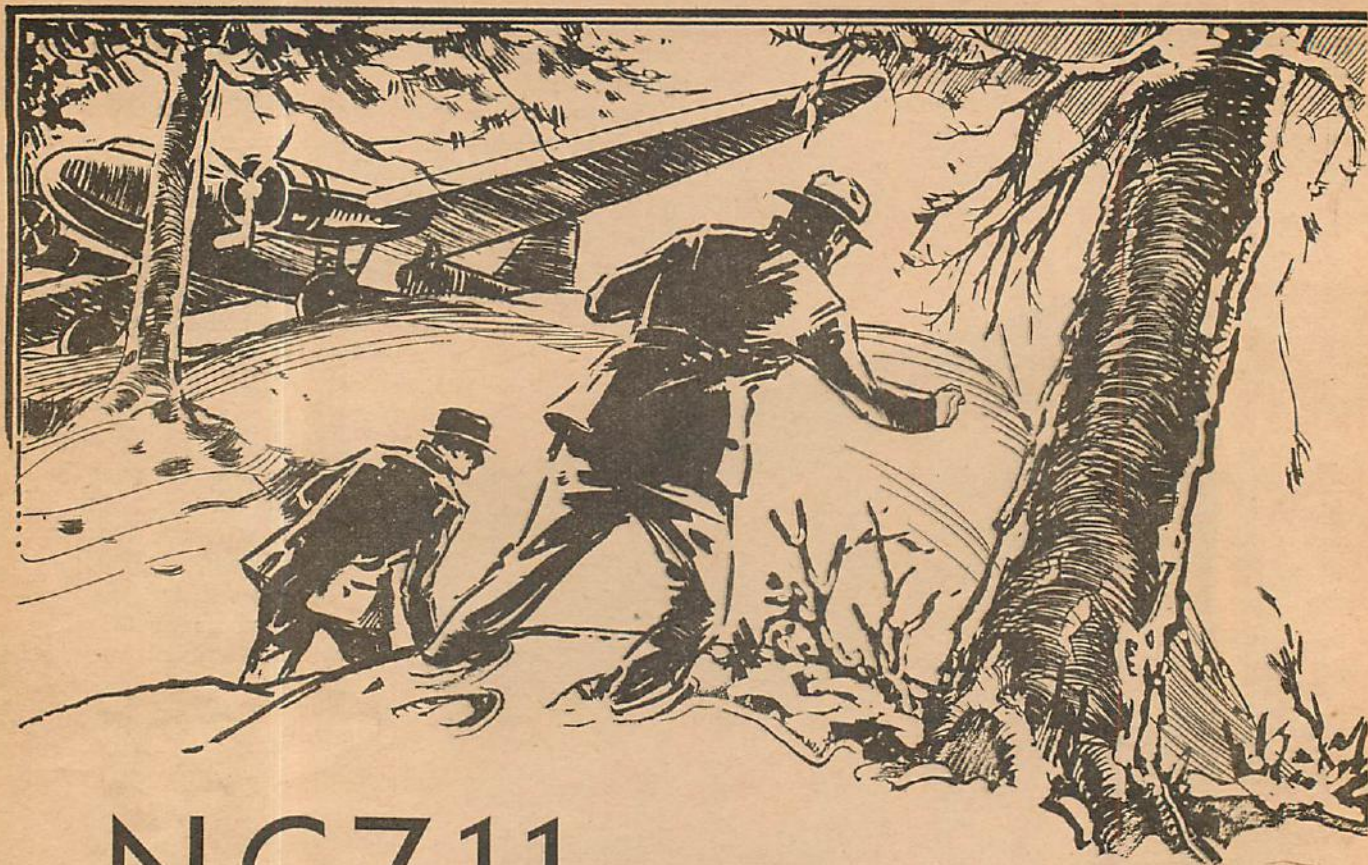


Substituting liquid fuel (gasoline and liquid oxygen, which have an explosive force ten times that of TNT) for the less practical and more dangerous powder fuel, the American rocket leader continued his lone way, and in 1927 shot the first liquid fuel rocket to leave the earth. Tested at Worcester, it exploded at 900 feet, but apparently was a success.

Dr. Goddard now obtained a \$100,000 grant from the late Simon Guggenheim, took a leave of absence from Clark, and retired to Mescalero Ranch, near Roswell, New Mexico. There he built a laboratory exclusively

book called "Rocketing Toward the Planets," by Professor Oberth, who undoubtedly had been influenced by Dr. Goddard's first paper.

In 1927 a pupil of Oberth, Max Valier, and Johannes Winkler founded at Breslau, Germany, the German Interplanetary Society, first of its kind. During the following year came the first practical rocket experiment. Valier got Fritz von Opel, the automobile manufacturer, to try out powder rockets on his machines. The cars attained 100 miles an hour. A rocket glider flight also was held, and in 1929 Valier drove a (Turn to page 93)



NC711 Going Down!

by A. S. Gregory

"Now look here, Garibaldi," Dorn said. "You know and I know that we can get through this soup all right. You're riding the beam that'll take us right to the field. The passengers don't understand that. They're thinking every second we're gonna ram into a mountain. You think it's right to scare ten years' growth out of them?"

Old Garlic looked up, the smile leaving his face. He said: "So what?"

Dorn stiff-fingered the pilot on the shoulder. "This—you set down in the emergency field until the fog lifts!"

"You lay off me!" the pilot warned. "I'm flying this bus!"

"Yeah? With me the passengers come first."

"They're first with me, too," replied Old Garlic. "My job is to get them to their destination. That's what they're paying their dough for."

Dorn whirled on Hauser. "How's the weather at the other end?"

"Ceiling eight hundred feet, visibility five miles and closing in fast," the co-pilot answered.

"You hear that, Garibaldi? It'll be zero-zero in a half hour, and we're not equipped for blind landings!"

A scowl twisted Old Garlic's face. "I told you I'm flying this bus! I know what I'm doing. Get back in the cabin where all deadheads belong!"

"Garibaldi," Dorn snapped, "I'm ordering you to set

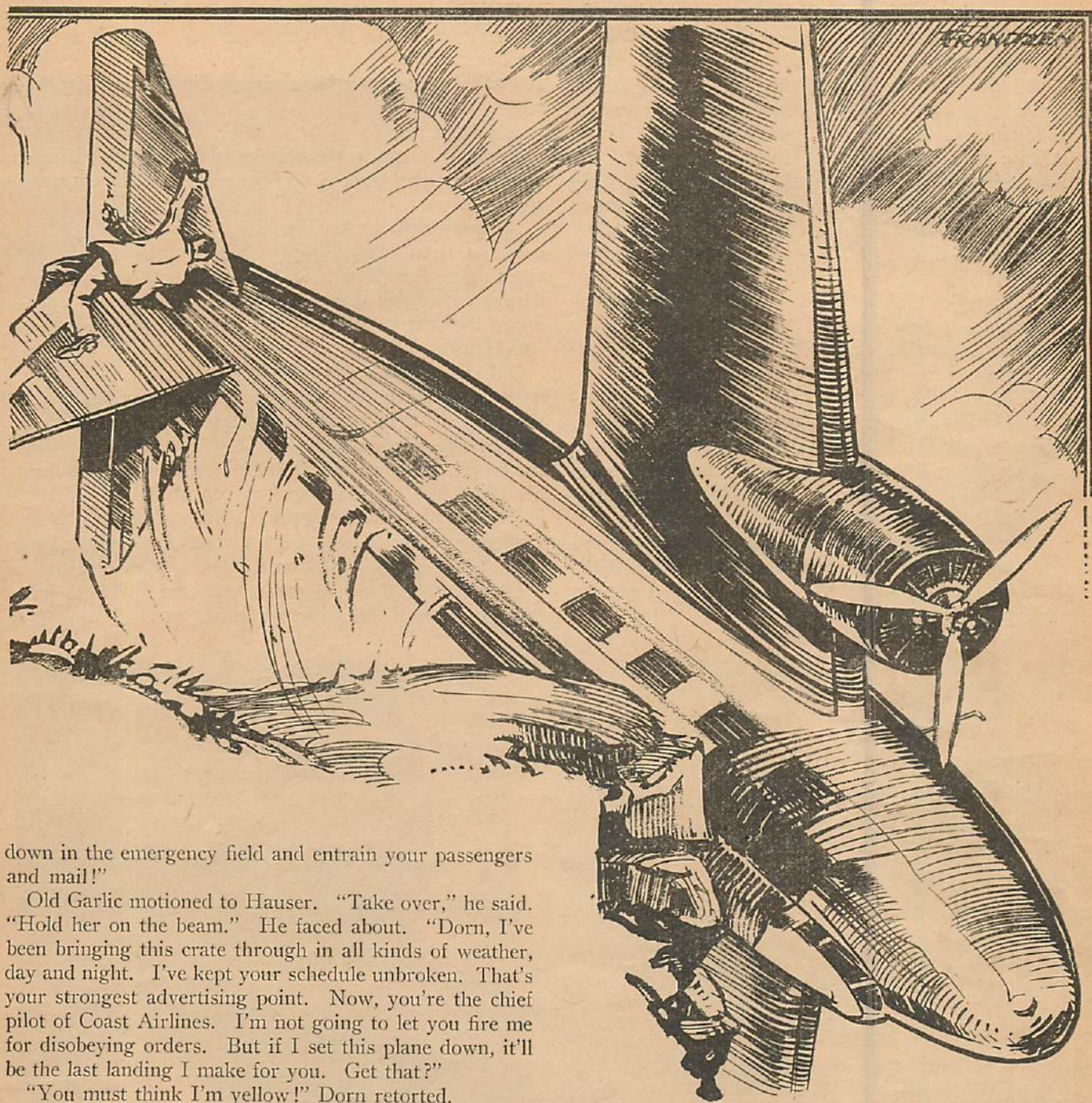
*Queer things happen in the
chief pilot got ordered out of
guess what*

FITZGERALD DORN tried almost everything except socking "Old Garlic" on the jaw.

That was the pilot he'd never been able to break to his own style of flying. His idea was to standardize flight technic, although he knew darned well that no two pilots flew exactly the same. Each one had his own peculiarity in taking off, in landing and in flying the routes. Yet he felt duty bound to try out this regimentation idea. It sounded reasonable and he felt about right to tackle Nick Garibaldi, which was Old Garlic's official name on the pay roll.

Dorn started up the aisle of the two-motored transport. A passenger stopped him and spoke uneasily about the thickening weather. Dorn assured the grayish man the fog was nothing to worry about, and at the same time an idea popped into his head. He'd order Old Garlic to set down in the emergency field. If he won, his battle with the toughest flier on his line would be over. He'd have Old Garlic eating out of his hand.

He squeezed himself in the cockpit between Old Garlic at the wheel and Fred Hauser, the co-pilot, who was taking down the weather report.



The rudder post struck—and bounced up again!

down in the emergency field and entrain your passengers and mail!"

Old Garlic motioned to Hauser. "Take over," he said. "Hold her on the beam." He faced about. "Dorn, I've been bringing this crate through in all kinds of weather, day and night. I've kept your schedule unbroken. That's your strongest advertising point. Now, you're the chief pilot of Coast Airlines. I'm not going to let you fire me for disobeying orders. But if I set this plane down, it'll be the last landing I make for you. Get that?"

"You must think I'm yellow!" Dorn retorted.

"No, Dorn, you're too good a pilot for anybody to make that crack. Only I want you to understand I'm the pilot here. If you're going to deadhead along as a sort of glorified air conductor, you get yourself a crew that'll take off their hats every time they talk to you. Once I'm in the air, it's up to me. My best judgment tells me it's O. K. to barge through. And if my judgment is haywire, it's time for me to retire to the farm. All you have to do is repeat that order!"

Dorn's eyes clashed with the black pools of molten anger. It was on the tip of his tongue to say: "You're through!" With that order he knew he'd lose his most

dependable pilot; the clearest-headed flier that ever won a scheduled air transport rating; a guy with a will power of his own to fight not only the elements but for what he believed to be right. It had never been made so plain to him before that Old Garlic was over his nursing-bottle days in the air game. Without a word Dorn reentered the cabin.

And after the transport landed, Garibaldi said: "One more thing, Dorn. As long as I'm flying for Coast Airlines you stay out of my plane. Right?"

"Right, Old Garlic!" Dorn answered.

That was three days ago. To-day, as Fitzgerald Dorn was going over the monthly reports of pilots, the first hint of disaster to Old Garlic came by radiophone.

It came in the same form as any routine call made periodically every ten minutes by all pilots aloft. Except that Nick Garibaldi had signed off not more than three

flying game. But when the Nick's ship, he couldn't would follow—

minutes ago with "All's O. K.!" Now his voice burst in again, strong and fast. It electrified the airline office.

"Seven eleven calling Oakland. Seven eleven calling Oakland. Seven eleven calling Oakland."

Dorn swung about sharply in his swivel chair to face Claude Rickley, the division superintendent. "That's Old Garlic himself," he said. "He sounds excited."

"Something's wrong up there!" cried Rickley. "He reported in only a coupla minutes ago—exactly twenty minutes to noon—and here he comes barging in again." He replaced the desk fountain pen in its holder, snapped open a silver cigarette case and took a smoke.

They listened to the operator in the radio room adjoining the administration office.

"Oakland answering seven one one." This was repeated rapidly three times.

Garibaldi was the only one who said seven eleven—another habit Dorn had tried unsuccessfully to break. "Naturals for me," had been Garibaldi's answer, and he insisted on using the Bureau of Air Commerce license number instead of twenty-seven, the usual company number of the big twin-motored, low-winged monoplane.

In the doorway of the glass partition suddenly appeared the operator. He shouted across the room: "Mr. Rickley! Seven one one seems to be in trouble! I got his regular report not more than——"

He was drowned out as the amplified voice from the air again boomed in the radio room: "Both engines heating fast. Oil pressure dropping. . . . Wait. . . . It's going up again. No chance. Engines getting hotter——"

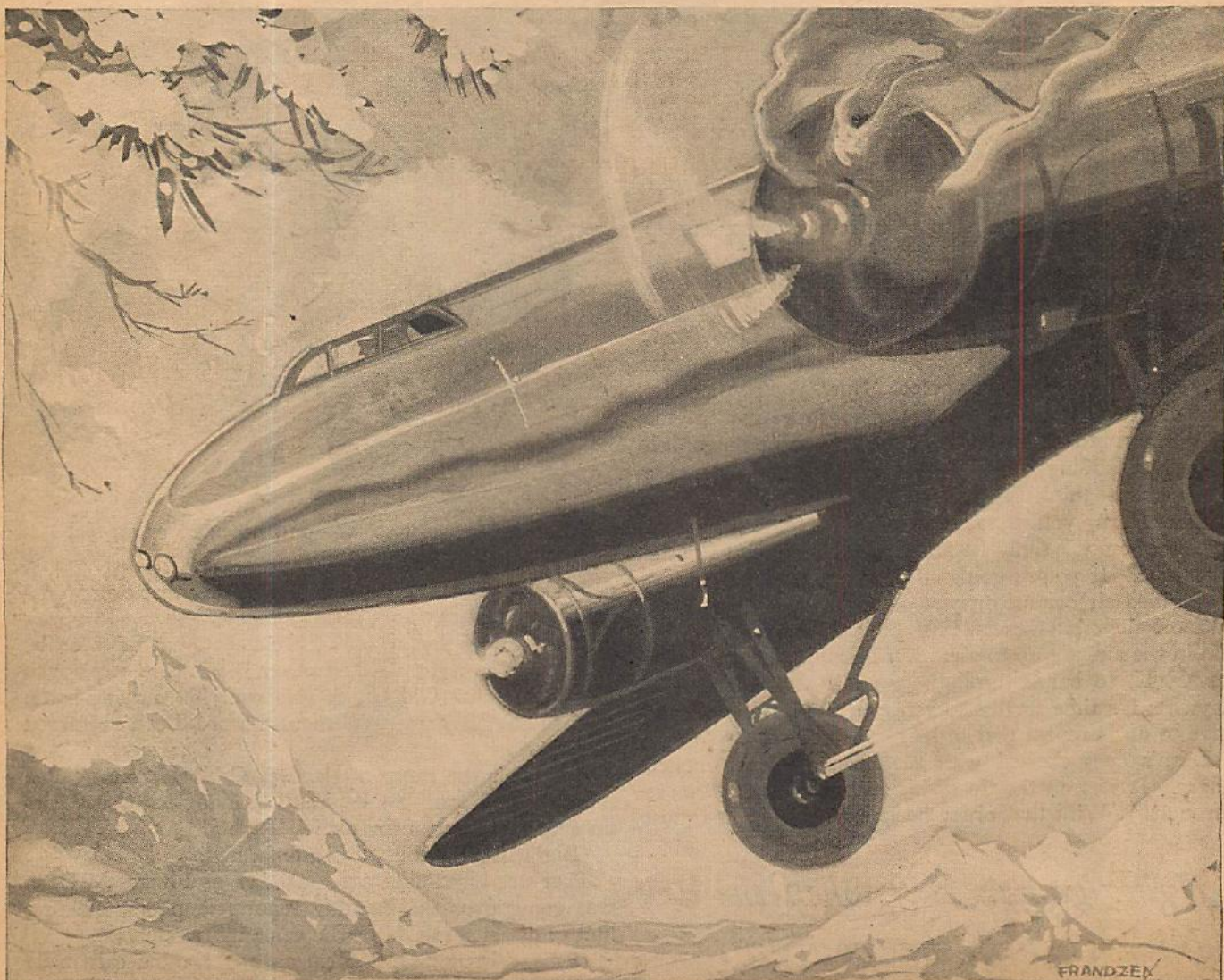
Silence!

The only sound in the office was the teletype clacking out the weather reports, and the soft drone of the radio apparatus.

Dorn crushed out his cigarette. He was in that plane now, up front. The luxury passenger liner that had taken off an hour and a half ago for Salt Lake City, with the first scheduled stop at Reno. He saw himself standing in the narrow aisle of the cockpit between Garibaldi and Hauser.

Old Garlic was working away desperately, jazzing the engines, checking the oil supply, his eyes on the board, watching the crazily jumping pointers of the two dozen instruments. His short, thick body was hunched over the wheel. The perpetual sunny smile was gone from his jovial face. Sweat stood out on his broad forehead in great beads, trickled down the sides of his thick nose. Dropping oil pressure meant a cracked or clogged oil line. The engines would burn up—explode—fire!

Dorn leaned down close and shouted in Garibaldi's ear: "Pick out a spot to set down in!" (Turn to page 83)



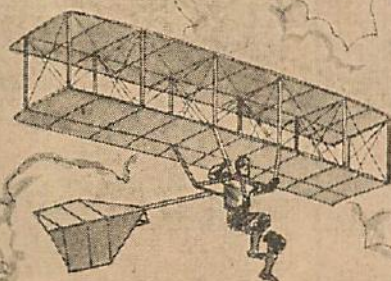
Dropping oil pressure meant a cracked or clogged oil line. The engines would burn up.

Pictorial History of Man in the Air

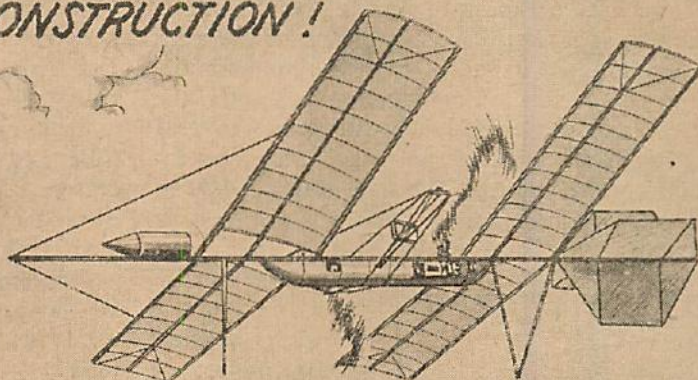
1887 THOMAS SCOTT BALDWIN
MAKES HIS FIRST PARACHUTE
DROP IN AMERICA. LATER HE
BECOMES AMERICA'S LEADING
PARACHUTIST, AND INSTRUCTS
PILOTS FOR WORLD WAR SERVICE.



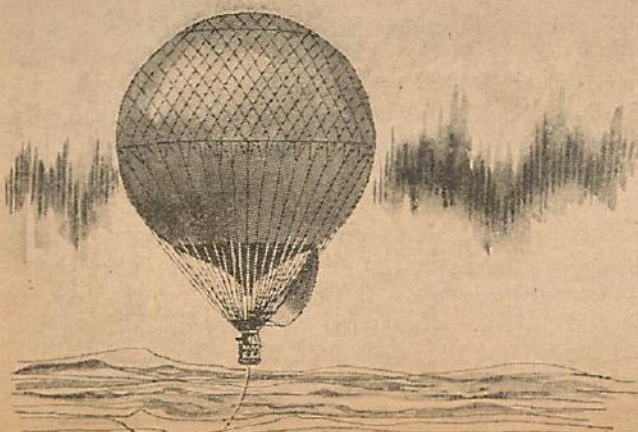
1896 GLIDING
FLIGHTS OF OCTAVE
CHANUTE PROVE
EFFICIENCY OF THE
BIPLANE TYPE OF
CONSTRUCTION!



1896 DR. LANGLEY'S
STEAM DRIVEN "MODEL
NO. 5" MAKES A FLIGHT
OF OVER HALF A MILE
AT 25 M.P.H., PROVING



THE PRACTICABILITY OF MECHANICAL
FLIGHT. THIS HAD A $1\frac{1}{2}$ H.P. ENGINE.



1897 ON THE ELEVENTH OF
JULY, DR. ANDREE, FRAENKEL,
AND STRINDBERG STARTED
FOR THE NORTH POLE FROM
DANES ISLAND, SPITZBERGEN,
IN A BALLOON. THEY NEVER
RETURNED OR WERE FOUND.

Stepping Up Wing Lift

What designers are doing to-day to safeguard landing speeds while air speeds increase is told in this interesting article.

HOW can the top speed of airplanes be increased and yet a safe landing speed be maintained?

by Daniel Jordan

Both features are of the greatest importance in flying. Low landing speeds have been troubling designers ever since the top speeds began to creep over the 100 m.p.h. mark. In many cases landing speeds have been sacrificed for increased high speeds. This is especially true in high-speed military and racing planes, which often have dangerous landing speeds of 80 to 90 m.p.h.

When the top speed of an airplane is raised by increasing the power, increasing the wing loading, or developing some other refinement in design, the landing speed is also boosted, unless the plane is equipped with a low-landing-speed device.

Essentially, the problem of slow landings reduces to finding a method of increasing the lift of the wings. In addition, the pilot must be able to regulate this increase in lift for take-off and landing purposes. Let's examine the methods of stepping up wing lift.

The method which has gained the most popularity is the wing flap. In the past several years it has become standard equipment on almost all private planes and airliners. The flap is a small movable portion of the main wing. In normal flight it is drawn up to round out the shape of the wing. During landings and take-offs, the flap is lowered. Extending downward from the rear of the wing, it changes the shape of the wing and increases its lift. The width of the flap is usually 20 to 25 per cent of the wing chord. On small planes flaps are hand-operated. In large planes, such as transports,

flaps are usually lowered and raised by a small electric motor.

The advantages of flaps are as follows:

1. Decrease in the total wing area. With lift-increasing flaps, the same amount of lift is available for landings and take-offs even with reduced area.

2. Decrease in dimensions of the airplane. This facilitates handling in the air and on the ground.

3. Decrease in

structural weight, which naturally follows from decrease in wing area. This advantage is partially but not seriously

offset by the added weight of the flap-operating mechanism.

4. Increase in maximum speed. With the decrease in wing area, there is an increase in the wing loading of the airplane—the amount of weight carried per square foot of area—a condition which permits higher speed.

5. Decrease in landing speed. When operated, the flap permits the airplane to fly more slowly by increasing the wing's effectiveness.

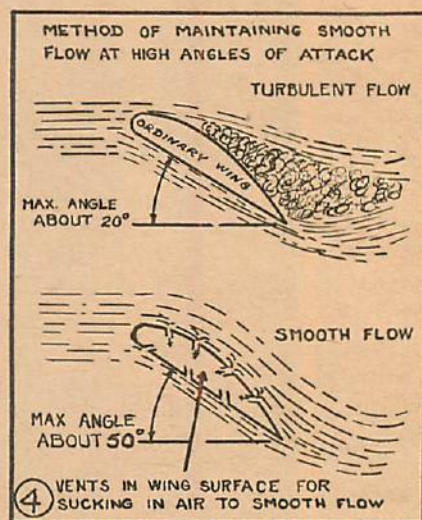
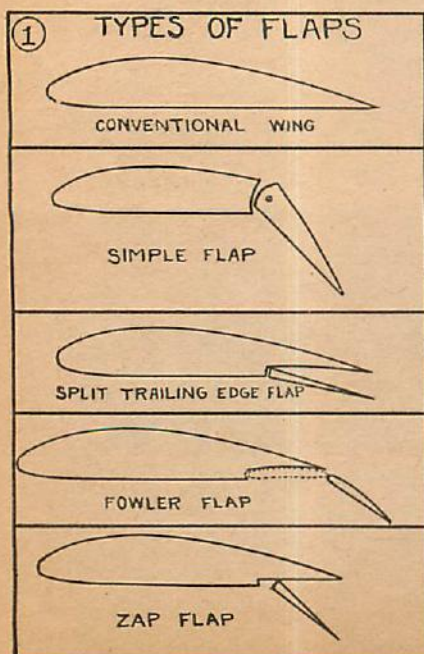
Some of the types of flaps now in use are illustrated in drawing No. 1. With the flaps lowered at a 45-degree angle, the following increases in lift have been recorded in wind-tunnel experiments: the simple flap shows a 50

per cent increase in lift; the split trailing edge flap 66 per cent; the Zap flap 80 per cent, and the Fowler flap 90 per cent. These last two flaps involve structural difficulties and are little used for that reason. They are by far the most effective, however, and are certain to be more widely used in the future.

The above increases in lift do not hold good for the entire wing, since flaps are seldom used along the whole span. The necessity of mounting ailerons along the trailing edge of the wing cuts down the length of the flap, which reduces its effectiveness. For this reason, flaps on low wing airplanes usually extend underneath the fuselage as well as along the rear of the wing.

Shifting the ailerons above the wing and utilizing the entire wing span for flaps has been tried. Likewise several experimental planes have been built with a slot-type aileron in the center of the wing. This latter type shows the most promise. It consists of a small uncovered section of the wing located at about the center of the chord. This gap in the wing covering can be opened or closed from the cockpit. The action on each wing is reversed; that is, when one slide is covered, the other is open. The resulting difference in lift gives the plane ample lateral control.

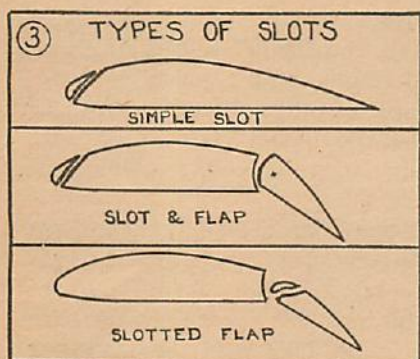
This type of aileron offers increased resistance at high



speeds over the conventional trailing-edge type, but it does permit an increase in flap area and therefore a lower landing speed. Full-span flaps and center-wing-slot ailerons seem to be the future combination for airplanes designed for use by private fliers.

The Fairchild Baby Clipper amphibian is equipped with Zap flaps, in which the flap's leading edge slides backward along the under side of the wing while it is being lowered. This flap is effective by increasing the wing area in addition to changing the wing shape. It lowers the landing speed from 68 to 58 m.p.h. Simple trailing-edge flaps on the Cessna reduce the landing speed from 54 to 47 m.p.h.; on the Ryan S-T from 48 to 42 m.p.h.

Flaps are not the only solution to the problem of high top speed and low landing speed. The wing slot is another approach. Before looking at the various types of



slot, let's consider its action as a lift-increasing device.

An airplane wing produces lift only as long as the air flowing past it is free from excessive turbulence. In other words, as long as the wing slips through the air without causing

boiling and burbling it will produce lift. See drawing No. 2. When the wing is moving through the air in an almost horizontal position, it causes little disturbance. However, when it is inclined at an excessive angle (any angle greater than 17 to 20 degrees) its lifting power falls off. The air passing over the airfoil begins to boil, and instead of a smooth flow there is a whirling and eddying. Under such conditions the lift falls off and resistance of the wing to forward motion is greatly increased. At high angles the wing is no longer an efficient lifting device. It is not capable of supporting the airplane and so it stalls. This condition causes the plane to dive or spin until the speed is reached where the wings will again support the plane.

The wing slot is a method of smoothing out the air flow over the top of the wing when it is at high angles of attack. If the air can be made to follow the shape of the wing instead of breaking up into whirling currents, the wing, instead of stalling at high angles, will produce even more lift than at low angles.

The wing slot is a small wing mounted in front of the main wing. It is fixed at such an angle that when the wing is flying at an excessive angle of attack the slot deflects the air so that it passes smoothly over the top of the wing. Wings with slots will still produce lift at angles as high as 29 degrees.

Types of slots are illustrated in drawing No. 3. Wind-tunnel tests indicate that the simple slot increases lift about 27 per cent. The slot-and-flap combination proves more effective by raising the increase to 70 per cent. The slotted flap shows an increase of 75 per cent. As will be noted by comparison, slots do not measure up to flaps as

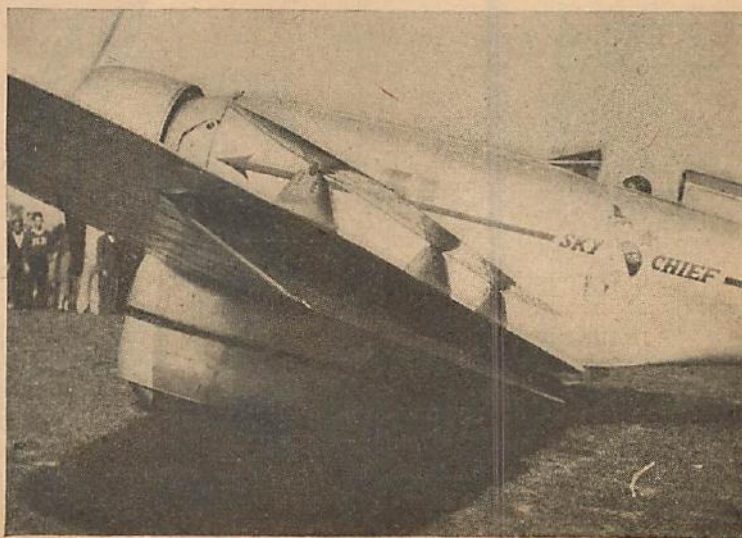
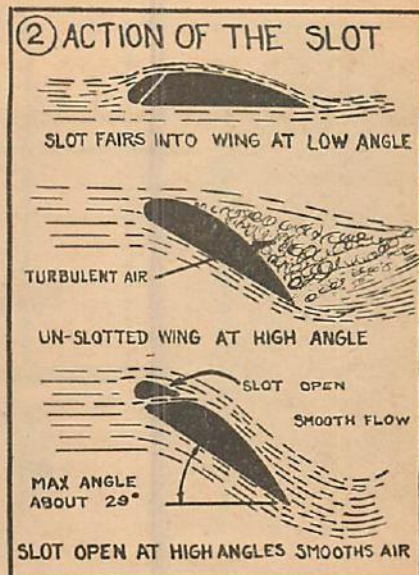
a means toward better lift. Difficulty of installation and added resistance at high speeds are their bad points.

There are two types of slots—fixed and automatic. The fixed slot is permanently mounted ahead of the main wing. The automatic type fits into the front of the wing during normal flying attitude. When the stalling angle is approached, the slot surface automatically separates from the wing and allows the air to flow through. In this way the automatic slot performs the same task of smoothing out the air flow as does the fixed slot, with considerable decrease in resistance.

Fixed slots were tried on the Curtiss Coupé. In combination with split trailing-edge flaps, the landing speed was cut to 44 m.p.h. This combination provided good handling of the airplane at stalling speeds.

The slot is little used in this country. The automatic slot was developed by the Handley Page airplane company of England, and has been used on numerous planes of their manufacture. Considering all factors, however, we can discount the effectiveness of the slot in solving the high-top and low-landing-speed problem. It shows the most promise when used in combination with some other type of lift-increasing device.

There is another way of maintaining a smooth flow of air over the top of the wing at high angles. We've seen that slots will do this, but their disadvantages are annoying. This new device, under development by the National Advisory Committee on Aeronautics, is a suction pump that will suck in some air off the top of the wing, and in this way maintain smooth flow. It is effective up to angles of 50 degrees, as (Turn to page 86)



Ailerons mounted above wing to permit full-span flaps.



FROM—STEVE STERLING,
Skyways Air School,
Greenville, Calif.

"Dear
Harry—"

TO—HARRY REED,
Burton, Pa.

DEAR HARRY,

Well, here I am at Skyways Air School, and all set to learn the gentle art of airplane piloting. Boy—am I thrilled! After years of reading about aviation, talking about aviation, and dreaming about aviation, I'm actually getting into the flying game. From my window I can see a dozen planes on the airport, all kinds, big and little, monoplanes, biplanes, even an autogiro. There goes a ship down the field—just listen to the motor roar. But you can't hear it, can you? That's a good joke on me. Anyway, it shows you how excited I am to think that soon I, personally, will be gripping the stick of an aircrate and tearing through the sky. Just wait till I zoom over the old home town and cut loose with some barrel rolls, loops and power dives. Maybe the staid and sedate residents of Burton won't rush out to see me in my "airplane"—and maybe rush in again when I leapfrog over the housetops at 100 miles an hour!

But that's a little in the future. First I've got to get some practice in taking off, landing, and so on. Bet I won't need much, though. The pilot who instructs me in the high art of flying will probably want to know whether I haven't flown before, because I know so much about planes from reading stories and seeing airplane movies. And that, by the way, brings up the main subject of this letter.

Do you remember the theory you and I often discussed in regard to a person flying an airplane his first time up, with no instruction whatsoever? Well, when I was in the school office signing up for my course I mentioned this theory to the owner of the school, who is also the chief pilot, a bird named Norwood. I told him how I figured that a fellow like myself, who had read hundreds of stories about flying and seen dozens of aviation mov-

Letters of an Air Student to His Friend

by George Swift

ies had a pretty good idea how planes were flown and ought to be able to actually pilot a ship, at least take off and land.

Well, you should see this guy Norwood laugh. And to make it worse, a couple of other pilots happen to be in the room, and they almost split their sides, too. Finally Norwood quits cackling and puts his hand on my shoulder.

"Son," he says, as though I am a two-year-old, "that idea of yours sounds all right, but if you should try to carry it out it would be just too bad. As a matter of fact, I once saw a chap try the very stunt you have in mind, and after the crash they sold the plane for kindling wood, the pieces being too small for any other purpose."

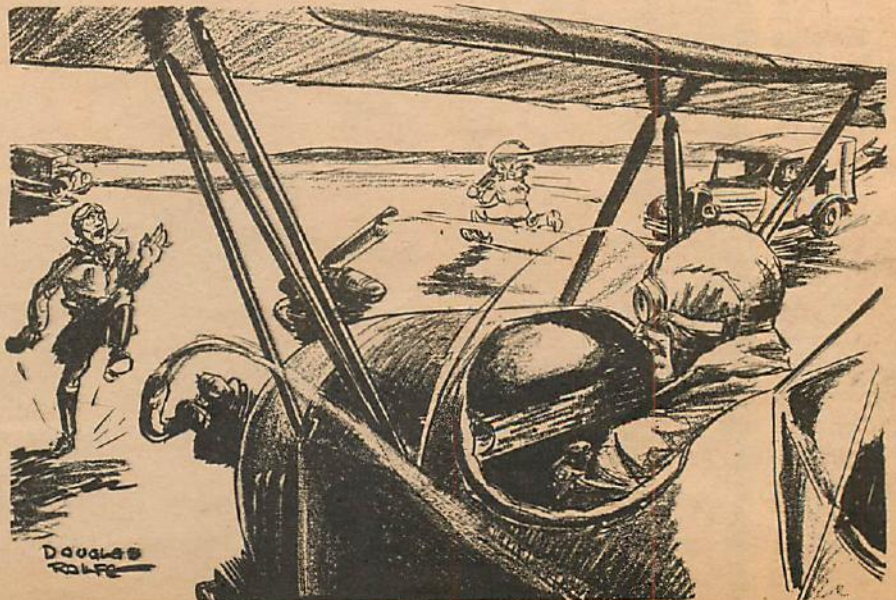
I don't say anything to that, just maintain a cool silence, but I am thinking fast. Before the day is over, I promise myself, I'm going to show these laughing hyenas something that will make them sit up and stare.

As soon as I leave the office I go over to the hangars and watch and wait.

My chance comes.

Some mechanics run out an open biplane, start the motor and go away. At this point I have an opportunity to make a big mistake, but remembering the stories I've read, I delay action until

(Turn to page 92)



One guy—it's Norwood—runs into my path and puts up his hands to stop.

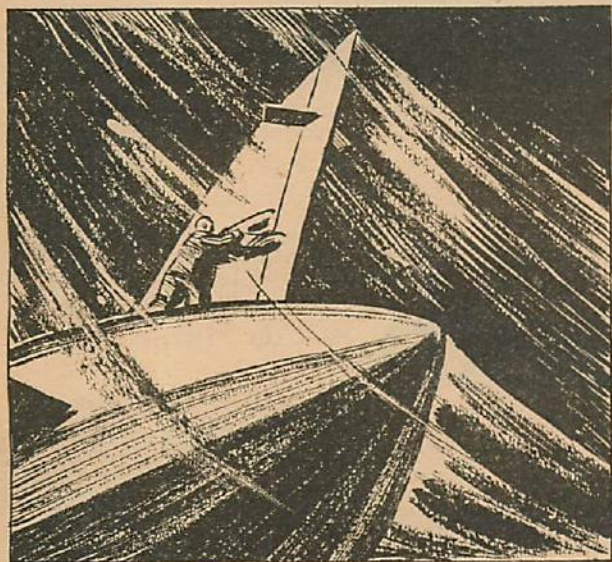
SPLIT-SECOND ACTION

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



IN AN EMERGENCY LANDING. — HIS SHIP AFIRE, ROY WARNER THOUGH BADLY BURNED, WENT BACK THROUGH THE FLAMES AND SAVED THE MAIL. THE GAS TANKS EXPLODED SOON AFTER. FOR THIS DEED HE WAS AWARDED THE AIRMAIL MEDAL OF HONOR.

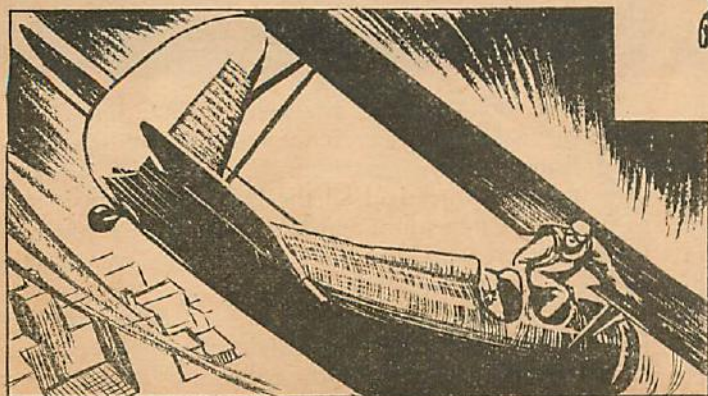
CLYDE PANGBORN ONCE CLIMBED UNDER A PLANE IN FLIGHT TO DISENTANGLE A GIRL CHUTE JUMPER CAUGHT IN THE UNDERCARRIAGE.

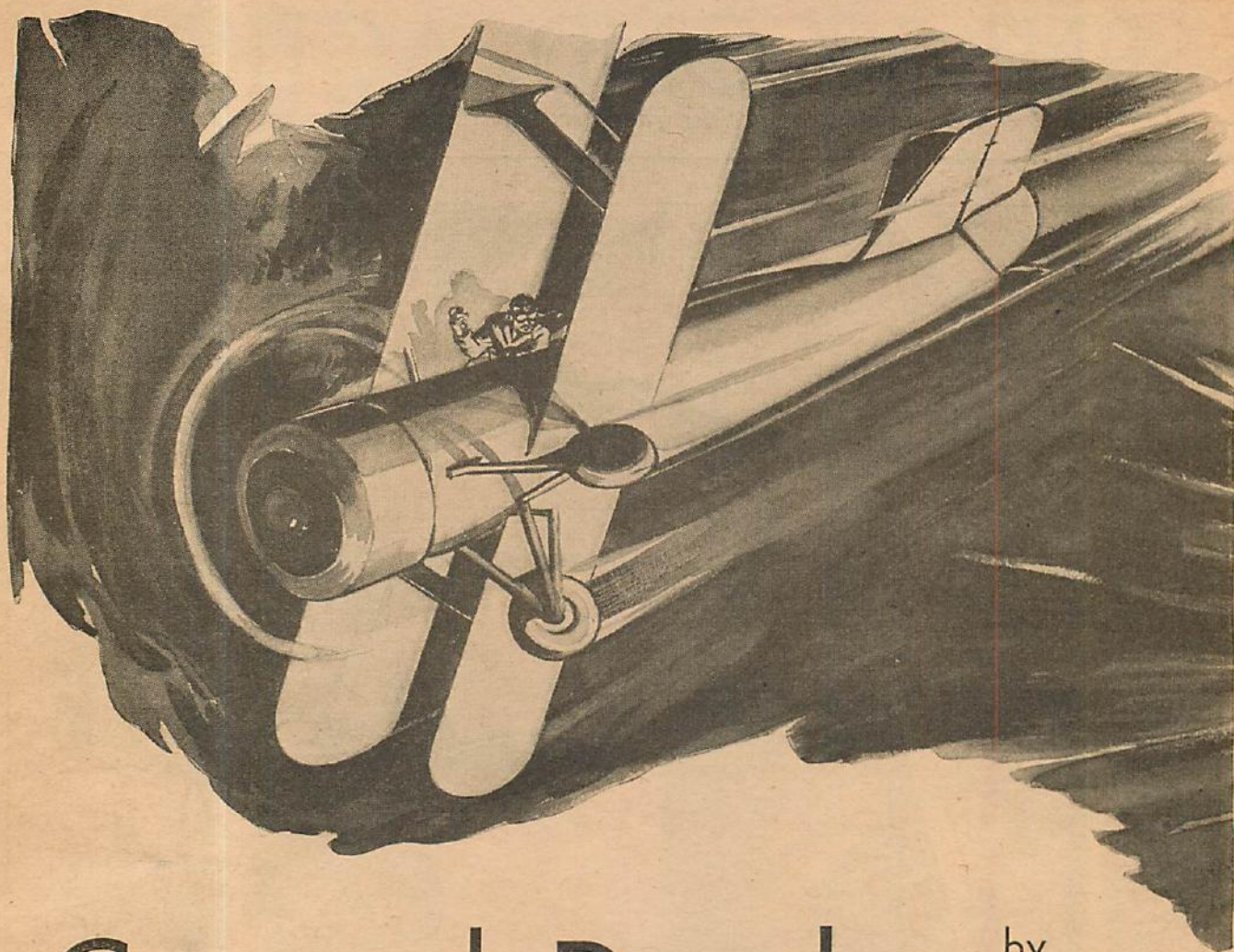


IN THE MIDST OF A TERRIFIC STORM OVER THE ATLANTIC, KNUT ECKENER AND ANOTHER MEMBER OF THE CREW, WORKED EIGHT HOURS REPAIRING THE TORN TAIL FIN OF THE GRAF ZEPPELIN.



THE ONLY NON-FLIER TO WIN THE DISTINGUISHED FLYING CROSS — CORPORAL TURNER. WHEN CLERK IN THE MARINE SQUADRON OFFICE, HE FLEW AS PASSENGER WITH SERGEANT HOFFER. THE PILOT FAINTED. THE PLANE OUT OF CONTROL. TURNER, AFTER 15-20 MINUTES EXPERIMENTING, PREVENTED A CRASH AND EFFECTED A SAFE LANDING.





Canned Death

by
William
E.
Barrett

Co-piloting sky-liners was too dull for Dan Cooper, but flying perilous cargo in the oil fields was full of sweet romance—or was it?

OIL CITY!"

Dan Cooper nodded to Tony Grayson and turned over the controls of the big silver liner. Tony was the pilot; he always made the landings at important centers. Cooper sat back, his arms folded.

It didn't make any difference any more. Perhaps it hadn't ever made any difference. Tony Grayson was the pilot, and it was his privilege to take whatever glory there was and pass the work to his co-pilot. Lord knows there was little enough of anything but monotony in this business any more. A fellow might as well be a milkman.

There was another ship in the sky between the airport and the setting sun. Dan Cooper looked at it enviously. It was neither silver-winged nor pretty; it was just a

big, black-winged brute of a ship that would never be pictured in a roto supplement nor reproduced in a colored ad to lure passenger traffic.

"Just a tramp steamer passing a de-luxe liner."

Cooper said it to himself thoughtfully, and there was no derision in the comparison. To his notion, the crew of a tramp steamer had all the best of it when it came to fun and to adventure and to real living. By the same token, the crew of that dark-winged ship was aviation as the gods had meant it to be.

The boys who flew those big sturdy babies were hauling the stuff that made the oil industry. They were not slaves to time as the transport crews were; for the most part, they were racing against time. They made unscheduled trips, and they dropped down on unmarked



JON L.
BLUMMER

There was an explosion that seemed to rock the universe.

little airports or open fields to make rush deliveries. An oil man would run against an emergency at a well where minutes of delay meant thousands of dollars in deficits: the call, then, was, "It's impossible; but can you do it?"

The boys in the black ships met such challenges by spitting on their hands and saying "Sure."

Dan Cooper leaned back and let himself dream on that. It was the kind of thing that had lured him into aviation, the kind of thing that he hadn't been able to get. In the life that the independent freighters lived in the air there was hazard and adventure and novelty; none of this sissy stuff of neat blue uniforms, precise

schedules, emergency landing fields, radio beacons, and all of the safeguards—automatic and otherwise—that made a motorman of a pilot.

Coming in—

Nan Halliwell, the stewardess, had her passengers all strapped in and ready. Tony was holding the big ship on a long, sighing glide. Below the ship there was a bustle of activity; porters, ground crew, dispatchers—a well-trained gang that snapped into action like robots attached to strings. Cooper unfolded his arms.

It was his last trip and he didn't feel a pang.

They unloaded their passengers. Tony Grayson stepped down with his reports in his hand. Dan Cooper

was going to taxi the ship to the hangar, and then he was through. Tony hesitated. He was a big, blond, capable-looking brute, and the best dresser on the line. He towered over Dan Cooper, and Dan was no midget himself.

"Haven't changed your mind, have you, kid?" Tony's voice was different from what it ordinarily was; more grave, somehow.

Dan shook his head. "Nope. This is the last one, Tony."

"I'll miss you, kid—but happy landings!"

Tony stuck out his hand. Dan took it. Unaccountably, he did feel a pang at that handshake. He hadn't expected to feel anything. He'd cursed Tony enough and groused about him enough, but this moment was almost solemn.

"Thanks, Tony."

He watched the swing of the pilot's shoulders as he made his way to the operations office. The good-looking, conceited brute had been a good flying mate. Dan was going to miss him. He hated to admit it.

Ten minutes later he had the ship away and he was sitting in the operations office himself. Ned Loring, the division superintendent, was sitting across the desk from him—a lean, wiry man whose close-clipped mustache was flecked with gray and whose past included a couple of years with the British during the War.

"I'm marking this a leave of absence, six months, instead of a resignation, Cooper," he said. "You'll be back."

Dan Cooper shook his head. The kind of game was all right for birds like Loring, who had their adventure and their lives of action behind them. Fellows like Loring just forgot how they felt when they were young; they wanted to be individuals, not just cogs in a perfect system.

"Mark it a resignation, major," he said. "I'm not coming back."

"We'll see. I hate to see you go, Cooper." The major cleared his throat, lifted an envelope from his desk top. "I've written to Jim Dawson. Used to fly with him. He ought to be able to give you the kind of thing you'd like to do. Look him up."

"Thanks." Dan Cooper accepted the envelope.

Loring was standing up, his hand extended. They shook solemnly, and again Cooper felt a pang. It was a bit hard, at that, to leave a place where you were liked and where people wanted you. He swallowed something in his throat and stepped outside. When the cold air hit him he had his back to the operations building, and that was that. He was all through, and he had walked out.

"Hand-shaking is part of what's the matter with it," he growled. "The boys on the independents probably don't even shake hands with relatives."

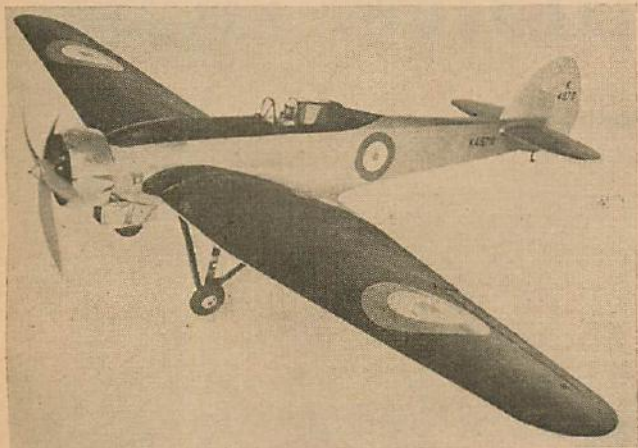
He looked at the envelope that Loring had given him. "Jim Dawson—Oriole, Oklahoma." A glow of anticipation warmed him. That was more like it; it had the sound of black ships against the sun. (Turn to page 87)



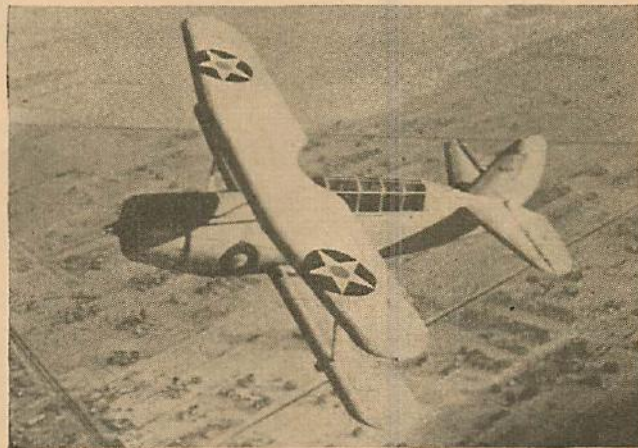
Men usually walked away from crack-ups like that, but Dan made sure that these men didn't.

AIR TRAILS GALLERY

A Picture Page of Modern Planes for the Collector



BRISTOL 138A altitude record holder has 450 h.p. Pegasus VI-S. Span is 66 ft., length 44, height 10 ft. 3 in.; weight empty is 4,391 lbs., useful load 919.



CURTISS SBC-3 scout bomber has P&W Twin Wasp Jr. Span is 34 ft., length 27 ft. 10 $\frac{3}{8}$ in. The navy has ordered 83 for service aboard carriers.



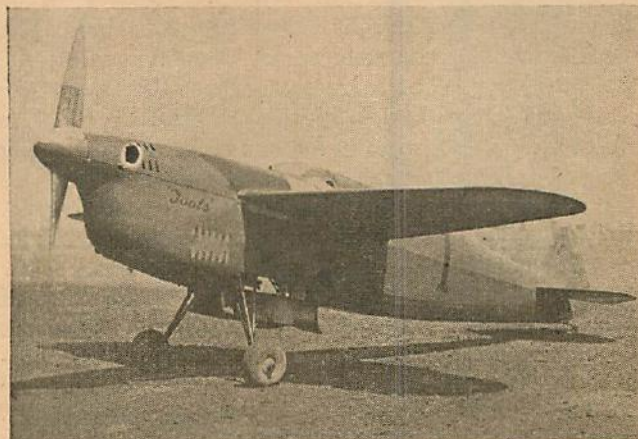
CURTISS P-36 for army is first Curtiss all-metal pursuit; 1,000 h.p. Wright Cyclone gives 300-m.p.h. top. Span is 37 ft. 3 $\frac{1}{2}$ in., length 28 ft. 7 $\frac{7}{8}$ in.



CURTISS A-18 with two 1,000 h.p. Cyclones is army's first twin-engined attack. Wheels partly retract in engine nacelles. Span is 59 $\frac{1}{2}$ ft., length 40 $\frac{1}{2}$.



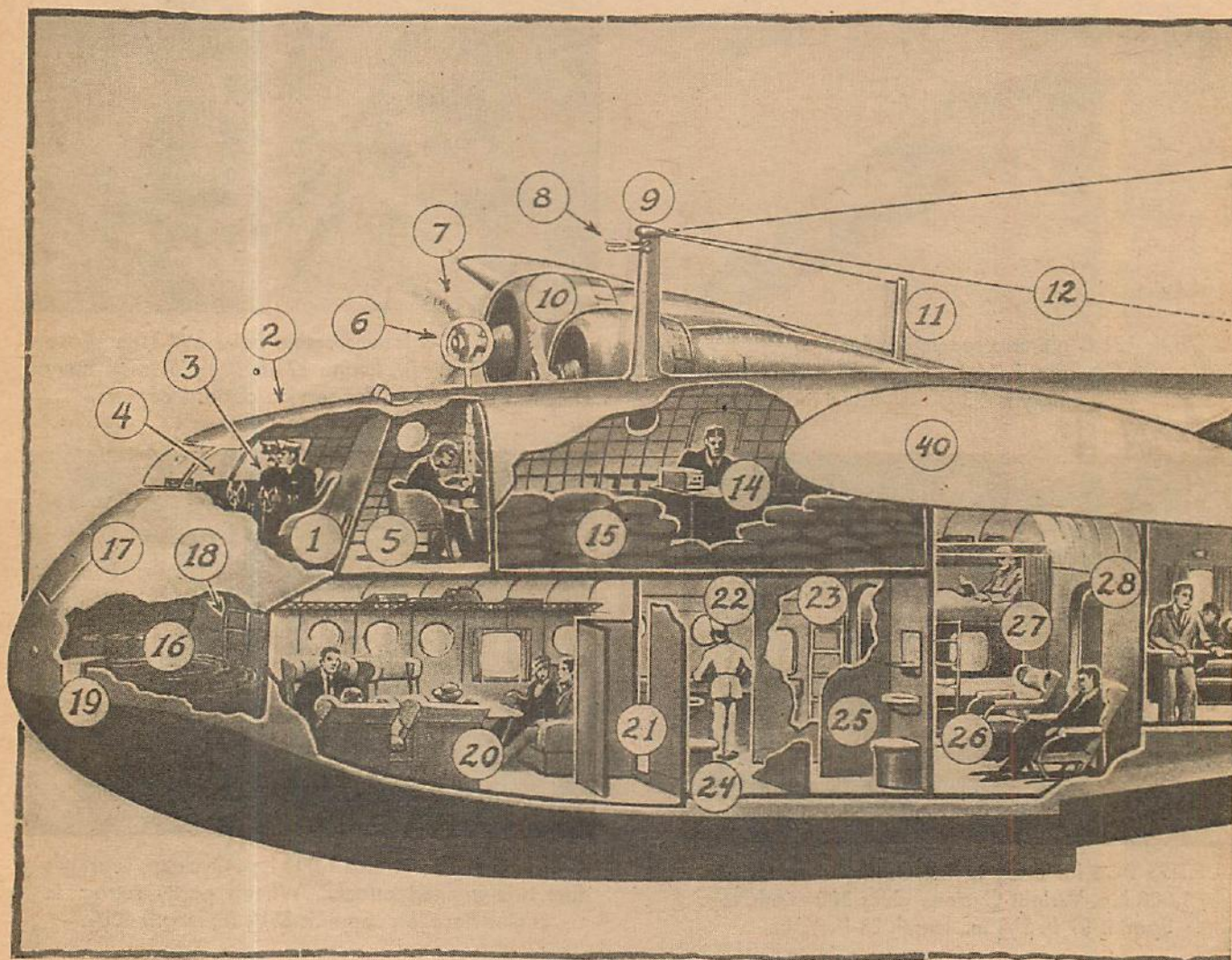
BELLANCA Flash of Capt. Mollison (see page 7), designed for England-Australia race, has Twin Wasp Jr.; length is 26 $\frac{1}{2}$ ft., span 46 ft. 13 $\frac{3}{4}$ in.



FOLKERTS Special 240-m.p.h. racer of 16-ft. span, 50 sq. ft. area, was outstanding at national races. Engine is 185 h.p. C4S Menasco.

AS it rapidly roars toward a neck-and-neck finish, the great international race to span the grim old North Atlantic with a regular commercial flying service has caught the interest of an air-minded world. In a sudden spurt, the field has rounded the last turn and is now pounding down the home stretch. At the present writing, Germany's entry, an experienced three-year-old from the southern circuit, is in the lead, with the colors of England and

The Short Empire Boat



the U. S. A. riding side by side a length behind. The French horse unfortunately sprang a tendon when the giant six-engined Latécoère flying boat *Lieutenant de Vaisseau Paris* capsized in Florida waters last year. As none of the other European nations seems to be actively interested in entering the race at this time, it looks as if the winner will be found among those already named.

Regardless of who "cops the cup," it becomes more and more evident that when crossing the old pond by air proves popular, the successful "first" may find himself facing some good old-fashioned cutthroat competition. It is apparent by now that no one nation will be permitted by the others to dominate the transatlantic air lanes, and as Lufthansa, Imperial Airways, Pan-American and Air France compete with more luxurious equipment, faster schedules, and lower rates, John Q. Traveling Public stands to reap the benefit.

Only recently the first of the German Lufthansa mail

planes dunked her sturdy Teutonic bottom in the sheltered waters of the Port Washington seaplane base on Long Island. It was the first test flight in preparation for regular airplane mail service across the North Atlantic. Profiting by several years of experience in operating a similar line over South Atlantic waters and by intensive development of the technic of launching large flying boats from catapult ships, Lufthansa planned to station several of its floating bases between New York and Hamburg and start moving the mail. The equipment employed (Diesel-powered Do. 18 flying boats) is designed for mail carrying exclusively. As no passenger accommodations are provided, the ships can hardly be compared with giant luxury boats of the *China Clipper* and Short Empire class.

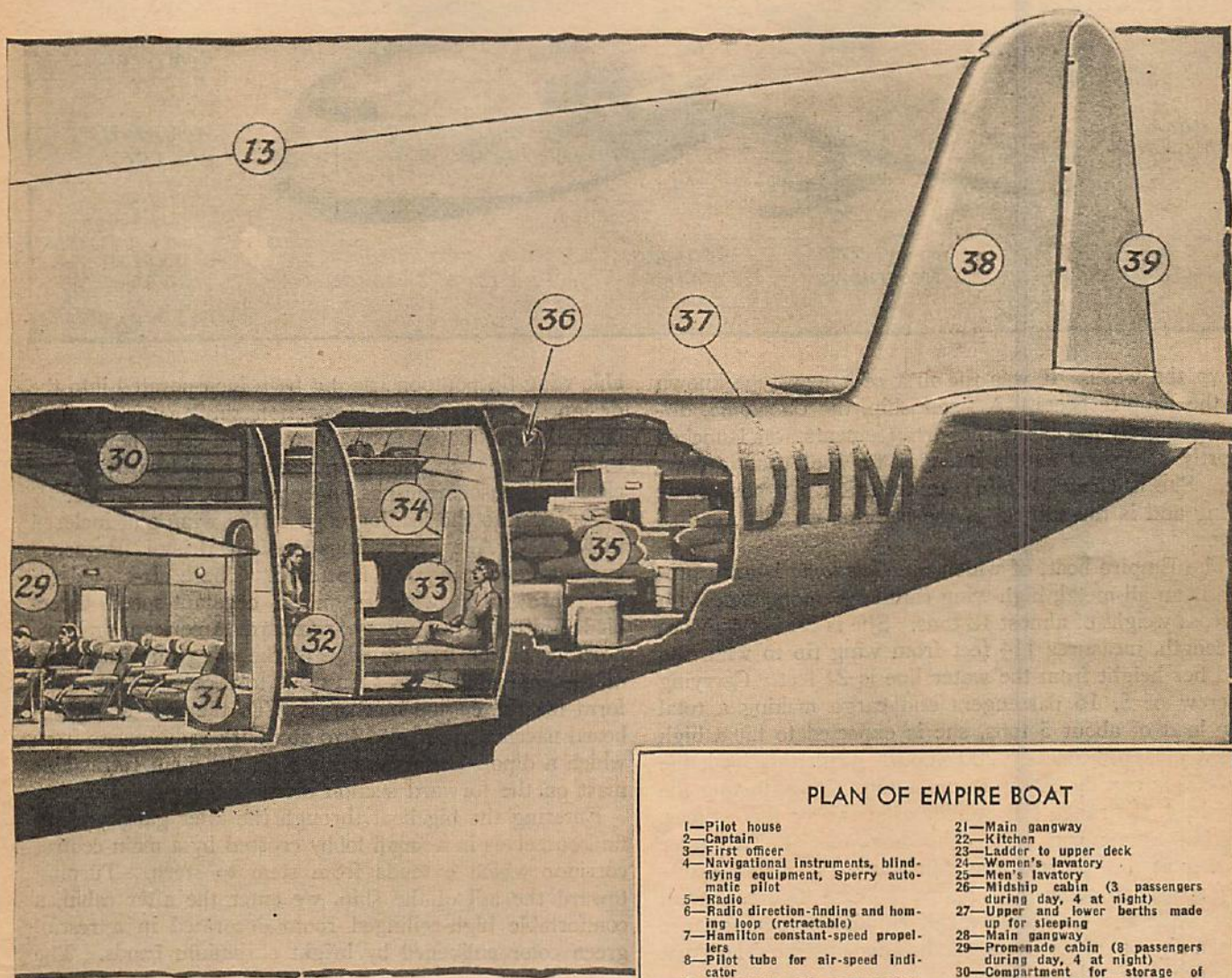
Like the much-discussed Armstrong seadrome, basically the same idea, the use of catapult-equipped mother ships in connection with small short-range aircraft is

About Britain's big new luxury air-liner for Atlantic and Asiatic routes — the plane on the cover.

by Frank Tinsley

the present time. However, there is no doubt that Pan-American would have to be heavily subsidized to make a profit.

Traveling in shorter hops via Bermuda and the Azores is complicated by the fact that both islands are owned by foreign powers and jealously reserved for their own national air lines. For several years now negotiations have been in progress with a view to combining the resources of Pan American and Imperial Airways and establishing a jointly operated line using the island route.



PLAN OF EMPIRE BOAT

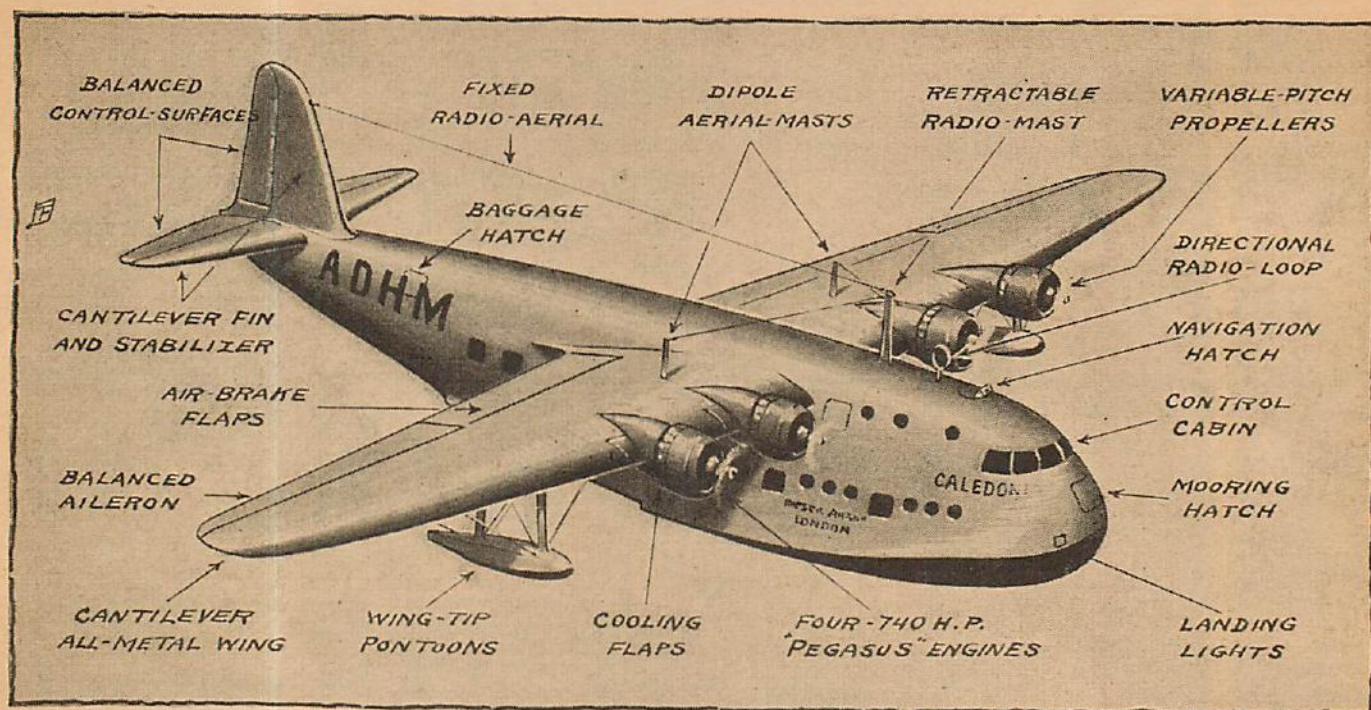
- | | |
|--|--|
| 1—Pilot house | 21—Main gangway |
| 2—Captain | 22—Kitchen |
| 3—First officer | 23—Ladder to upper deck |
| 4—Navigational instruments, blind-flying equipment, Sperry automatic pilot | 24—Women's lavatory |
| 5—Radio | 25—Men's lavatory |
| 6—Radio direction-finding and homing loop (retractable) | 26—Midship cabin (3 passengers during day, 4 at night) |
| 7—Hamilton constant-speed propellers | 27—Upper and lower berths made up for sleeping |
| 8—Pilot tube for air-speed indicator | 28—Main gangway |
| 9—Retractable radio mast (navigation light on top) | 29—Promenade cabin (8 passengers during day, 4 at night) |
| 10—Four Pegasus 740 h.p. air-cooled radial engines | 30—Compartment for storage of bedding during day |
| 11—Dipole aerial mast | 31—Adjustable chairs |
| 12—Dipole aerial | 32—Main entry |
| 13—Main aerial | 33—After cabin (6 passengers during day, 4 at night) |
| 14—Ship's clerk | 34—Berths made up for sleeping |
| 15—Mail compartment | 35—Mail, freight and baggage hold |
| 16—Mooring compartment | 36—Freight hatch |
| 17—Mooring hatch | 37—International registration marking |
| 18—Ladder to pilot house | 38—Cantilever fin |
| 19—Retractable landing light | 39—Balanced rudder |
| 20—Smoking cabin (7 passengers during day, 4 at night) | 40—Wing root |

now considered by thoughtful observers to be merely a stop-gap measure. It is evident that the successful transatlantic air-liner will have to be of enormous size, and rugged enough to keep afloat in rough water. Spacious passenger accommodations must be provided. A range sufficient to carry a maximum load at least 4,000 miles is imperative.

Until recently, the only existing types approaching these requirements were the Sikorsky S-42A and Glenn Martin's *China Clipper*. The former is capable of carrying 32 passengers, a crew of 5, and full cargo a distance of 1,200 miles at a cruising speed of 170 m.p.h. The Martin 130 boat accommodates 24 passengers and a crew of 5, cruises at 163 m.p.h., and has a range of 3,200 miles. The Sikorsky is powered with four 750 h.p. Hornets; the Martin with a similar number of 800 h.p. Wasps. By cutting the passenger list, either of these ships may be used on the New York-La Havre run at

This has been slowed up by a desire evinced in certain high quarters of running an all-British line from Britain directly to Canada. Another delay was caused by the unwillingness of Imperial Airways, for understandable patriotic reasons, to use American machines.

To surmount this hurdle, the great English firm of Short Brothers, Ltd., was commissioned to produce a large commercial flying boat that would meet or better the performance of the Yankee Clippers. Recently their answer to the problem was christened *Canopus* and slid



down the ways. It was the first of a new type known as the Empire boats. A sister ship, the *Caledonia*, differing slightly in her internal arrangements, was launched shortly afterward and is intended for the Atlantic service. She is Great Britain's contribution to transoceanic flying and is the subject of the painting on this month's cover.

The Empire boat, of which the *Caledonia* is an example, is an all-metal, high-wing cantilever monoplane with a gross weight of almost 18 tons. She is 88 feet 6 inches in length, measures 114 feet from wing tip to wing tip, and her height from the water line is 24 feet. Carrying a crew of 5, 16 passengers and cargo making a total pay load of about 5 tons, she is expected to hit a high speed of approximately 200 m.p.h. With this load, the *Caledonia* can fly 800 miles non-stop. By adjusting the pay load, the range can be increased two or three times. During a test run with chief test pilot J. Lankester Parker at the controls, the ship showed a normal cruising speed of some 150 m.p.h. These figures reveal that while the *Caledonia* about equals the performance of the big American boats, she has demonstrated no great advance over the older designs. There is no doubt, however, that the Empire boat is a much roomier craft, providing more cubic space per passenger. This, of course, is a definite luxury in heavier-than-air flying. The accompanying table shows the comparative sizes and performance of the three craft.

The internally braced full cantilever wing gives the British ship a very clean appearance. It is unfortunate, however, that some type of retract-

able wing-tip pontoon has not been incorporated into the design. If a system of retraction similar to that used on the Consolidated P3Y-1 patrol boat could be adapted to the Short craft, the Empire type would easily be the cleanest transoceanic passenger aircraft in existence.

Faired into the leading edge of the wing and inclosed in N. A. C. A. type cowlings are four Bristol "Pegasus" engines developing 740 h.p. each. These air-cooled radials are fitted with Hamilton constant-speed three-bladed propellers. As in standard American practice, portions of the leading edge of the wing on either side of the engine nacelles swing out to form working platform for the engine mechanics. To the rear of the in-board nacelles are placed two auxiliary radio masts from which a dipole aerial connects with the main retractable mast on the forward section of the fuselage.

Entering the big boat through the after gangway, we find ourselves in a small lobby crossed by a main central corridor which extends from stem to stern. Turning toward the tail of the ship, we enter the after cabin, a comfortable high-ceilinged room decorated in a restful green color enlivened by bright chromium bands. The

cabin is arranged for daylight travel and is provided with seats for six passengers. It is lighted by four large windows and provided with an overhead rack on either side in which are stowed the traveler's hand luggage. A white-coated steward politely explains the system by which berths are installed at night, transforming the compartment into a cozy, four-bed sleeping cabin.

We peep for a moment through (Turn to page 92)

Comparison of Leading Boats

| | Sikorsky S-42A | Martin 130 | Short Empire |
|--------------------|-------------------|---------------|-----------------|
| Length over-all | 68' 0" | 90' 10 1/2" | 88' 6" |
| Height over-all | 21' 5" | 24' 7" | — |
| Wing span | 118' 2" | 130' 0" | 114' 0" |
| Wing area | 1,340 sq.ft. | 2,315 sq.ft. | — |
| Total engine power | 3,000 h.p. | 3,200 h.p. | 2,960 h.p. |
| Gross weight | 40,000 lbs. | 51,000 lbs. | 36,000 lbs. |
| Useful load | 16,800 lbs. | 26,389 lbs. | — |
| Maximum passengers | 40 | 48 | 24 |
| Normal service: | | | |
| passengers | 32 | 24 | 16 |
| crew | 5 | 5 | 5 |
| freight | 1,000 lbs. | 2,000 lbs. | 7,000 lbs. |
| range | 1,200 mi. | 3,200 mi. | 800 mi. |
| Maximum speed | 190 m.p.h. | 180 m.p.h. | 200 m.p.h. |
| Cruising speed | 165 m.p.h. | 157 m.p.h. | 150 m.p.h. |
| Stalling speed | 65 m.p.h. | 65 m.p.h. | — |

(See also the Douglas DF, page 6)



Air Adventurers, *Attention!*

Bill Barnes-AIR TRAILS is three years old this month. It's hard for me to believe, the way time has flown, but it's true. Three years since the editor and I, working together, planned for our great organization by mapping out, step by step, a course for the magazine and the *Air Adventurers Club* to follow.

"For three years," he said, "you will lead your membership as lone eagles. There must be careful grounding in the fundamentals of aviation before we begin to develop further. Work out the creed and let the membership decide by voting on each point.

"Keep them learning," he continued, "while we develop the magazine to its proper position of first in its field. Then, when we've done that, come back and we'll talk it over."

Well, you *Air Adventurers* know it has been done. Next month, starting the magazine's fourth year, the title will be simply AIR TRAILS. It is first in the field. The departments and features have given you ample opportunity to gain a thorough working knowledge of aviation. The model department has developed an authoritative presentation of a wide variety of models every month. The articles have brought many famous aviators into our pages. The Bill Barnes stories are better than ever.

So, I went back to the editor and we talked over our club. New activities? Yes, the time has come. Expansion? Yes, that's all right, too! When? Right away! Start the year right. Make an announcement. Maybe some of the *Air Adventurers* have suggestions to make?

If you have, send them now. I'm already working—because NEXT MONTH the *Air Adventurers* are stepping out. We're going places, in step with the greatest aviation magazine in the world.

And listen, those of you who have held back—who have delayed in applying for membership—do it now,

this month, so you'll be ready to step out with the thousands of others who have waited patiently for this day.

If you've been slow about the creed—learn it now. Dig out those back issues and read over the various points. Self-Reliance, Courage, Initiative, Independence, Loyalty, Integrity, and Obedience.

If you're not a member, join now by filling out and mailing the coupon below. If your application is approved, your certificate of membership and your Air Adventurer's Wings will be mailed to you as promptly as I can attend to it.

Happy landings!

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 February 15, 1937.)

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: The lift of a wing comes almost completely from the top of a wing. The air exerts a pull upward on the wing. Wouldn't the wing exert a pull downward if the wing were upside down, since the top is now the bottom? B. J. D., Utica, N. Y.

Answer: I assume that this reader has the usual upper-cambered wing in mind, and appreciating that the cambered side creates a more pronounced aerodynamic effect than the usually flat under-surface, queries the effect of reversing the wing in flight. Which makes a nice question, but one that's not so knotty as it may seem.

We know what the answer is in practice, for planes successfully fly upside down. That leaves us with the problem of squaring practice with theory. The theory above, however, is somewhat mis-stated. In the first place, the lift does not necessarily come "almost completely" from the top camber. Remember that flat airfoils were once used and that symmetrical airfoils, in which upper and lower camber are equal, are in use today. In the second place, angle of attack is not taken into consideration, and it is the most important element. Almost any elongated section will produce lift, if slanted sufficiently against an air stream, regardless of its shape. That is what happens when a plane flies upside down. Although the shapes of the upper and lower surfaces are transposed from what would be their most effective places, the angle of attack overcomes this and the reversed wing, though inefficient, produces lift.

Question: Please give the names of the winners of the Bendix Trophy and Thompson Trophy races, the years, and the make of planes. D. C., New Milford, Conn.

Answer: For the Bendix Trophy: 1931, James H. Doolittle, in a Laird (Wasp engine), Los Angeles-Cleveland, average speed 223.038 m.p.h. 1932, James H. Haizlip, Wedell-Williams (Wasp Jr.), Burbank-Cleveland, in 8 h. 19 m. 45 s. 1933, Roscoe Turner, Wedell-Williams (Wasp), New York-Los Angeles in 11 h. 30 m., averaging 214.78 m.p.h. 1934, Douglas Davis, Wedell-Williams (Wasp), Los Angeles-Cleveland, 216.237. 1935, Benjamin O. Ward, Howard Mr. Mulligan (Wasp), Los Angeles-Cleveland, 238.704. 1936, Mrs. Louise Thaden, Beechcraft (Whirlwind), New York-Los Angeles, 14 h. 55 m. 1 s.

For the Thompson Trophy: 1930, "Speed" Holman, Laird (Wasp Jr.), 203.874 m.p.h. 1931, Lowell Bayles, Gee Bee Super-Sportster (Wasp Jr.), 236.239. 1932, James H. Doolittle, Gee Bee Super-Sportster (Wasp), 252.686. 1933, James R. Wedell, Wedell-Williams (Wasp Jr.), 237.952. 1934, Roscoe Turner, Wedell-Williams (Hornet), 248.129. 1935, Harold Neumann, Howard Mr. Mulligan (Wasp), 220.194. 1936, Michel Detroyat, Caudron C-460 (Renault), 264.261.

Question: Is it possible to have the tail fin and rudder below the horizontal tail surfaces? D. F., Toledo, O.

Answer: As a matter of aerodynamics, there's generally no reason why not. If it's solely the relation between the positions of the horizontal and vertical surfaces that's meant, they'll both do their work whether one is below, intersecting, or above the other. But in the design of the conventional airplane, a vertical surface intersecting or projecting from above the horizontal surface has been found far more convenient. If the horizontal surface is kept in its usual position—in the middle or atop of the rear end of the fuselage—a single vertical surface of average sufficient size placed entirely below it would meet the ground when landing and taking off.

Multiple small vertical surfaces may be hung below the horizontal surface, instead of a large one fastened to the fuselage, but such construction is not very strong or handy to control in flight, and could be used only where speed is moderate and the strain slight, such as in the Kellett wingless autogiro.

Question: How do you work the controls to come out of a tail spin? T. L., Dorchester, Mass.

Answer: Exact movement of the controls will vary with the individual plane and whether power is on or off. Early planes used to spin much more easily than modern ones do and getting them out of a spin sometimes required considerable imagination and ingenuity in the use of the controls. Nowadays the average plane will bring itself out if all controls are neutralized—that is, moved to a position where they are not acting one way or another. For quick results, the usual procedure is to apply opposite rudder; if you're spinning to the right, then left rudder, and so forth. When the spin is stopped, you bring the stick back to lift the nose smoothly.

A Coupe for War

by Albert J. Carlson



AN interesting transition from a peaceful, "safe-flying" plane, designed for the amateur pilot without many hours to his credit and with no desire to indulge in skyrotechnics, into a rough-and-tough military job is seen in the new Curtiss-Wright 19R basic trainer. The extent of change is not fully revealed in that description "basic trainer," either, for the 19R is capable of dealing out death and destruction as a full-fledged two-seat fighter or attack ship.

Close similarity to the harmless 19L Coupé, brought out by Curtiss-Wright as a candidate for the government's safe-plane development program and discussed in AIR TRAILS in the March issue, will be apparent to anybody who recalls that article or has seen the Coupé. Although a little longer in body, a little huskier around the nose, bearing sliding hatches instead of a closed cabin, and minus the fixed leading-edge slots, the 19R

Curtiss-Wright's all-metal sport plane appears as a military job.

acknowledges the "safety" plane as its daddy—or as its mamma, however you figure the sex of airplanes. There isn't any doubt,

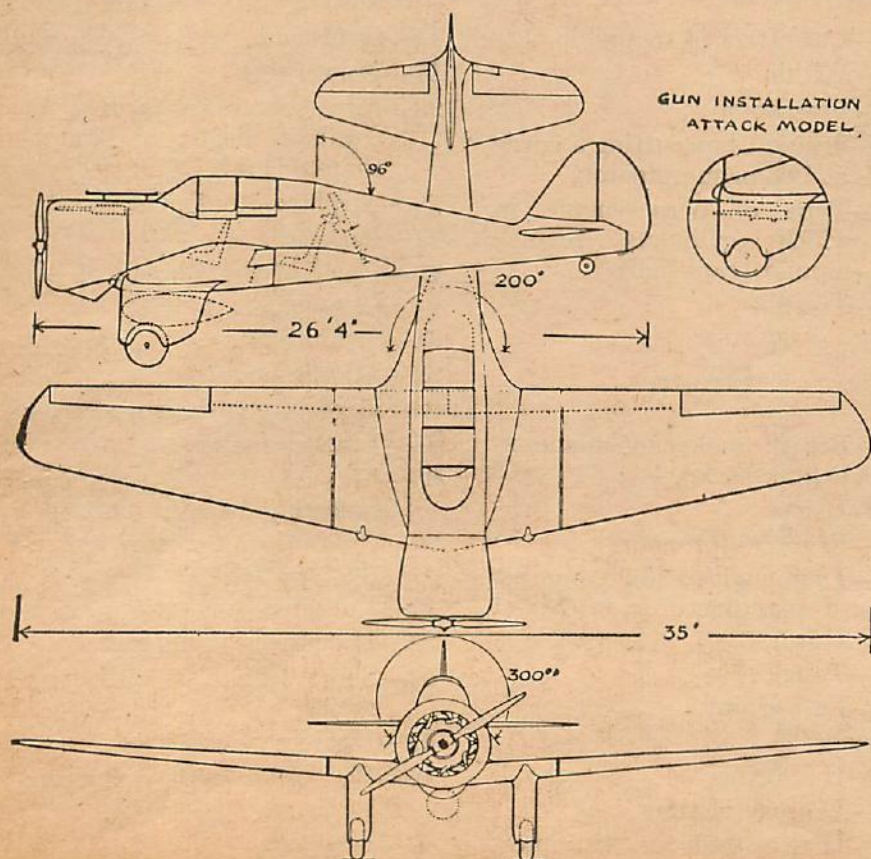
however, that the Coupé's offspring is masculine. It looks and acts that way.

All-metal like its parent, the 19L is of semi-monocoque fuselage construction, consisting of Alclad stressed skin with longitudinal stringers at intervals and rings crosswise. A tripod nose-over guard is erected behind the front seat in the cockpit. The wing, employing a special Curtiss-Wright airfoil section that is claimed to combine high lift, low drag, and exceptional stability, is cantilever; construction is of multi-cellular 24ST Alclad stressed skin over ribs and five shear beams. Ailerons are dynamically and statically balanced. The tail unit is built like the wing. The landing gear is simple; shock absorption is provided by automatic lowering of the wheels from the fairing for an 8-inch oleo stroke when the wing flaps are depressed for landing. Hydraulic brakes and parking control are standard equipment. Fuel is stored in two wing tanks of 70 gallons total capacity, with a 10-gallon reserve held in one. The 6½-gallon oil tank is located in the engine compartment ahead of the double-steel-and-asbestos fire wall.

The plane is designed to take interchangeably any of the Wright 7- or 9-cylinder Whirlwind engines of 250 to 420 h.p.

As a basic trainer, the 19R is ready to fly as it stands. For more lethal purposes, provision has been made for various armament installations. Fittings are ready for a fixed .30-caliber machine gun ahead of the fire wall, firing through the prop, with cartridge case for 500 rounds, and a gun sight in front of the windshield. Other warlike features can be added as easily.

Performance of the 19R naturally varies with engine power and armament load. It ranges from a top of 182, with the supercharged 320 h.p. R-760E2 and armament load, to 215 as a trainer with the supercharged 420 h.p. R-975E2. In flight, the 19L Coupé of 90 h.p. and 131-mile top would be left far behind by its warlike descendant.



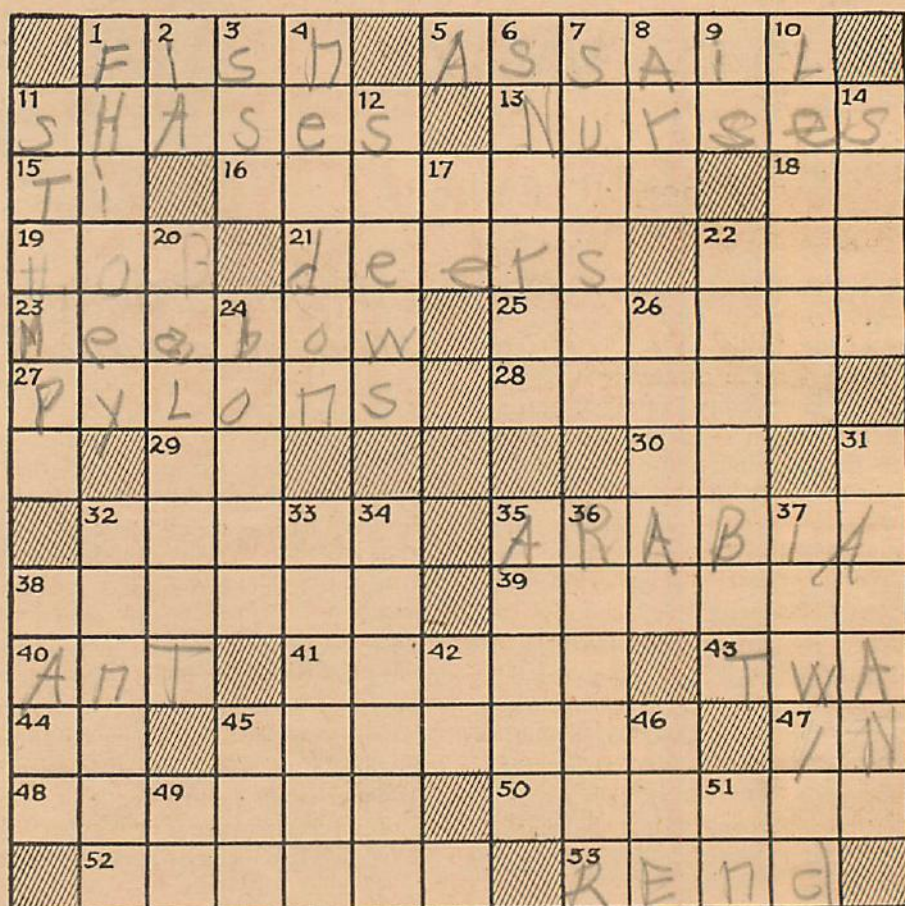
Scale is 1/8" to the foot; arc degrees indicate rear gun swiveling range.

CROSS WINDS

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

Across

- 1—Inhabitant of fluid medium other than air
- 5—To attack
- 11—Frames for window glass
- 13—Nurtures
- 15—Seventh note of scale
- 16—Participant in contest
- 18—Ratio of circle circumference to diameter
- 19—Sphere
- 21—Horned and hoofed wild animals
- 22—Latin term for air, part of many aviation words
- 23—Grassland
- 25—Rigid pieces turning about one point, with forces acting at other points
- 27—Marking posts in air races
- 28—Agitates
- 29—Behold!
- 30—Accomplish
- 32—Jewel weight of 200 milligrams
- 35—Scene of Bill Barnes' adventures in "The Blood-Red Road to Petra"
- 38—Make of American private 4-seat plane, winner of Earhart Trophy
- 39—Flying
- 40—Busy insect
- 41—Knot in wood
- 43—Cross-country air line with lowest fares
- 44—Ryan plane



- 45—Car attached to airship
- 47—Within
- 48—Possession
- 50—Straight line cutting a curve at two or more points
- 52—Type of aero engine in which cylinders revolve around crankshaft
- 53—To split

Down

- 1—British maker of plane in definition No. 4
- 2—Exists
- 3—Feminine pronoun
- 4—Twin-engined night bomber of manufacturer in No. 1 Down
- 6—Tangles
- 7—End of day
- 8—Skill
- 9—Has being
- 10—Leprosy victims
- 11—Dialect term for "tramples"
- 12—Boils
- 14—Gentlemen
- 17—Concerning
- 20—Any substance carried to regulate height of lighter-than-air craft
- 22—Airplane stunt pilot
- 24—Portals
- 26—Chief of the Bureau of Air Commerce
- 31—Swimming
- 32—Middle point
- 33—Kind of goat-hair wool
- 34—Leather maker
- 35—Make of British reconnaissance-bombers, in plural
- 36—Cylindrical bearing for reducing friction
- 37—Entwine
- 38—Form from liquid metal
- 42—Short term for "advertisement"
- 45—Plunder of contents
- 46—War pilot with many victories
- 49—Negative
- 51—Indefinite article



The MODEL WORK- SHOP



Conducted by

Gordon S. Light

1936, Meet 1937!

IT'S about time to discard old calendars and replace them with new ones. But before we consider the new year, and what it holds for modeling, we should reflect on the past year's activities. Ideas which have proved to be good should be expanded during 1937. The bad ideas should be discarded as emphatically and thoroughly as we dispose of the worn-out 1936 calendars. Keeping this in mind, let's look back at the year's results.

The popularity of the gas model continued to increase. The "hardy pioneer" attitude which accompanied the first few gas models has completely disappeared. Even some unskilled beginners now make their debut into the hobby with gas jobs, attaining success that is conclusive evidence of gas-model advancement. In a few years construction of these models has spread from a select group of experts to any one who has ordinary mechanical ability and the price of a motor—this latter requirement still proving the obstacle in too many cases. Our first wish for 1937 therefore is that the price of motors be reduced. No one with energy enough to build a model should be grounded for lack of a motor.

There are several dark spots on our 1936 record. These concern the loss of two famous trophies—the Wakefield and the Moffett. One went west and the other east, but 1937 should see them back again, each one resting atop some American builder's mantel.

Before waging a campaign to bring back the Wakefield, the complete English rules governing this competition should be available to every American contestant. The misunderstanding of rules at the 1936 event took all the fun out of the contest. We hope to publish the complete rules just as soon as they're agreed upon by the English society. The only information available now is that the weight requirement will probably be boosted from 4 to 8 ounces.

One appealing feature of the year's activities was the increase in model

contests. The national meets of various organizations at Detroit, Buffalo, Boston, St. Louis, and Indianapolis, along with scores of

smaller State and local meets, kept the airports, parks, and open fields well filled with modelers from the time the snow melted until it returned. The builders maintained a continuous bombardment of the records and by the end of the year only a few of the old ones were still standing.

The year's flying brought out some interesting technical developments. One is the disappearance of the twin pusher. This 35-year-old favorite has been replaced by the small single tractor. With a phenomenally steep climb and flat glide, it makes an ideal contest model. In the hands of such experts as the boys from Tulsa, Oklahoma, it is a sure winner. It must be remembered, however, that Vernon Boehle of Indianapolis was the real pioneer. Back in 1934 his single tractor was already winning contests.

One of the year's disappointments was the failure of the radio-controlled model to materialize. Whether radio control was too difficult or whether interest was lacking is difficult to determine. Next year should bring a definite answer.

An important development was the formation of the American Academy for Model Aeronautics, to raise modeling to its rightful scientific level. Another was the announcement of a \$200 prize for a radio-controlled model and large cash awards in other 1937 events.

But a survey of the year would be different for each of us. Probably the most important event for you personally was when you first saw daylight between the ground and the wheels of your first model, or if you're not a beginner, when you test-flew a new design or lengthened your flights. All that is past history now. As we look forward, accept the heartiest wishes of a dyed-in-the-wool balsa-and-tissue enthusiast that each of you will have a model year during 1937!

The Contest Calendar

JUNIOR BIRDMEN National Indoor Contest, San Antonio, Tex., Dec. 28. Open to winners of the elimination contests held in nineteen wing cities during Thanksgiving week.

The Model Workshop asks the aid of readers and clubs in developing for their benefit a complete, detailed report of all model contests and exhibitions, large or small, everywhere. Listings should be received by The Contest Calendar, AIR TRAILS, 79 7th Ave., New York City, at least two months in advance; news of winners and results as soon as possible.



Vernon Gray holding his 1935 Moffett entry, which finished seventh.

MANY years ago all the world's troubles were tightly locked in a box. Every one was happy, until some inquisitive person, anxious to see what was inside, opened the box and released the evil spirits. This was the beginning of the world's troubles. Ever since then conscientious people have tried unsuccessfully to get these spirits back into the box.

This fable of Pandora's box applies to model building. Before July, 1936, we had the Moffett International Trophy, and peace and quiet existed throughout the model world. And then, without warning, some one opened the box containing Vernon Gray's Moffett entry. Instead of an evil spirit, however, a well built and cleverly designed model flew out of the box. Up and away it soared as though it seemed glad to be free after its 30-day trip from New Zealand. As quickly as possible the model was recaptured and put back into the box. But the damage done in that short time will take at least a year for us to repair.

But if Bert Pond had not opened Gray's box last July, we would have missed one of the year's outstanding models. Since it turned in such an excellent flight, we can forgive the damage it has done and cheerfully set about regaining the trophy in 1937.

Before examining the features of this remarkable model and starting work on a replica, we should know more about its capable designer and builder, who is holding the Moffett Trophy for a year. Vernon is 21 years old, and has had five years of modeling experience. Strangely enough, he has concentrated mostly on indoor models, and at present holds three New Zealand records. In 1935 he took up outdoor models seriously by sending an entry to the Moffett contest in St. Louis. This model had a good climb, but was tricky to adjust and fly. Despite the good work of the American proxy flier, it placed seventh with a rather poor flight of only 1 minute 18 seconds.

Building on the knowledge and experience of 1935, Gray built a ship that would be easy to handle and simple to fly. As Gray himself puts it, "The design is clean and straightforward, and above all, the model is a consistent flier." Proof of this is the winning flight of 44 minutes 14 seconds which Bert Pond, proxy flier, turned in at Detroit after several short trial flights.

The Moffett

*AIR TRAILS presents
for building the New
flew 44 minutes*

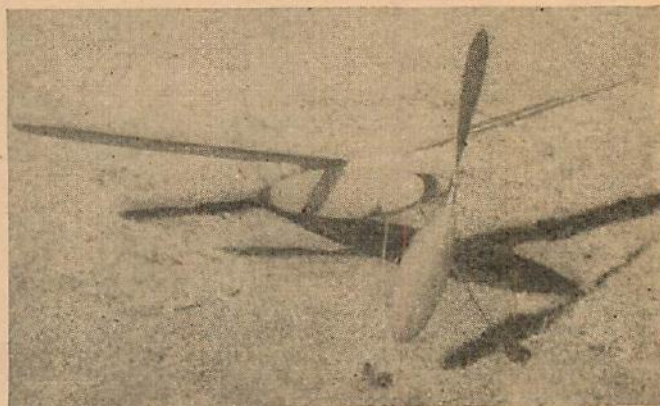
prepared by
Gordon S. Light

The model follows closely the American formula for good flights. The large 16-inch propeller is shaped and carved in the way we're used to doing it. Likewise the lifting elevator parallels our designs closely. It is interesting to think that the same practices in model building have spread throughout the world. Regardless of nationality and country, we all speak a common language of propeller sizes and wing shapes.

And now for actual construction. The plans and instructions for building have been prepared from data supplied by Gray. Every detail is shown as it appeared on the original ship. Incidentally, last month in announcing these plans, they were incorrectly referred to as those of the winning Stout Trophy model. The Stout model, like the Moffett, is open to cabin fuselages. However, it is not an international contest like the Moffett.

FUSELAGE

The fuselage is of simple square cross section. Only the side view of the fuselage has been included in the plans, since the top view is identical to it. Build two fuselage sides at the same time from $\frac{1}{8} \times \frac{1}{8}$ " balsa lon-



Gray's well-designed 1936 Moffett International winner.

gerons. After they've completely dried, put in the cross braces. On the fifth upright, cement a piece of $\frac{1}{8} \times \frac{1}{2}$ " balsa at a slight angle to give forward slant to the landing gear struts. The struts are bamboo $\frac{1}{16} \times \frac{1}{8} \times 8\frac{1}{2}$ ". They can be cemented directly to the balsa. Or if you wish to have a demountable landing gear, cement spaghetti-tube sockets to the balsa cross brace. Balsa fillets are added to strengthen the fuselage at this point. The tread of the landing gear is 9".

Trophy Winner

*plans and instructions
Zealand model that
and 14 seconds —*

*in collaboration with
Vernon Gray*

The fuselage separates at the rear to permit handling of the rubber. The rear hook is attached to the rear section of the fuselage. Fasten the hook to a cross brace of $\frac{3}{16} \times \frac{1}{4}$ " balsa. The nose of the model back to the first upright brace is covered with $\frac{1}{16}$ " sheet balsa. Likewise the two sides of the fuselage at the extreme rear are covered with $\frac{1}{16}$ " sheet to provide a substantial attachment place for the elevator.

Fuselage construction is completed by adding wire axles to the ends of the landing struts and slipping on a pair of $1\frac{1}{2}$ " diameter wheels built up of three sheets of $\frac{1}{16}$ " balsa cemented together with the grains crossed. A $5\frac{1}{2}$ " tail skid of $\frac{1}{8} \times \frac{1}{16}$ " bamboo is added at the position indicated in the drawing.

WING

The rib section is one familiar to all of us. It is the Clark Y. The bottom surface is flat and the maximum camber is slightly more than 11 per cent. It is shown full size in the drawings. Cut 24 ribs from $\frac{1}{20}$ " sheet and cut out the notch for the leading edge, $\frac{1}{8} \times \frac{1}{8}$ ", and the spar, which is $\frac{9}{32} \times \frac{5}{64}$ ". Mark the rib positions and then slide the ribs onto the spar. Line up the ribs and cement them in place. Add the $\frac{1}{8} \times \frac{3}{8}$ " trailing edge to the rear ends of the ribs. The leading edge is of hard balsa, and cemented to the front of the ribs. The wing tips are bent from $\frac{1}{16} \times \frac{1}{16}$ " bamboo to a graceful curve. When attaching these to the ends of the wing, it will be necessary to cut portions off the front and rear of each end rib. After this has been done and the tips are firmly cemented, sand down the end ribs so they fit into the bamboo tips.

Dihedral is added by breaking the wing at each side of the center section. The center section itself is flat. Raise each tip $3\frac{1}{2}$ " and add cement to strengthen the break. Finally add the balsa fillets as additional strengtheners.

TAIL

The one-piece elevator is constructed like the wing. Ribs, shown full size, are cut from $\frac{1}{20}$ " sheet. Necessary dimensions are available from the drawing. The fuselage is cut away to receive the elevator.

The ruddershape is shown reduced. To reproduce



Bert Pond, proxy flier,
with the trophy.

this shape, line off a sheet of paper into $\frac{1}{2}$ " squares. Locate the points on this drawing which correspond to those on the reduced drawing.

The rudder is built in two pieces. The top rear section is movable. It is hinged to the main rudder structure with two short lengths of soft copper wire. The rudder ribs are simple streamline shape. That is, they are about $\frac{3}{16}$ " at the center and curved toward the front and the rear. The leading and trailing edges are cut from hard $\frac{1}{16}$ " sheet balsa. The pieces fit edgewise to the ends of the ribs.

PROPELLER

The propeller is carved from a block $1\frac{3}{4} \times 1\frac{5}{8} \times 16$ ". Use medium balsa. Carve so the blade is $\frac{1}{4}$ " thick at the widest part, tapering to about $\frac{1}{16}$ " at the tips. Cover with superfine paper, add a coat of dope and smooth with fine sandpaper.

FREE-WHEELING

We thought we had seen all types of free-wheeling until Gray sprang this one on us. It is a clever method, and not at all difficult. Look at the drawing showing the free-wheeling detail. Here the propeller is shown enlarged. First cut two washers of $\frac{5}{16}$ " radius from .01" tin steel. (Ordinary tin-can metal will do nicely.) These washers are slotted and bent as those in the drawing. One washer is soldered to the end of the propeller shaft. The other washer is soldered to a thin strip of copper sheeting which is wrapped around the hub of the propeller. Incidentally, when soldering the washers, place a sheet of paper between them to prevent soldering them together.

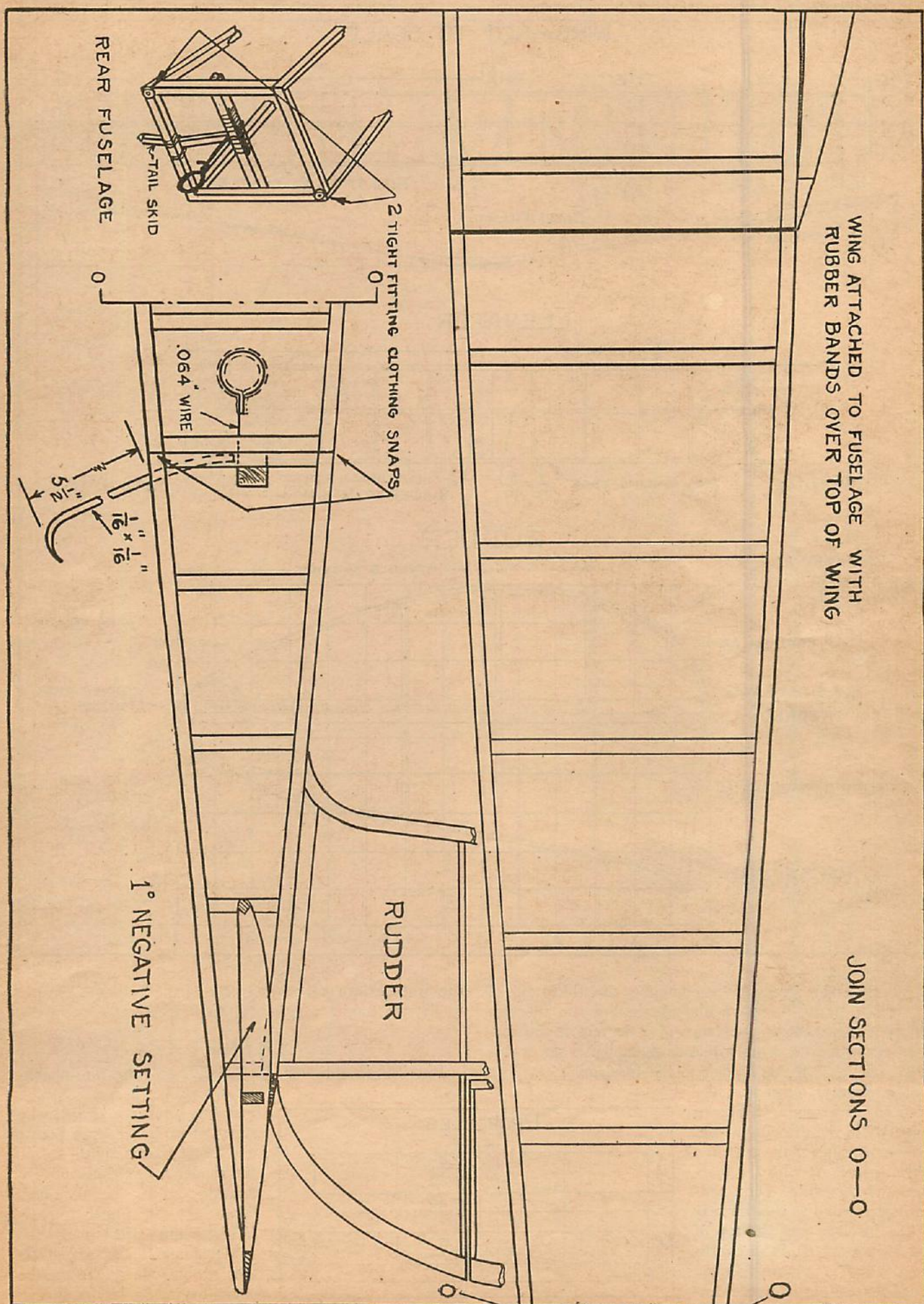
When the rubber is wound, it pulls the outside washer up against the washer on the propeller and engages the propeller. After the tension is relaxed, the washers no longer engage, but allow the propeller to spin free.

COVERING

The fuselage is covered with yellow paper. Water-spray it and apply two or three coats of clear weak dope. Cover the wing with red tissue. Repeat the spraying operation and follow with two coats of weak dope. The permanent part of the rudder is yellow and the movable portion is red. The elevator is covered with yellow tissue. Both the elevator and rudder covering are treated with water spray and dope. The landing struts are painted black. The propeller is given four coats of black lacquer, with a rubdown between coats.

ASSEMBLY

Put a $\frac{3}{16}$ " block of balsa under the front edge of the wing and fair it into the rib profile. The curved top



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 age classes. For February, the subject is gas rules. 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.

FROM past experience I believe the present classifications should be continued. An ideal age for the Junior division would be between 10 and 17. You may be sure no one under 10 would be able to make a flying model. Between 18 and 21 are preferable ages for the Senior class. Boys of this age are usually old-timers in the game and should be classed by themselves. The Open class should be for every one from 10 years up. I object to having every one compete in the same contest for the same prizes regardless of age, because the builders younger than 18 don't have a fair chance.—DONALD KING, Omaha, Neb.

Model building has advanced so that it is no longer "child's play" but recognized as a real sport, so we should discontinue the age divisions which bar older builders from many of the contests. I believe age limits encourage the idea among outsiders that modeling is for children only.

Past national contests proved that Junior and Senior contestants can equal or surpass the flights of the Open-class contestants. Thus the younger modelers will not suffer by competing in the same class with the older builders. And since there would be fewer prizes to be awarded, it would make better prizes possible.—EDGAR FULMER, McKees Rocks, Pa.

I think entrants in contests should be divided into four classes instead of three—Junior, Lower Senior, Senior, and Open. Age limits should be: Junior—all below 16; Lower Senior—16-18; Senior—19-21; and the Open class for all over 21. I would object to competing with contestants over 21 years because of their advantage in years and experience.—DAVID WEINFELD, Baltimore, Md.

The present classifications and age limits are suitable and should be continued. The Open class should be kept separate, even though better prizes might result if every one competed in the same contest. After 21, most builders are either working or going to college. Thus it is impossible to spend much time on models and consequently they do not develop models as fast as the younger boys. If these fellows over 21 had to com-

pete with the Seniors, it would not be long until they would lose interest. The Open class should be encouraged by retaining a separate division where all would suffer the same handicap—lack of time to develop models.—ROY WRISTON, Tulsa, Okla.

The present classifications should be continued with their present age limits. If every one was to compete in the same contest for the same prizes, the older entrants would have a big advantage, such as: more experience in designing, building, and flying models, more complete knowledge of mathematics and mechanics as an aid for designing and building models, and usually more money to carry out their modeling ideas. Youngsters who failed to win prizes in competition against older contestants might be discouraged and discontinue model building.—ALBERT KRAMER, Philadelphia, Pa.

Following are my suggestions for a more suitable classification of contestants. Beginners—up to 13 years; modelers at this age have not reached the expert's degree of skill. Juniors—13 to 18; builders of this age are well matched in skill, most of them having passed the beginner's stage. Seniors—18 to 21. Open—over 21 for all grown-ups who are still enthusiastic builders.

I would strenuously object to one contest regardless of age. Beginners would be too discouraged even to enter such a contest and the experts themselves would get scant satisfaction in a victory over inexperienced younger beginners.—FRANK MITCHELL, St. Vital, Manitoba.

COMING UP are these topics:

For March—*To what extent should a model be streamlined? Is careful attention to "cleaning up" the smallest details justified by improved flights?* Answers must reach us by January 1st.

For April—*What color combination is best on an all-weather outdoor model for greatest visibility?* Answers must reach us by February 1st.

This Month's Topic

Should the present classifications—Junior (up to 16 years), Senior (16-21) and Open (over 21)—be continued? What should be the age limits for each class? Would you object to having every one compete in the same contest for the same prizes, regardless of age?

Best Models of 1936

A wealth of valuable information is revealed in this exclusive Model Workshop feature that lists complete specifications of the year's outstanding designs.

IN everything we do, there's no better road to success than to study the achievements of those who succeed.

By learning from them the details of the work in which they have excelled, we can pattern our efforts after theirs with a fair chance of duplicating their results. Equally important, also, is the fact that by such study we can often discover for ourselves, behind the practical details, a good deal about the correct theories and principles that are involved.

These things hold true in model airplane building as well as elsewhere. For this reason The Model Workshop of AIR TRAILS has gathered together for its readers the specifications of the outstanding model designs of 1936, which have been tabulated in the accompanying charts.

There were so many outstanding models developed during the year that it was impossible to include all of them. Those which we picked for the tabulation have proved outstanding in contests and are the work of outstanding designers. Thus they can be considered representative of the year's trend in model design.

Included in the list are the models of some of the year's trophy winners—Carl Goldberg, Frank Tlush, Bruce Luckett, Ervin Leshner, Albert Judge, Vernon Gray—and many others whose consistent good work has put them in the top flight among model builders and fliers.

The charts have been prepared as a collection for handy reference. A few minutes' inspection will show the difference and likeness among the models. A little arithmetic applied to the statistics presented will also reveal many other significant points, such as particular and average wing loadings per given area, percentage of elevator area to wing, relation of span to length, and so forth. It should be interesting to compare the specifications of these record-breakers to those of your own design. If you make a habit of referring to the charts when designing a new model, you certainly can't go wrong.

It was necessary to abbreviate many specifications to keep the charts compact and easy to read. Abbreviations have been standardized on the charts. They are listed as follows:

| TYPE: RUBBER OUTDOOR DESIGNER & BUILDER | CLASS | TOTAL WEIGHT IN OZS | SPAN | OVERALL LENGTH | RUBBER LENGTH | WING | | | | ELEV. | | PROP | | | RUDDER AREA | FUSELAGE LENGTH | DIRECTION OF TURN | RUBBER SIZE & COLOR | NUMBER OF STRANDS | GLIDE RATIO (SINKING SPEED) | BEST UNOFFICIAL FLIGHT | BEST OFFICIAL FLIGHT | REMARKS | |
|---|----------------|---------------------|------|----------------|---------------|-----------------|-----------|-----------------|----------|-----------------|-----------|--------------|----------|--------|-------------------|-----------------|-------------------|---------------------|-------------------|-----------------------------|------------------------|----------------------|---------|--|
| | | | | | | AREA IN SQ. IN. | INCIDENCE | AIRFOIL | DIHEDRAL | AREA IN SQ. IN. | INCIDENCE | AIRFOIL | DIAMETER | PITCH | | | | | | | | | | OFFSET THRUST |
| DANIEL CLINI | STICK TRACTOR | 4 1/4 | 42 | 44 | 36 | 169 | 2° | CLARK Y | 6 | 60 | -2° | S | 18 | 21 | N 2° R 0° | — | 28 | 35 | L 1/8 x 1/30 BR | 20 | — | 5M | 39M | 18M GLIDE FROM 3000 FEET |
| ERVIN LESHNER | CABIN FUSELAGE | 4 1/2 | 49 | 37 | 39 | 196 | 0° | EIFFEL 400 | 6 | 84 | -2° | CLARK Y | 18 | 25 | N 3 1/2° R 0° | 110s | 22 | 37 | R 1/8 x 1/30 BR | 22 | 60 FT PER MIN | 3M | 36M | STOUT WINNER |
| JIM CAHILL | CABIN FUSELAGE | 46 | 56 | 34 | 40 | 199 | 2 1/2° | CLARK Y | 6 | 75 | 0° | MOD. CLARK Y | 18 | 25 | N 1 1/2° R 1° | 120 | 22 | 27 | R 1/30 x 3/32 BR | 18 | 5:1 | 4M | 3M | FLOWN IN ONLY ONE CONTEST |
| DICK EVERETT | CABIN FUSELAGE | 28 | 36 | 25 | 20 | 125 | 2° | EIFFEL 430 | 3 1/2 | 47 | 1 1/2° | CLARK Y | 16 | 22 | N 2° R 2° | 90 | 22 | 24 | R 1/8 x 1/30 BR | 14 | 10:1 | — | 10M | — |
| DICK EVERETT | STICK TRACTOR | 35 | 52 | 34 | 27 | 165 | 3° | EIFFEL 400 | 5 | 65 | 1° | CLARK Y | 17 | 23 | N 2° R 2° | 120 | 31 | 33 | R 1/8 x 1/30 BR | 16 | 16:1 | 3M | 26M | TWIN RUDDERS W-SHAPED WING 500 FT CLIMB |
| BOB JEFFERY | CABIN FUSELAGE | 4 | 42 | 37 | 27 1/2 | 195 | 4° | R.A.F. 32 | 3 1/2 | 59 | 0° | CLARK Y | 18 | 22 | N 3 1/2° R 1 1/2° | 90 | 195 | 35 | R 1/8 x 1/30 BR | 16 | — | — | 11M | TWO SUCH SHIPS LOST IN THE MOFFETT CONTEST |
| BRUCE LUCKETT | STICK TRACTOR | 2 3/4 | 32 | 26 | — | 125 | 2° | EIFFEL 400 | 5 | 38 | -2° | CLARK Y | — | — | N 3° R 2° | — | 18 | — | R — RED | — | — | 3M | 41M | MULVILL WINNER |
| EDW. J. LIDGARD | CABIN FUSELAGE | 37 | 38 | 29 1/2 | 25 | 180 | 5° | MOD. CLARK Y | 3 1/2 | 52 | -2° | CLARK Y | 16 | 21 | N 0° R 0° | 60 | 22 | 28 1/2 | L 1/8 x 1/30 BR | 16 | 10:1 | 95M | 15M | — |
| ROBERT COPLAND | CABIN FUSELAGE | 5 1/4 | 41 | 32 | 40 | 195 | 2° | R.A.F. 32 | 3 1/4 | 54 | -1° | LIFT SECTION | 17 | 24 | N 0° R 2° | 115 | 30 | 28 | R 1/30 x 1/16 BR | 14 | 20:1 | — | 20M | ENGLISH WINNER |
| HARRY CORNISH | STICK TRACTOR | 29 | 36 | 26 | 20 | 139 | 2° | R.A.F. 32 | 3 | 45 | -4° | CLARK Y | 14 | 21 | N 2° R 1 1/2° | — | 185 | 25 1/4 | R 1/8 x 1/30 BR | 14 | — | — | 61M | — |
| ALBERT JUDGE | CABIN FUSELAGE | 4 1/4 | 44 | 31 1/2 | 60 | 195 | 1° | MOD. CLARK Y | 4 | 50 | -1° | CLARK Y | 15 1/2 | 14 | N 0° R 0° | — | 23 | 30 | — 1/4 x 1/20 BL | 6 | — | — | 4M AVE | WAKEFIELD |
| CHESTER LANZO | CABIN FUSELAGE | 4.1 | 42 | 36 | 35 | 200 | 3° | MOD. CLARK Y | 5 | 80 | 0° | CLARK Y | 18 | 24 | N 2° R 0° | 60 | 40 | 35 | R 1/8 x 1/30 BR | 24 | — | — | 49M | — |
| ROY WRISTON | CABIN FUSELAGE | 4 | 45 | 30 | — | 200 | 2° | MOD. EIFFEL 400 | 4 | 68 | -1° | CLARK Y | — | — | N 2° R 2° | — | 24 | — | R — RED | — | — | 24M | 41M | — |
| BRUNO MARCHI | CABIN FUSELAGE | 43 | 43 | 35 1/2 | 34 | 200 | 6° | CLARK Y | 4 | 55 | 0° | CLARK Y | 18 | 40 | N 2° R 4° | 70 | 18 | 33 1/2 | R 1/16 x 3/16 BR | 16 | 7:1 | — | 8M | — |
| VERNON GRAY | CABIN FUSELAGE | 28 | 39 | 27 1/4 | 19 | 132 | 3° | CLARK Y | 3 1/2 | 52 | -1° | MOD. CLARK Y | 16 | 22 1/2 | N 2° R 2° | — | 16 | 26 1/4 | R 1/8 x 1/30 BR | 16 | — | — | 44M | MOFFETT |

[illegible]

Make of gas motor is designated by C—Baby Cyclone, T—Thush Super ace, B—Brown Junior, H—Hurleman.

The abbreviation "mod" in the listing of airfoils indicates that the designer has made some slight modification in the airfoil section for his own use. The word "original" shows that the builder has designed his own special airfoil shape.

The dihedral angle is given in inches. This means that each tip of the wing is raised the indicated number of inches from a level position.

In listing elevator airfoil shapes, the capital letter L indicates a lifting section, while S designates a symmetrical section. Where the shape of the elevator airfoil is definitely known, the name of it is listed.

Under the heading "Offset Thrust" the notation N indicates negative thrust, followed by the number of degrees. R indicates right thrust.

In considering the direction of turn, the letter R means right circle against torque. L indicates left circle or with torque. In the classification of indoor models, the abbreviation W. T. indicates turn with torque.

The speed of the gas motors is given in thousands of revolutions per minute. In designating the color of a rubber motor, the abbreviation BR indicates brown rubber, while BL is black.

The durations listed under the column "Best Official Flights" have all been made at N. A. A.-sanctioned contests with accredited timers.

To get the most out of these charts, you should clip them from the magazine and put them up on the wall of your shop, where you can refer to them frequently.

All of the models are the embodiment of successful model aerodynamic laws. If you make your models check with these, your designs are certain to have the same characteristics.

We want to express our appreciation to the builders who have enabled us to compile this tabulation. It is in no sense a complete roster of all the expert designers competing in this country, and no slight is intended to those who may have been omitted. We feel certain, however, that it may be taken as exemplifying the best work that is being done to-day.

| TYPE: GAS | TOTAL WT. | MOTOR | SPAN | OVERALL LENGTH | WING | | | | ELEV. | | | RUDDER AREA | PROP DIAM. | PITCH | OFFSET | THRUST | RPM IN 1000 | MIXTURE RATIO | FUSELAGE LENGTH | DIRECTION OF TURN | BEST OFFICIAL FLIGHT | BEST UNOFFICIAL FLIGHT |
|--|-----------|-------|--------|----------------|-----------|-----------|------------|----------|-----------|-----------|---------|-------------|------------|-------|-----------|--------|-------------|---------------|-----------------|-------------------|----------------------|------------------------|
| | | | | | AREA SQFT | INCIDENCE | AIRFOIL | DIHEDRAL | AREA SQFT | INCIDENCE | AIRFOIL | | | | | | | | | | | |
| DESIGNER & BUILDER | | | | | | | | | | | | | | | | | | | | | | |
| VERNON BOEHLE | 6 | C | 14'-8" | 7'-1" | 19 | 1 1/2° | ORIGINAL | 19" | 6.5 | -1 1/2° | L | — | 13 | — | NONE | — | 3:1 | 6'-11" | R | 24m | — | |
| TLUSH BROS. | 6 | T | 9' | 5'-3" | 8 | 1° | EFFEL 400 | 10" | 2.4 | 0° | S | .55 | 16 | 6 | NONE | 3 1/2 | 5:1 | 5' | R | 45m | 2hr | |
| KENNETH ERNST | 4 3/4 | B | 8'-2" | 82 | 7 1/2 | 1° | KOVEL MOD. | 11" | 2 | -1° | S | — | 14 | 6 | N 2° | 3 | 5:1 | 5 | L | 55m | 66m | |
| BRUNO MARCHI | 4 | H | 7' 4' | 6 | 0° | | CLARK Y | 10" | 1.9 | -3° | S | — | 15 | 25 | N 4° R 2° | 3 | 4:1 | 3'-4" | R | 45m | — | |
| CLYDE GOEHRING | 4 3/4 | B | 7'-6" | 48" | 7 | 0° | ORIGINAL | 5" | 1 3/4 | 0° | S | — | 16 | 6 | NONE | 3 | 6:1 | 4'-4" | L | 20. | 1hr | |
| LEGEND: C-BABY CYCLONE T-TLUSH B-BROWN H-HURLEMAN L-LIFT ELEV. S-SYMMETRICAL SECTION | | | | | | | | | | | | | | | | | | | | | | |

Racing Speed

DURING the past several years the trend in light racers has been toward cleaner and safer planes. The new Folkerts Special is an outstanding example in respect to its streamlining and ability to place high in speed events. The achievements of this little racer in the 1936 National Air Races are already well known in aviation circles.

The design of the Folkerts is excellent for a flying scale-model racer. The large plane's features are included in the model to the best advantage.

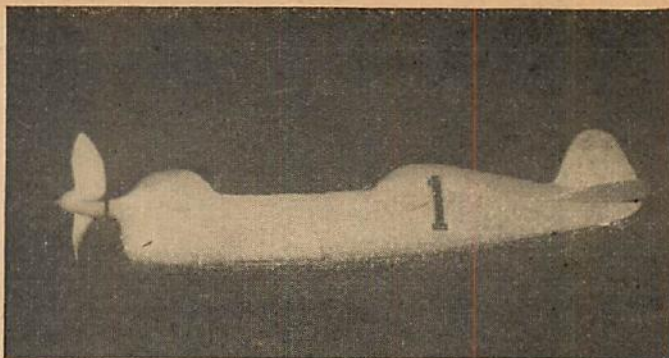
The flaps are held up while winding the motor, at which time the right aileron rises from the rubber tension. After the motor is fully wound, the landing gear is pushed up into the wells, where it automatically latches, and the well hatches are closed, all by hand. Then as the propeller turns and the rubber unwinds, the aileron gradually resumes its normal position, and finally the flaps and landing gear snap down.

All of these features are incorporated in our $1\frac{1}{4}$ -ounce model, and yet it has astounding speed under full control, made possible with the torque-counteracting aileron. That sounds good, eh? O. K. Let's start work.

The construction of the model conforms with that of the real plane. First make a 2×6 " sheet of plywood of two layers of $\frac{1}{32}$ " sheet cemented cross-grained, from which to cut the fuselage formers. Now carve the cowl block from medium hard balsa. After obtaining the correct finished shape, apply several coats of dope to protect the finish.



Landing position, with gear extended and flaps down. Above, skeleton view showing simplicity of framework.



With gear up, ready to go places fast.

FOLKERTS SPECIAL

The two side $\frac{1}{16}$ "-square longerons are cemented in the step in the cowl block and are left to dry parallel to each other. This is important, because the formers are assembled on the two side longerons.

After cutting the formers, cement them to the longerons. The bottom of the #3 section is fitted with a former to take the landing-gear hinges (D). Cement the top and bottom longerons into the slots and check carefully to see that the frame remains lined up as the cement sets.

The wing panels are simple to make. Cement two layers of $\frac{1}{64}$ " sheet balsa together cross-grained to form a 6×12 " sheet of plywood.

Cut the oversize wing panels from this and make certain you have two pairs, and that the exposed grain will run from the roots to the tips.

Pin the two bottom panels (a right and a left) to a board and assemble the ribs by cementing directly to the panels. Remember that both flaps operate. Only the bottom panel is cut for this purpose, in order to leave the top panel intact. The flap ribs and spars are independent of any other assembly and are kept so by using small pieces of waxed paper where a stick-up seems likely. Only the right aileron is controlled and it, also, is independent of the wing.

The procedure was to assemble the wing panels to completion and then cut the plywood where necessary by holding the wings before a strong light to see the spar divisions.

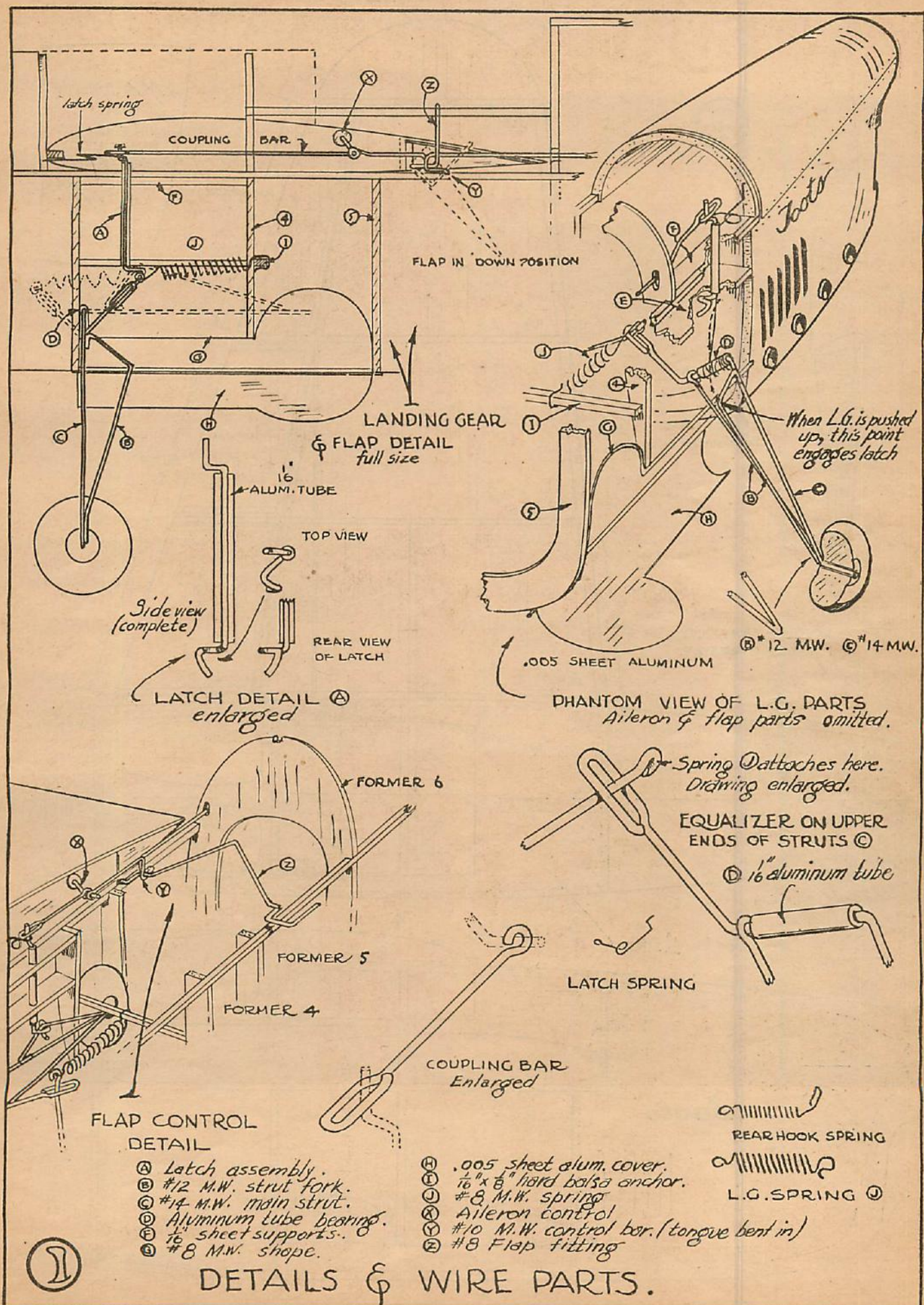
After removing the flaps and aileron, cement the flaps back to the bottom surfaces of the wings with jap-tissue hinges. The aileron hinge goes on top.

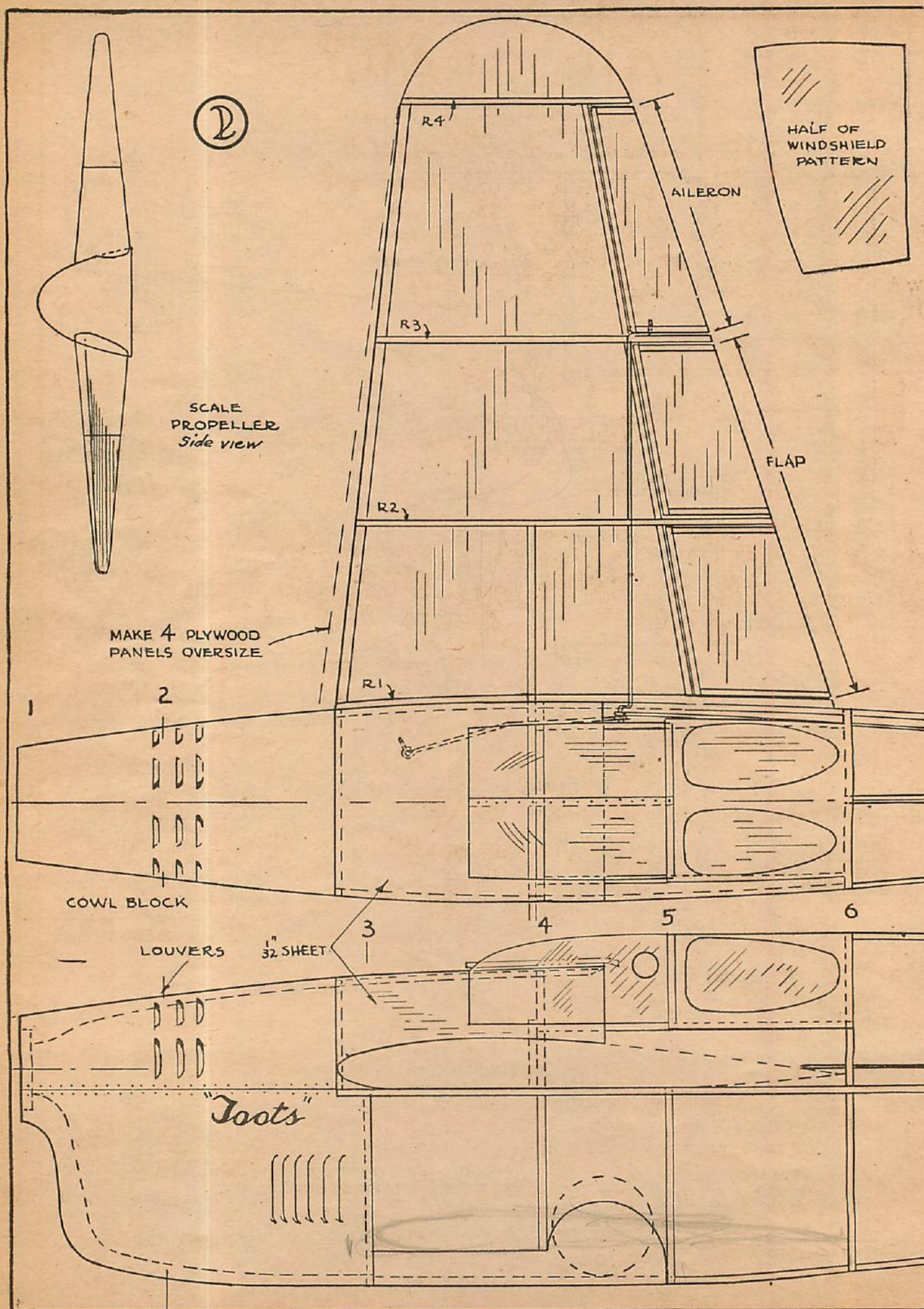
The stub spars should be cemented carefully and firmly into the

(Turn to page 96)

"Toots" has contest-winning zip as well as self-lowering wheels, anti-torque aileron, and flaps!

by Alan D. Booton



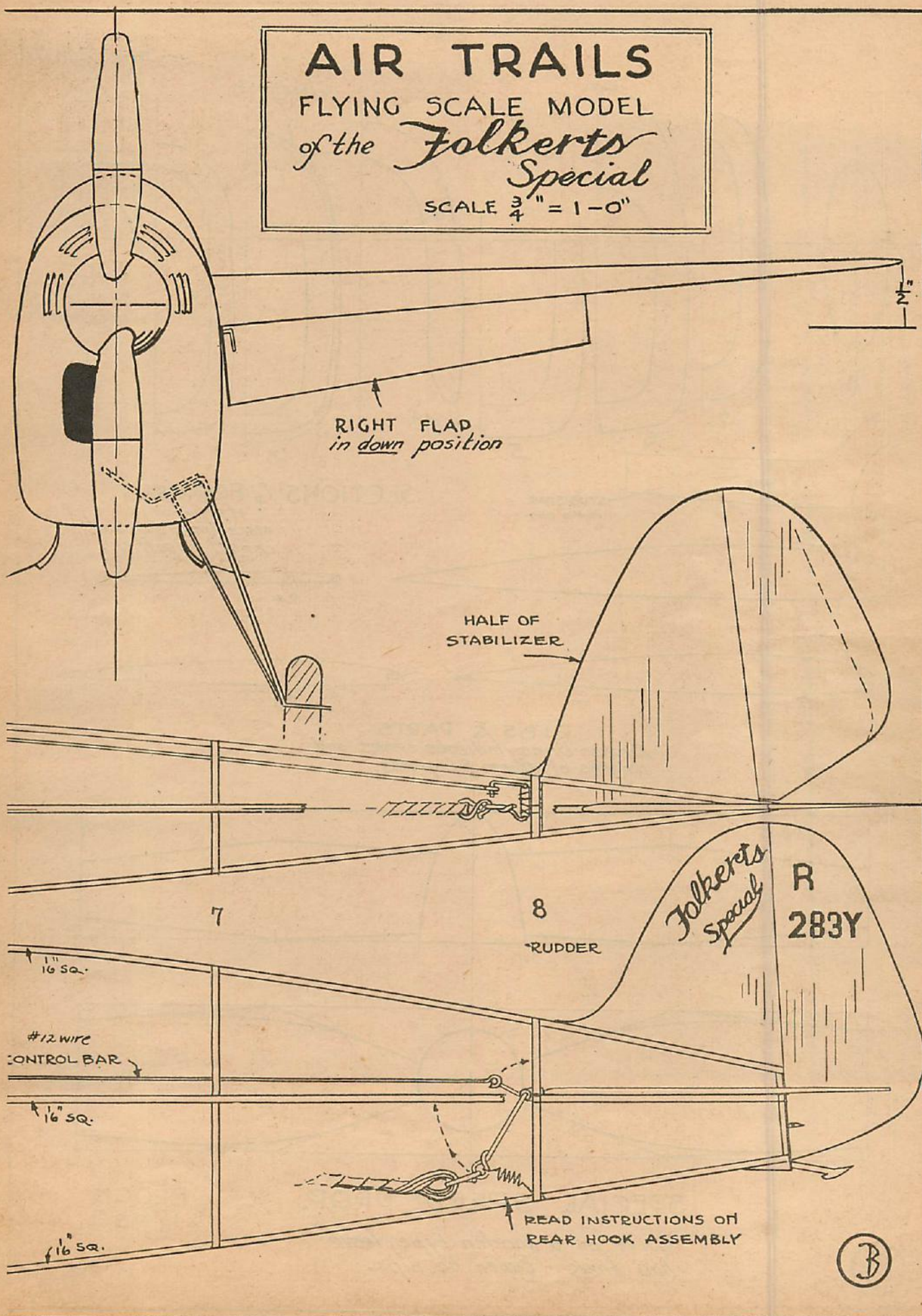


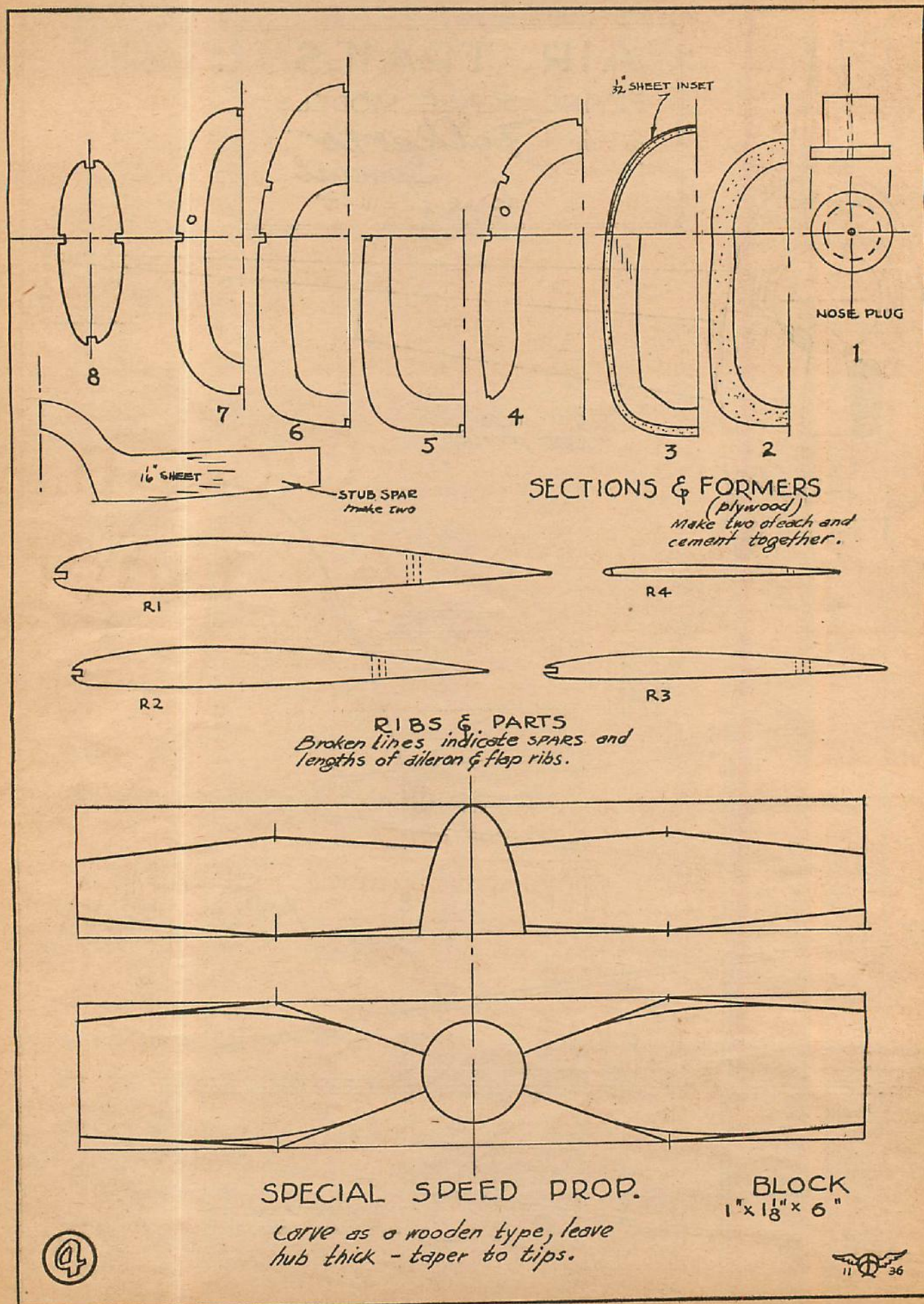
AIR TRAILS

FLYING SCALE MODEL

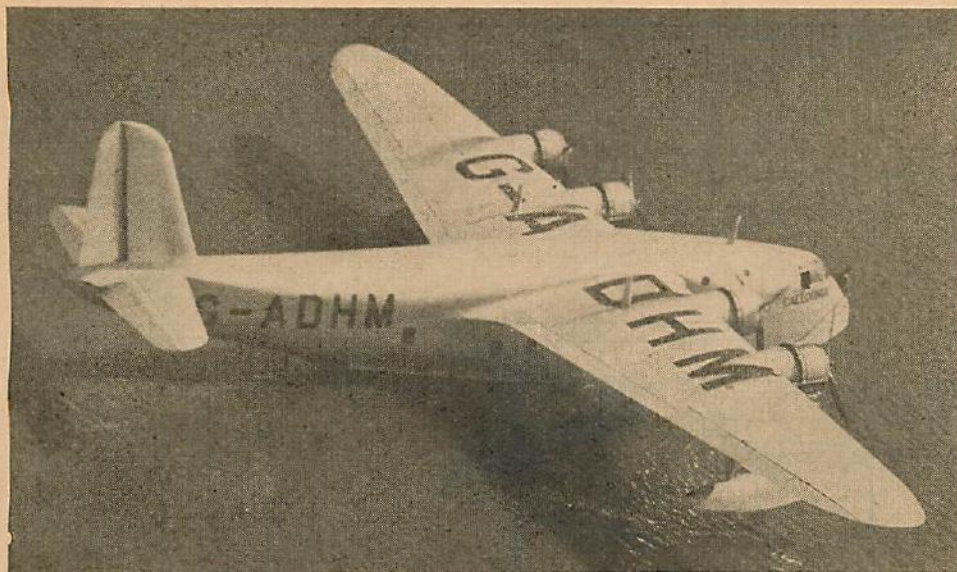
of the *Folkerts Special*

SCALE $\frac{3}{4}$ " = 1'-0"





by
William
Winter



From our cover to The Model Workshop comes an important new plane in a fine solid scale model, complete with miniature beaching gear.

Ocean Air-Liner

THE Short Empire flying boat, designed for Imperial Airways' far-flung routes to the East and for the transatlantic service, is a giant as airplanes go.

The span of the four-motored monoplane is 114 ft., and the length is 88 ft. 6 in. The height from the water line when afloat is 24 ft. Construction is of metal throughout. For day service, 24 passengers are carried. As a sleeper, 16 passengers will be carried. The crew numbers five.

The four Pegasus 740 h.p. engines are expected to yield a top speed of approximately 200 m.p.h., and a cruising speed of 150-160 m.p.h. The wing flaps are of generous area and permit a reasonable landing speed.

Our $\frac{1}{8}$ " scale model is of the *Caledonia*, the second Empire boat of a series of twenty-nine to be constructed. It differs from the *Canopus*, the first to be completed, in that the *Canopus* is to be placed on the Mediterranean hop in the India service, while the *Caledonia* is said to be intended for Atlantic flights. Incidentally, the principal difference between these two boats that is evident to the eye is in the number of windows. Since the weight of the *Caledonia* is 5,000 lbs. more than that of the *Canopus* and as most of the windows have been omitted on the *Caledonia*, it is probable that interior arrangements are designed for larger fuel capacity on the ocean-hopping ship.

To start construction, trim a soft block down to the required outside hull dimensions. Draw the side profile of the body on the block and cut away the excess wood. On the top of the partially carved block, mark the top outline and again shave away the surplus wood. Round and shape the hull as required by the block cross sections given. Drill two holes for the $\frac{1}{8}$ " dowels. Sand the block to a satin finish.

Cut the tail surfaces from $\frac{1}{8}$ " sheet balsa and sand smooth, rounding the leading edges and pointing the trailing edges. Cement the finished tail units in position.

The wings are made in two halves and are cut from $\frac{1}{2}$ " balsa. Carve to the proper airfoil sections, checking with the patterns given on the plans. Slant the inner ends, which fit against the fuselage, to allow for the proper dihedral. Cut out sections in the leading edges to accommodate the engine nacelles and sand the finished panels. The nacelles are carved to the required shapes from 1" square balsa. After a trial fit, cement them in

place. Provide small holes to take the pointed ends of the dowels and force each wing panel in place, using plenty of cement. The fillets are molded from wood filler.

Carve the wing tip floats to shape from $\frac{1}{2}$ " square balsa. After sanding them carefully, mount them on streamlined or rounded bamboo struts. Do not add the bracing threads until the painting has been completed.

The four propellers are cut from scraps and are mounted on pins so that they are free to turn. Note that they are all left hand, in accordance with European engine custom.

Give the model several filler coats of clear varnish, sanding lightly between each coat with very fine paper.

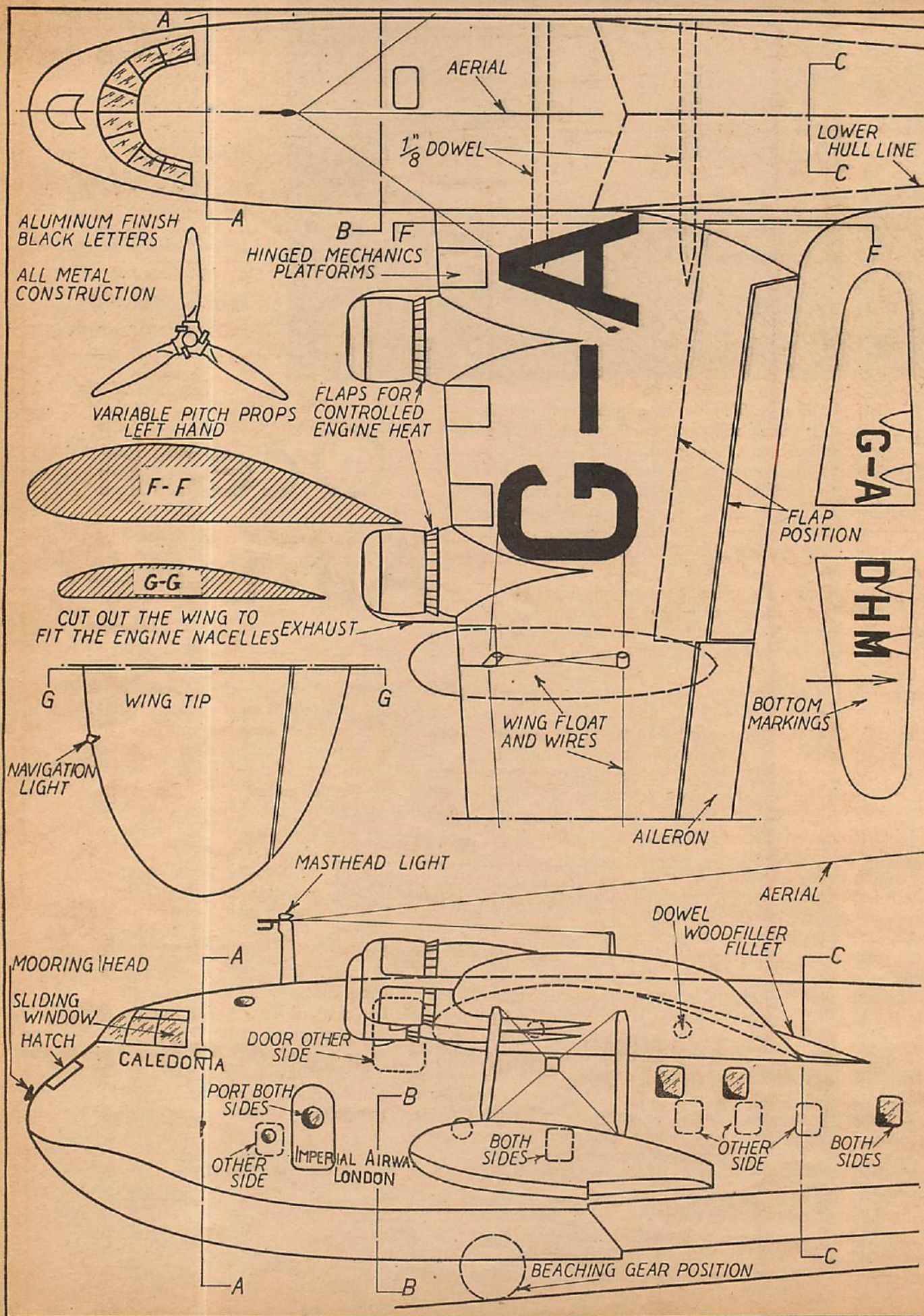
Finish the ship in silver, making all trim and letters black. Put the thread bracing wires on the tip floats and construct the beaching gear and dolly.

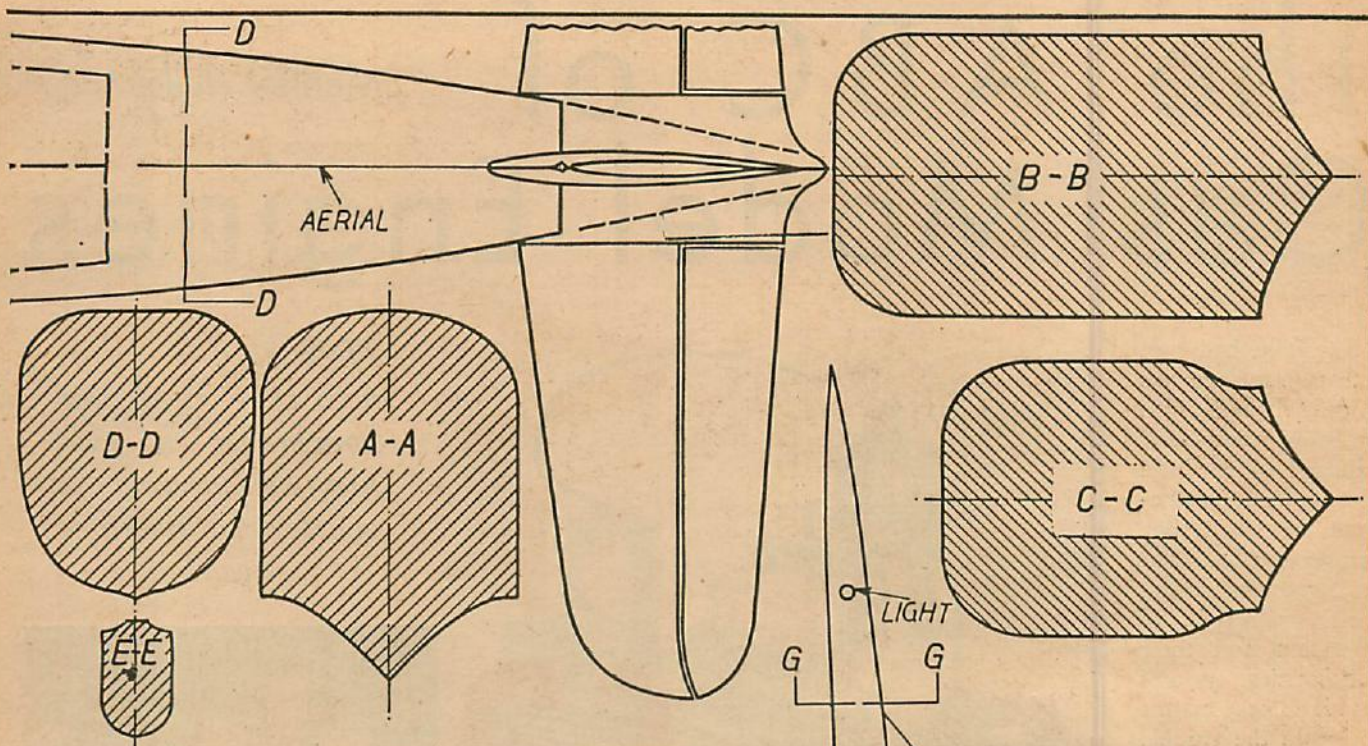
These last-named articles of equipment are used to facilitate the handling of the real Empire flying boats. A front view photograph of the beaching gear appeared in AIR TRAILS for October. The model beaching gear may be made demountable by embedding pins in it for attachment to the hull. To display the model, the beaching gear and dolly will hold far more attraction than a stand.

SHORT EMPIRE

MATERIALS

- | | |
|---|-----------------------------------|
| 1 $11\frac{1}{4} \times 2\frac{1}{4} \times 1\frac{5}{8}$ " | 1 $18 \times \frac{1}{8}$ " dowel |
| 1 $\frac{1}{2} \times 3 \times 13$ " | 1 $\frac{1}{2}$ " sq. x 4" |
| 1 $\frac{1}{8} \times 2 \times 12$ " | $\frac{1}{2}$ oz. cement |
| 1 $\frac{1}{8} \times 3 \times 6$ " | clear varnish |
| 1 1" sq. x 8" | wood filler |
| 1 $\frac{1}{16} \times \frac{1}{8} \times 6$ " | black #60 thread |
| | silver and black paint |



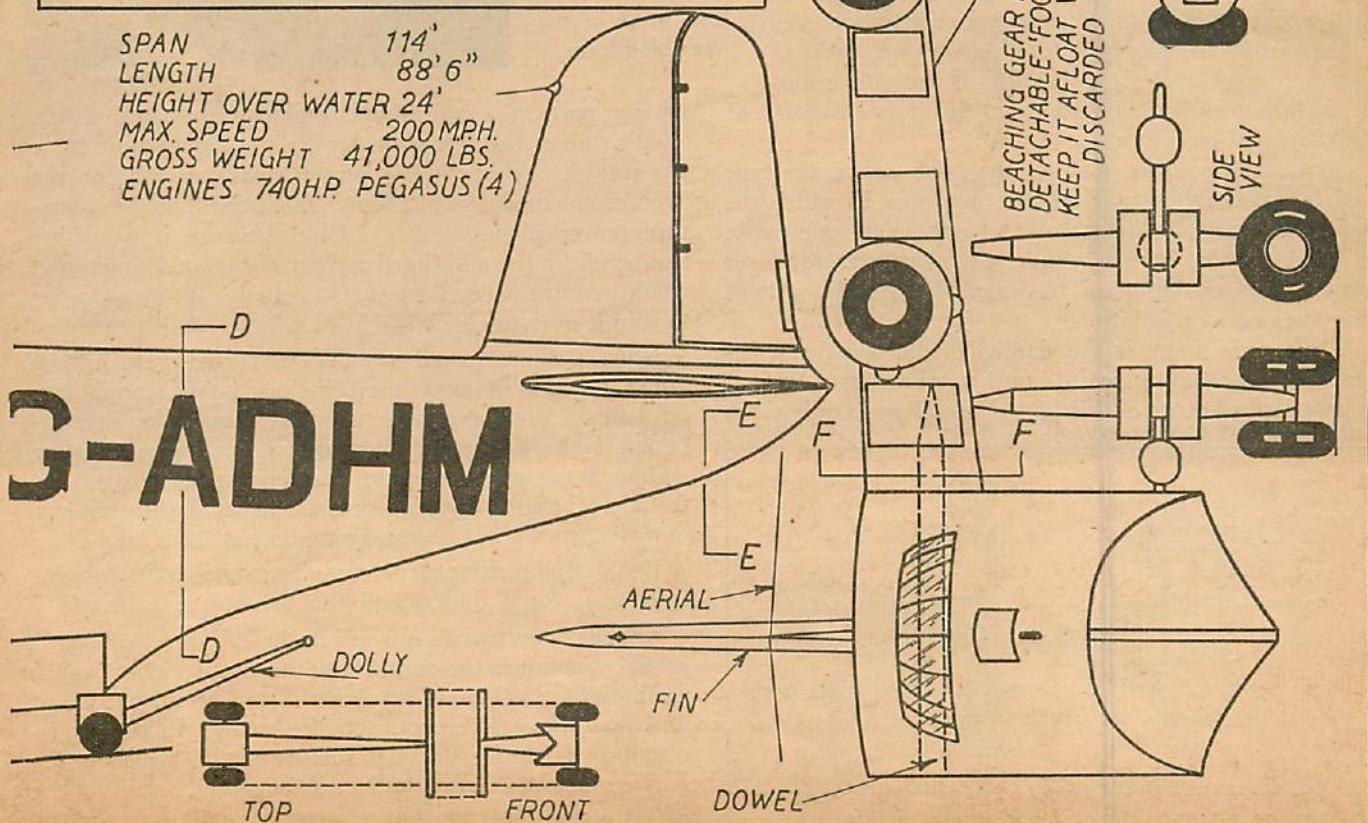


SHORT BROS. $\frac{1}{8} = 1$ EMPIRE FLYING BOAT

CALEDONIA THE SECOND OF 29 EMPIRE BOATS IS INTENDED FOR TRANSATLANTIC SERVICE-THE CANOPUS BUILT FIRST IS FOR SERVICE TO INDIA AND HAS MANY MORE WINDOWS-THE CALEDONIA IS HEAVIER BY $2\frac{1}{2}$ TONS-DAY SERVICE SEATS 24-AS SLEEPER ACCOMMODATES 16-CREW 5

SPAN 114'
LENGTH 88'6"
HEIGHT OVER WATER 24'
MAX. SPEED 200 M.P.H.
GROSS WEIGHT 41,000 LBS.
ENGINES 740 H.P. PEGASUS (4)

3-ADHM



The ABC of Gas Model Engines

by
Manley Mills

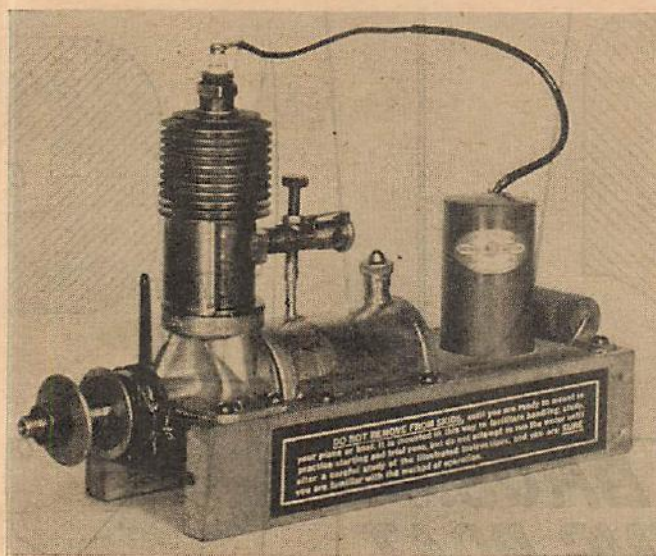
IF you've had any experience with gas models, you probably know how baffling those little motors can sometimes be when they refuse to run. But once you understand their principle of operation and their peculiarities, you'll find it an easy matter to locate the trouble and correct it. Model gasoline motors are really so simple that there isn't much to get out of order. On

the other hand, they're quite sensitive because of their small size and if everything isn't just right, they'll be hard to start and keep running.

Practically all the miniature gasoline motors on the market at present are of the two-cycle type. Incidentally, while this term is universally used, it's actually somewhat misleading; the correct one is "two-stroke cycle." This means that only two strokes of the piston are required to complete one cycle of operation. A "cycle," in the case of a gasoline motor, is the induction, compression, firing and exhaust of one charge of gas.

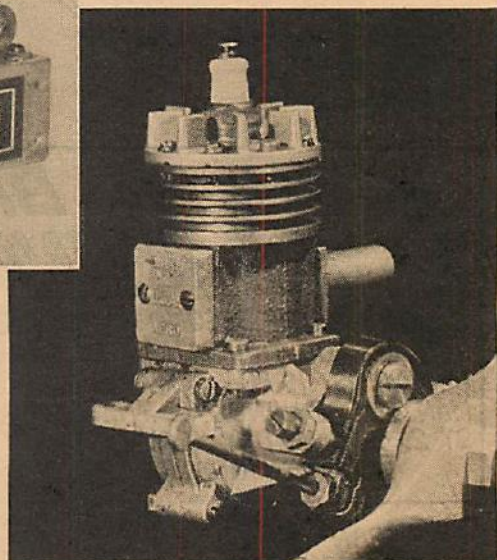
For comparison, there's the four-cycle motor, the type used in automobiles and full-size airplanes, in which the piston has to make four strokes to complete one cycle. In other words, a one-cylinder four-cycle motor fires every *other* revolution of the crankshaft, while a two-cycle fires *every* revolution.

A two-cycle motor is the simpler of the two types, because it has no timing gears, camshaft or valves. In fact, a one-cylinder motor of this type ordinarily has only three



Two 1/5 h.p. model engines: the Brown Junior (above) mounted on testing base, and the G. H. Q., which is available in kit or assembled form.

How they're built, how they run, and how to keep 'em running by learning the gentle art of troubleshooting.

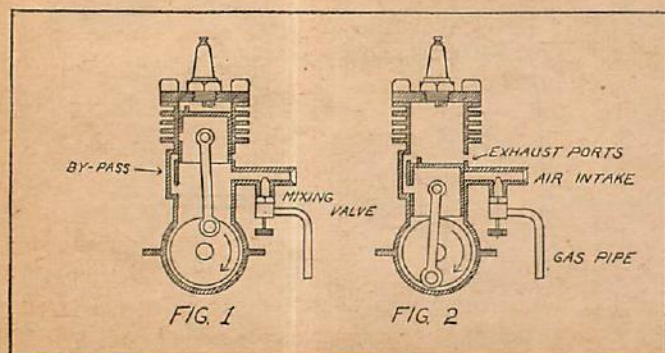


moving parts: the crankshaft, connecting rod, and piston. That's one of the reasons why it's the logical type for a gas model. A four-cycle motor small enough for the average gas model would be much heavier than the miniature power plants now available, because it would be hampered by the additional weight of the valve gear, and would require either a flywheel or a very heavy propeller to spin it over to compression each time.

Now, perhaps you'll wonder why two-cycle motors aren't more commonly used in automobiles and large airplanes. Well, the reason is that they have some inherent faults that make them unsuitable for automotive and aviation work. These disadvantages, mostly of a technical nature, are not present in miniature motors, however, so it's not necessary to discuss them here.

By studying Figures 1 and 2 of the accompanying drawings, you'll understand the two-stroke principle.

As the piston travels upward in the cylinder, it creates a partial vacuum in the crankcase (the circular part) which is air-tight. When it reaches the top of the stroke, it uncovers the intake port, and the suction in the crankcase draws in a mixture of gasoline and air. (See Fig. 1.) Now, when the piston starts downward, it shuts off the intake and compresses the mixture below it. At the end



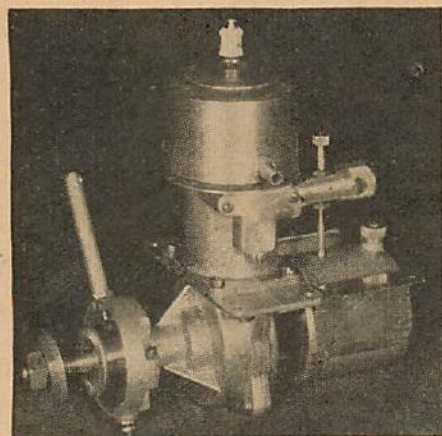
Ins and outs of the two-stroke cycle.

of the down stroke, the port in the piston lines up with the lower port of the by-pass, and the mixture rushes up into the cylinder under its own pressure. (See Fig. 2.) The piston, moving upward, compresses the charge, which is fired just at the top of the stroke. The expanding gases, of course, drive the piston downward. At the bottom of the stroke, the burned gases escape through the uncovered exhaust ports, while, at the same instant, a fresh mixture rushes in through the by-pass on the opposite side of the cylinder. A baffle plate on top of the piston diverts the mixture upward and keeps it from escaping through the exhaust ports before they are again covered up.

Just remember that, while the motor is running, two things are always happening at the same time. At the top of the stroke, a mixture is being fired while a fresh one is going into the crankcase. As the piston is being driven downward, it is compressing the mixture in the crankcase. At the bottom of the stroke, the exhaust occurs at the same time that a new mixture is going into the cylinder. And finally, as the piston goes upward, it compresses the fresh mixture at the same time it creates a suction in the crankcase.

When a motor in good mechanical condition won't crank, the chances are ten to one that it's either not getting the right fuel mixture or something is wrong with the ignition system.

An electric spark won't ignite gasoline easily unless the fuel is in the form of a mist or spray, mixed with a definite proportion of air. The purpose of the carburetor or mixing valve is to break up the gasoline into a fine spray and mix it with air, the proportion of fuel being regulated

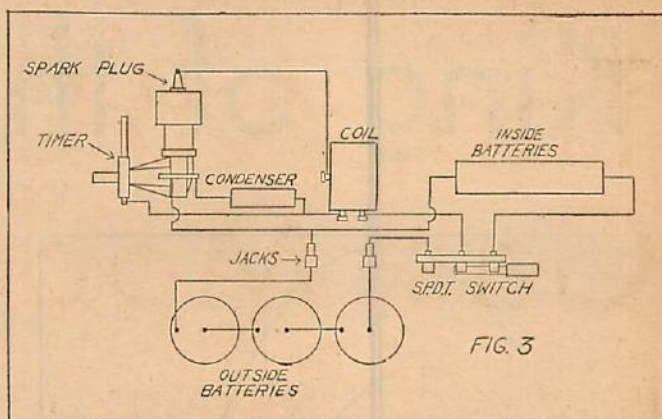


Left, a water-cooled job by Forster Bros., who also make a husky 1/3 h.p. aero motor, and 1/5 h.p. *Thlush Super Ace*.

by a needle valve. A *rich* mixture is one containing one part of gasoline to about six parts of air, while a *lean* mixture has one part to about fifteen of air. When a mixture is too rich—indicated by a smoky exhaust—the power is reduced and valuable fuel is wasted. A lean mixture, on the other hand, is more desirable

from the standpoint of efficiency, but one that is too lean causes overheating and loss of power.

A rich mixture, usually necessary for cranking, is obtained by opening up the needle valve. Turning it



Wiring diagram for a "booster" starting circuit.

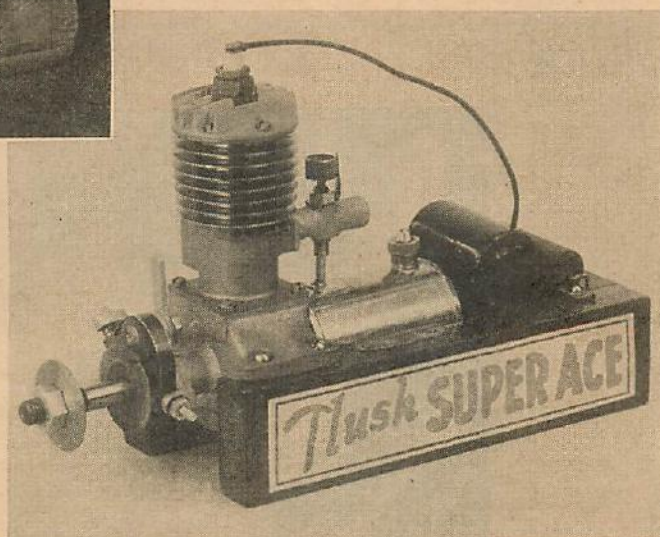
toward the closed position gives a lean mixture. There are no definite rules that can be followed in adjusting this valve; you simply have to experiment until you find the most efficient setting. The usual practice is to give it one complete turn from the closed position as a tentative setting.

To prime your motor, keep the switch off and hold one of your fingers over the air intake while you turn the propeller over two or three times. When your finger is wet with gasoline, the motor is primed. If it doesn't crank at first, don't carry the priming too far, for it's very easy to flood one of these little kickers. To clear a flooded motor, turn off the switch, close the needle valve, and spin the propeller over several times. This will blow the excess gasoline out at the exhaust ports.

If the motor fails to prime, first be sure that there is gasoline in the tank, and that the needle valve is open. Then look for a clogged gas line. Sometimes, but not often, foreign matter will get into the mixing valve and stop up the tiny jet. If you find this to be your trouble, screw out the needle valve and blow through the jet until the obstruction is removed. Also, it's a good idea to clean out the gas tank. All connections between the gas tank and the motor must be air-tight. Air leakage at the joint between the gas pipe and the carburetor mixer, or between the air intake and the cylinder, may keep the motor from priming.

Too much lubricating oil mixed in the gasoline, or the use of too light a grade, usually makes cranking difficult if not impossible. If much oil gets up into the cylinder, it coats the points of the spark plug, which prevents it from firing properly, and causes imperfect combustion by diluting the gas mixture. A very heavy grade of oil, S. A. E. 70, must be used. The ratio of oil to gasoline should be greater for a new motor than one that has been in operation for some time.

As a general rule, the ratio should be about 5 parts of gasoline to 1 of oil for a new motor, though it may vary with different makes. After the motor has had about ten hours of service, you can cut the ratio down to about 8 to 1. (Turn to page 94)



King of the Indoors

There's regal dignity in the long, leisurely flight of this big plane—member of the ruling class!

by Lawrence N. Smithline

THE spoiled child of models, the indoor tractor, has captivated the builder's imagination because of its seemingly majestic and apparently very deliberate flight. Every turn of the propeller has a very definite effect which you can see. Small models, particularly the R. O. G., when compared to the large tractor, seem to buzz around a while and then flutter down.

A successful model requires a great deal of care, patience, and discrimination. Every piece of material must be carefully selected for weight and strength before it can be used. However, in spite of the size of our Class C tractor (the class with wing area between 100 and 150 square inches) the cost of building one is extremely low. Sixty cents will pay for all the materials necessary, and leave some over.

CLASS C TRACTOR

MAKING THE WING

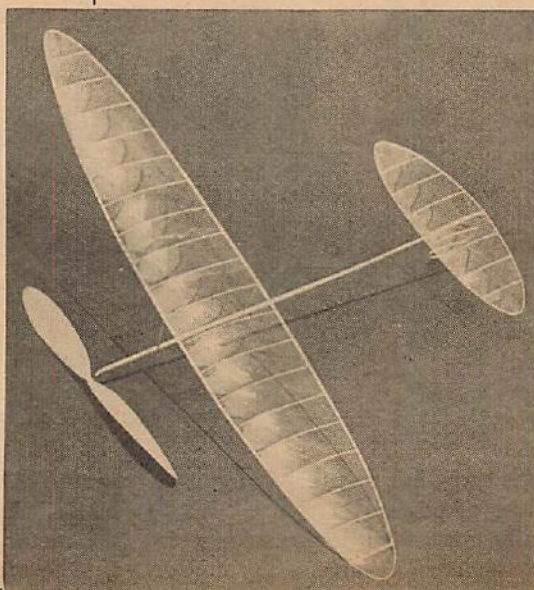
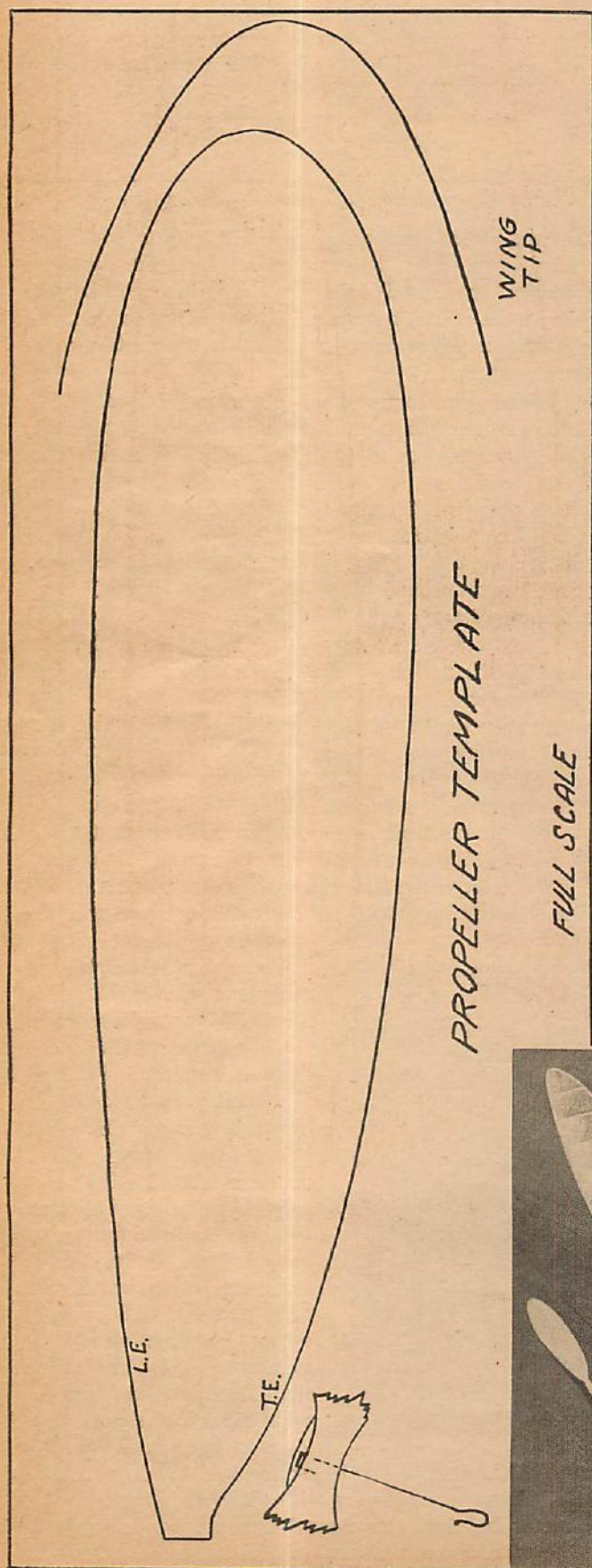
The shape of the wing is what is known as a swept-forward or double ellipse.

The center-section spars should be cut from 5 lb. $\frac{1}{16}$ " stock, made $\frac{5}{32}$ " wide at the center and tapered to $\frac{1}{8}$ " at the dihedral. Round off the edges and sand the spars smooth with #10-0 sandpaper. The center spars should weigh .0085 oz. The tip spars should be cut from 4-lb. balsa of $\frac{1}{16}$ " sheet $\frac{1}{8}$ " wide tapered to $\frac{3}{64}$ " at the tip. The tip spars, after sanding and smoothing, should weigh .008 ozs.

The ribs should be cut from $\frac{1}{32}$ " sheet in the following way. Cut along the template; then move the template down $\frac{1}{32}$ " and cut again. The total weight of the 17 ribs should be .002 ozs.

In inserting the ribs, the oversize ones should be trimmed to size by cutting one third the excess from the front and two thirds from the rear. Make a cardboard template of the tip, soak two $\frac{1}{32} \times \frac{1}{64}$ " strips in water, and

(Turn to page 94)



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.

MEASURING DIHEDRAL

Question: How are degrees of dihedral angle converted into inches? For example, how many inches should each wing tip be raised to add 5 degrees dihedral to a 24" wing? V. J., Chicago, Ill.

Answer: The following table is given as an aid for converting degrees of dihedral into inches. Let's examine it and work through the simple calculation for the particular case mentioned in the question. In the first column the degrees of dihedral are listed. To find the correct amount to raise each tip, multiply *half* the span by the value given in the second column. Thus for 5 degrees in a 24" wing, multiply 12 by .087, yielding 1.04, or just about 1" that each wing tip should be raised.

| Degrees | Value | Degrees | Value | Degrees | Value |
|---------|-------|---------|-------|---------|-------|
| 1 | .017 | 6 | .104 | 11 | .190 |
| 2 | .035 | 7 | .121 | 12 | .207 |
| 3 | .052 | 8 | .139 | 13 | .225 |
| 4 | .070 | 9 | .156 | 14 | .242 |
| 5 | .087 | 10 | .174 | 15 | .259 |

AUTOMATIC PILOT

Question: Would an automatic pilot be of any use on a model airplane? M. W., Avillo, Ind.

Answer: There is little use for an automatic pilot. Well-designed models show good stability without any outside help. Such a device seems certain to be heavy, making it useless for small rubber-powered models, and it seems unlikely that an automatic pilot could be made sufficiently effective and positive in its action to control a gas model's flight. Radio control from the ground is a better goal to strive for than development of an automatic pilot.

PARACHUTE RELEASE

Question: How is a model built to release a parachute? What type of 'chute should be used, and what is the simplest type of releasing mechanism? L. F., Del Rio, Texas.

Answer: A parachute can be made from a piece of silk, using thread for shroud cords and a piece of lead for weight. It should be carried in a small compartment built inside the bottom of the fuselage. A trapdoor hinged at the forward edge fits over the compartment, holding the parachute inside.

A convenient way to spring the trapdoor and release the parachute is by means of a small 1" diameter wind propeller. It is usually most convenient to mount the propeller directly beneath the fuselage forward of the 'chute compartment. The shaft of the small prop is attached to a short length of thread. As it revolves, the thread is twisted, and as it becomes tighter it pulls out a pin which had been holding the trapdoor closed.

The method of regulating the trapdoor is simple. Bend two wire eyelets and cement one to the edge of the trapdoor (the side opposite the hinge) and the other to the fuselage. To close the trapdoor insert a short piece of wire through the eyelets. This wire should fit loosely so that the tension of the twisted thread will pull it free. The time for releasing the parachute can be regulated by the length of the thread. In resetting the device, unwind the thread by blowing against the propeller from the rear.

RULE CHANGES

Question: Will there be any changes in weight rules before next June? Would it be safe to start designing and building now for the coming contest season? P. B., Lee, Mass.

Answer: At last we've found a model builder who doesn't wait until the night before the contest to build his models! Seriously, the weight ruling seems certain to be raised for 1937. Nothing definite will be known until the N. A. A. Committee for Model Plane Activities meets early in the spring. But don't let this stop your contest preparation. Design your models to conform to a weight rule of one ounce for every 25 square inches. This is twice the present weight requirement. Certainly the ruling will not be boosted higher than this. And if it isn't raised quite this high, you can easily lighten your models without damaging their performance. Building light ships and then adding weight to bring them within the weight rule does not have this advantage.

WEIGHING MODELS

Question: Could you tell me how to weigh complete models without having to take them apart and weigh them "piecemeal"? V. H., Vancouver, B. C.

Answer: The July, 1936, issue of AIR TRAILS had plans for a simple platform balance which would weigh slightly more than 2 ounces. In the issue of December, 1935, plans were given for a sliding-weight balance that will accommodate up to 5 ounces. Naturally, with the smaller scale it would be necessary to weigh the parts of a heavy model separately. But this is an advantage rather than a disadvantage. It enables you to keep a tabulated check on the weight. If the model is overweight, you'll know where you went wrong. We always weigh each part of the model several times during construction and then again before the final assembly. In this way it's possible to keep the model within the original weight estimates and still build it with maximum strength. If the finished model is heavier than planned, it means extra strands of rubber must be added, which reduces duration and seriously dims any bright hopes you might have had for the model.

Builder's Guide

Sticks
by William Winter

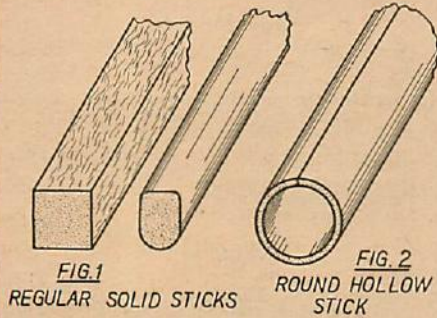


FIG. 1
REGULAR SOLID STICKS

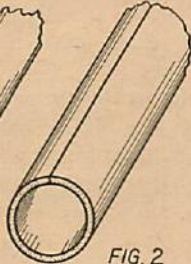


FIG. 2
ROUND HOLLOW STICK

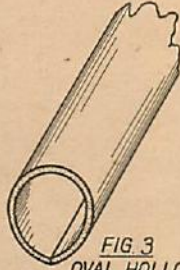


FIG. 3
OVAL HOLLOW STICK

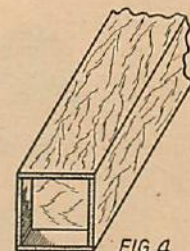


FIG. 4
BUILT UP SQUARE OR RECTANGULAR STICK

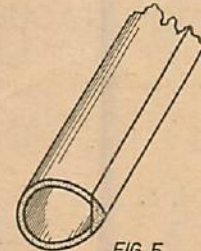


FIG. 5
STREAMLINE STICK FOR TWINPUSHER

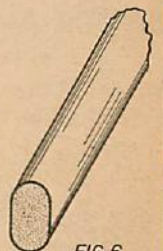


FIG. 6
SOLID STICK FOR TWINPUSHER

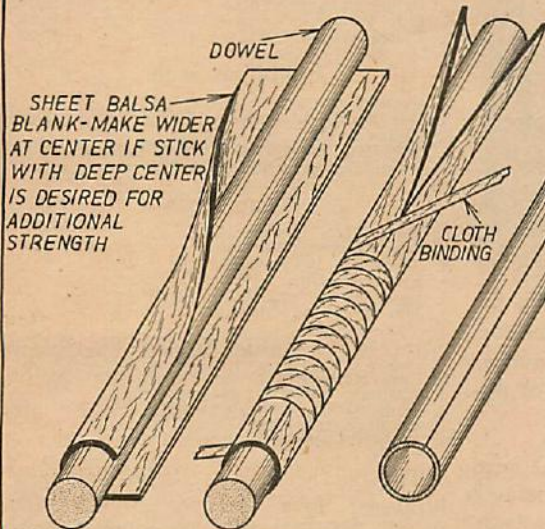


FIG. 7- HOLLOW STICKS MADE BY SOAKING OR STEAMING SHEET BALSA AND WRAPPING AROUND A DOWEL- BIND WITH CLOTH STRIP AND DRY IN OVEN- REMOVE CLOTH AND DOWEL AND CEMENT SEAM STARTING AT CENTER USE OVAL FORMER FOR OVAL STICK- 24" 30" STICK MADE OF $\frac{1}{16}$ " SHEET WOULD BE 1" THROUGH

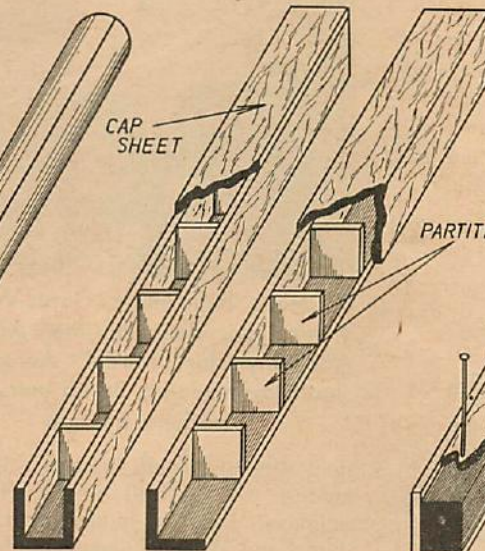


FIG. 8- BUILT UP STICKS CAN BE MADE BY USING U AND L BEAMS- PARTITIONS ARE CEMENTED IN- U BEAM IS CAPPED WITH SHEET BALSA

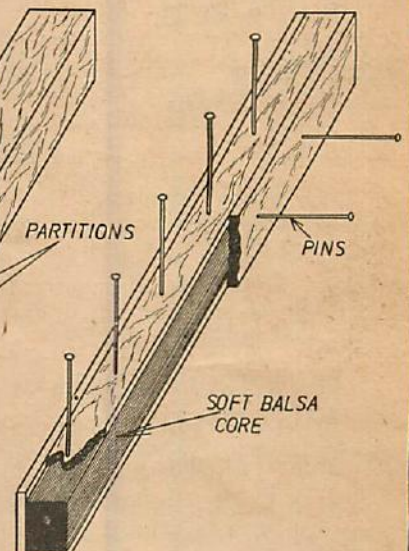


FIG. 9- A SIMPLE LIGHT STICK CAN BE MADE BY CEMENTING HARD SHEET BALSA ($\frac{1}{32}$ ") TO A SOFT BALSA CORE A 24" STICK WOULD MEASURE AT LEAST $\frac{1}{4}$ " x $\frac{3}{8}$ "



FIG. 10 VARIOUS SHEET METAL BEARINGS AND WIRE HOOKS

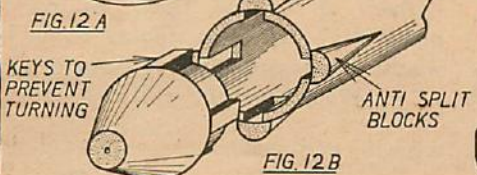


FIG. 11A

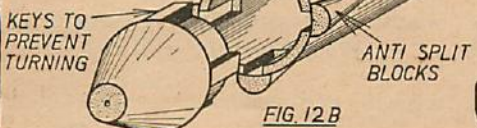


FIG. 11B

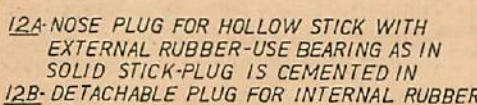


FIG. 11C

11A. HOOK AND PLUG FOR INTERNAL RUBBER- BUILD AS IN FIG. 12-

11B. PERMANENT HOOK AND PLUG FOR EXTERNAL RUBBER USED ON HOLLOW STICK

11C. WIRE HOOK YOKE USED ON TWIN PUSHERS- USE S HOOKS WITH ALL CLOSED HOOKS

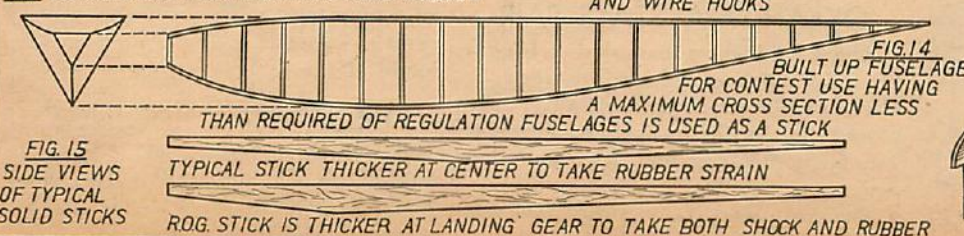


FIG. 12
SIDE VIEWS OF TYPICAL SOLID STICKS

FIG. 14 BUILT UP FUSELAGE FOR CONTEST USE HAVING A MAXIMUM CROSS SECTION LESS THAN REQUIRED OF REGULATION FUSELAGES IS USED AS A STICK
TYPICAL STICK THICKER AT CENTER TO TAKE RUBBER STRAIN
ROG. STICK IS THICKER AT LANDING GEAR TO TAKE BOTH SHOCK AND RUBBER

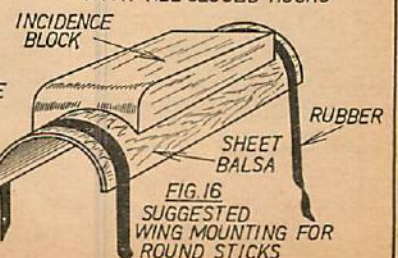


FIG. 16
SUGGESTED WING MOUNTING FOR ROUND STICKS

*Flight records
and contestants
in competitions.*

Model Matters

*Club notes and
news of model
organizations.*

(In contest tabulations, results are to be read as minutes (to left of colon), seconds, and fractions.)

JUNIOR AVIATION LEAGUE

Results of the indoor contest held Saturday, Oct. 3, by the Junior Aviation League of Boston are given below. An asterisk (*) denotes a new Boston record.

Stick H. L.

| | |
|----------------------|----------|
| 1. Capo (class C) | 12:13.4 |
| 2. Tyler (class B) | *11:53 |
| 3. Durup (class B) | *11:31.8 |
| 4. Phillips | 10:26.6 |
| 5. Pappas (class B) | 10:11.8 |
| 6. Oringer (class B) | 8:48 |

R. O. G.

| | |
|--------------------|--------|
| 1. Capo (class B) | *10:18 |
| 2. Tyler (class B) | 8:18 |
| 3. Sampson | 6:38.2 |

Glider

| | |
|-----------------------|-------|
| 1. Capo (class B) | :31.2 |
| 2. Phillips (class A) | :25.8 |
| 3. Sampson (class A) | :25.2 |

Scale Models

| | |
|------------------------|-------|
| 1. Sampson (Monocoupe) | :35.6 |
| 2. Hannon (Monocoupe) | :31.2 |
| 3. Sherman (Fairchild) | :24 |

Winners were awarded their prizes by Dick Merrill, famous Eastern Air Lines pilot and transatlantic flier.

NEWS FROM TULSA

The Model Aeronautical Engineers of Tulsa, Okla., have plans underway to hold a series of contests with ships such as those to be used in the 1937 Nationals. The contests will be about two months apart and each contest will include two events. The first contest was held Sunday, Oct. 18. Events were out-



Modelers' head man: Capt. Willis C. Brown, president of the American Academy for Model Aeronautics, shown examining a British entry at the national contest.

door stick and cabin fuselage. The next contest will be held during Christmas holidays, for the indoor field. Gas-model and Wakefield contests are scheduled for a later date. This series of contests will consist of a total of six. At the conclusion, the members who have gained the most points will be sent to the national meet with all expenses paid. Funds are already available for four trips and plans include raising additional money for four or five more free trips. If these plans work out, Tulsa should be represented by at least ten members in the national contest.

MAE members went to Oklahoma City to compete in the State Fair Contest Oct. 3 and 4. They won the first three places in the gas event and the first three in the cabin fuselage. Weather conditions—a steady 20 m.p.h. wind—hampered their operations. However, it might be added that they did very well in spite of bad weather. Following are the tabulated results of this contest.

OKLAHOMA STATE FAIR

The Cunningham Award and Chamber of Commerce Plaque awarded to Carl Huddleston, Oklahoma City. He placed 1st in the midget scale event, 1st, boat; 4th, gas; and 4th, exhibition scale.

The Army and Navy Award also was won by Huddleston.

Gas Models

| | |
|---------------------------------------|-------|
| 1. Dewitt Ross, Jr., Tulsa | 24:55 |
| 2. Roy Wriston, Tulsa | 24:31 |
| 3. Charles Stewart, Tulsa | 12:30 |
| 4. Carl Huddleston, Oklahoma City | |
| Lost from timers' sight after 12 min. | |
| 5. A. C. Nissen, Oklahoma City | |
| Lost from timers' sight after 8 min. | |
| 6. Robert C. Smith, Oklahoma City | 7:43 |
| 7. Barney Miller, Oklahoma City | 7:00 |
| 8. Bruce Luckett, Tulsa | 3:04 |
| 9. Earle Harrison, Wewoka | 3:15 |

Class C

| | |
|------------------------------------|------|
| 1. Dewitt Ross, Tulsa | 6:00 |
| 2. Vernon Sears, Tulsa | 2:18 |
| 3. Paul Strateger, Oklahoma City | 2:12 |
| 4. Paul Johnson, Tulsa | 1:38 |
| 5. Bruce Luckett, Tulsa | 1:20 |
| 6. Pete Pittsburger, Oklahoma City | 1:13 |
| 7. Victor Wilson, Oklahoma City | 1:09 |

Exhibition Scale

| | |
|-----------------------------------|--|
| 1. Gordon Slover, Oklahoma City | |
| 2. Bill Haybush, Oklahoma City | |
| 3. Victor Young, Oklahoma City | |
| 4. Carl Huddleston, Oklahoma City | |
| 5. Allan Berger, Oklahoma City | |

Flying Scale

| | |
|----------------------------------|--|
| 1. Jack Mize, Guthrie | |
| 2. Bill Clegern, Edmond | |
| 3. Nichols Odwon, Oklahoma City | |
| 4. Victor Wilson, Oklahoma City | |
| 5. Paul Strateger, Oklahoma City | |
| 6. Jim Keeshan, Oklahoma City | |

Midget Scale

| | |
|-----------------------------------|--|
| 1. Carl Huddleston, Oklahoma City | |
| 2. William Merritt, Oklahoma City | |
| 3. Andy Miller, Oklahoma City | |
| 4. Virgil Estes, Oklahoma City | |
| 5. James Hyden, Oklahoma City | |

The Southern Sales Radio Company furnished four "tranceiver" sets for the gas-model event. These small radio



This Thermal Finder, built by Harry Fosbury of Portland, Ore., has averaged 2:11 on three flights of 600 winds. Plans appeared in the March, 1936, issue of Air Trails.

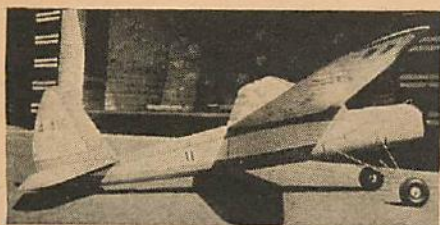
receiving and sending sets were installed in the timers' cars and in a plane, enabling the timers to be in constant contact with the plane and judges' stand. Nevertheless two planes were lost. Huddleston's plane was found four days later, fourteen miles from the take-off point. Nissen's plane had not been found at the time of writing.

BROADVIEW DOINGS

The Broadview Boys' Fall Fair is the biggest annual boys' fair in the world. A large showroom of hobbies is displayed in the Broadview Y. M. C. A.,



Dewitt Ross, Jr., of Tulsa, gas-model and Class C winner at the Oklahoma State Fair, with the model with which he won the Class D event in 14:16 at the Texas Centennial meet at Dallas.



Fine streamlining is apparent in this beautiful gas job by Harry Cornish, of Denver, Col., holder of the Senior Class C outdoor stick record.

of Toronto, Canada. In previous years, the model airplane contest was a minor part of the activities, attracting entrants from only the immediate neighborhood. This year, however, under Don Jacobs, the contest was extended to Toronto and vicinity and a full list of 90 entries were attracted. Indoor contests were held in the Toronto Fort York Armory with a ceiling of only 45-55 feet, depending on the position of the overhanging obstacles. Indoor events were run off Oct. 2 and outdoor flying Oct. 3. The



A workmanlike flying model of an old favorite, the Boeing F4B-4, by Ed Piszczek of Norwich, Conn.

flights made indoors were relatively short because of the low ceiling and the rules which required the ships to be paper-covered.

Jim Haffey, president of the Model Aircraft League of Toronto, was the outstanding contestant, winning three airplane flights, a half hour of flying instruction, and four ribbons.

Plans are already under way for next year's contest. Entrants from all parts of Canada are invited and the prize is to be made even more attractive.

Results were as follows:

INDOORS

(Junior, 14 years and under)

Semi-Scale Flying

- | | |
|---------------------------|--------|
| 1. Fred Bower, Toronto | 1:00.8 |
| 2. Howard Larkin, Toronto | :21 |

H. L. Gliders

- | |
|----------------------------------|
| 1. Charles Baker, St. Catharines |
| 2. Clyde Lockhart, Toronto |

R. O. G.

- | |
|-----------------------------|
| 1. E. Jones, Toronto |
| 2. H. Carr, Toronto |
| 3. Leslie Ferguson, Toronto |

Solid Scale

- | |
|---------------------------|
| 1. Harry Lucas, Toronto |
| 2. Jack Lingwood, Toronto |
| 3. Walter Noble, Toronto |

(Senior, 15 to 20 years)

Semi-Scale Flying

- | | |
|--------------------------|--------|
| 1. Jack Barton, Western | 1:46 |
| 2. Bob Milligan, Toronto | 1:45 |
| 3. Dow Smith, Toronto | 1:08.6 |

H. L. Stick

- | | |
|-----------------------------------|------|
| 1. Jim Haffey, Toronto | 8:02 |
| 2. John Forrester, St. Catharines | 1:47 |

R. O. G. Fuselage

- | | |
|----------------------------------|--------|
| 1. Jim Haffey, Toronto | 4:52.2 |
| 2. Charles Baker, St. Catharines | 1:05 |
| 3. Owen Corfield, Port Dalhousie | :34 |

OUTDOORS

H. L. Stick

- | | |
|--------------------------------|--------|
| 1. Jim Haffey, Toronto | 1:38.6 |
| 2. Cliff Baker, St. Catharines | 1:36.6 |
| 3. Ken Langdon, Toronto | 1:31.4 |

Wakefield (average of three flights)

- | | |
|--------------------------|------|
| 1. Jim Haffey, Toronto | 1:39 |
| 2. Ray Smith, Toronto | 1:15 |
| 3. Bob Milligan, Toronto | :53 |

Detailed Scale

- | |
|----------------------------------|
| 1. Fred Hollingsworth, Vancouver |
| 2. David Downie, Toronto |
| 3. Lloyd Rupert, Toronto |

NEW CONNECTICUT CLUB

Model Aero Engineers is the name of a new model club formed by Hartford, Conn., builders. Among the organizing members are Carl Scherer, Alfred Schmidt, George Gumbus, James Grant, Edward Brant, John Hayes, Edward Spelis, Ted Spelis, Edward Rosen, Elliot Schweiger, Melvin Thaler, Martin Riley, and Jean Card. These modelers will give instructions to the less experienced members in all model-building arts. Any person over 12 years is eligible and all who live in Hartford and vicinity are invited to get in touch with Chairman Alfred Schmidt, 29 Vernon St., Hartford, Conn.

MODEL GOSSIP

If any model-club secretaries and members—whose kind coöperation in sending along contest results and club news to us we wish to acknowledge here and now—are pained to find their reports missing from this issue of AIR TRAILS, we'd like to explain that we suffered the loss of a batch of mail here at the office, and their reports were probably in it. We'll try to make up for it

with a double portion of space next time.

Reginald Denny is an enthusiastic gas modeler. Recently he set a new open-class record of 1 h. 47 m. The flight covered ten miles and was followed by timers in a large plane. The model was a standard 6-foot Denny stock model.

Denny has a large model shop in Hollywood which sells models and supplies. He has spent much time and



John Townsley of San Francisco did such a skillful job on a 1/8-inch Martin "China Clipper," built from an Aircraft kit, that it has been acquired by the U. S. government.

money in the development of his hobby. Recently he is reported to have received a bid from a foreign government to construct a radio-controlled flying bomb.

At the recent conference in Warsaw, Poland, of the delegates of the Fédération Aéronautique Internationale, members of the N. A. A. representing this country proposed the formation of a commission to study model aeronautics. This group is known as the International Model Aircraft Commission and one of its first duties will be to consider the rules governing modeling which were adopted at the 1935 conference of the F. A. I. Mr. Alden, chairman of the N. A. A. model plane committee, has been appointed as a representative to the Model Aircraft Commission.



Clyde D. Goehring of Santa Monica, Calif., is the designer of this remarkable and consistent 8-foot gas model. It has made over 235 flights. Specifications are included in the chart on page 47.

HAWKS OF THE NORTH

(Continued from page 14)

The effect on Silver was to make him wilder, more bitter. His words dripped vitriol. His attacks became more scathing. He took small incidents and ballooned them up to monstrous proportions. And it didn't take him long to jump on the theft of the Cobbs Commander.

The morning after the incident, with the rest of the newspapers giving but brief, incomplete accounts, a full column appeared under General Murdock Silver's by line. He struck with all his fury. He made wild guesses and wilder statements. His blistering words condemned the inadequate guarding of the Commander; condemned Bill Barnes, Richard Cobbs, the navy. He cast blazing suspicion on the story Gerbano had told after he had been rescued from the ocean. He shouted for an investigation, for arrests, for action.

And day after day his column was filled with the same subject. He took the terse explanatory words of Bill Barnes, twisting them out of all proportion. And on Thursday morning, two weeks after the Commander had been stolen, he devoted his entire article to an unbridled attack on Bill Barnes, the country's premier airman.

The country's premier airman read the account. He sat at his desk in the administration building of his Long Island field, the morning paper spread open before him. He read, his eyes smoldering.

It was nine o'clock.

"Sandy" Sanders, the kid ace of the flying organization, sat across the room and stroked the sleek head of a small monkey. Alphonso's eyes were closed and he was contentedly munching a raw carrot.

"That mug!" Bill said.

Sandy looked up, startled. "Aw, Bill, Alphonso's not doing anything except get his vitamins. I have to watch his diet. He gets indigestion easier than—"

Bill shook his head impatiently without looking up. "I mean this guy Silver."

The door opened and Shorty Hass-further came inside. The squat flier's grizzled face was grim. He had a newspaper bunched in his hand.

Bill said, "You've read it?"

Shorty banged the folded paper down on the desk. "I'll say. You going to let that bird get away with it?"

The expression on Bill's face was vicious. "There's not a sentence in the whole thing that's libelous. It's his insinuations. Anyway"—his eyes locked with Shorty's—"anyway, I think I agree with a lot of things he says."

"What!"

Bill motioned to a chair. "Sit down.

We might as well have this out right here and now. Silver questions the whole set-up and particularly Gerbano's part in it. How do we know Gerbano's telling the truth? He may have planned the whole thing. His record condemns him. Why under the sun I ever allowed him to handle the testing, is beyond me."

Shorty's eyes thinned. "That puts it squarely up to me." His voice was angry. "I got Gerbano and I'll hold myself responsible for him. He's telling the truth. There was nothing for him to do but land out there. You'd do the same thing. So would I. Damn it, Bill, I don't like your attitude. And while I'm at it—let me have my say."

"This guy Cobbs—what do you know of him? Yeah, a smart designer. You throw in a fortune in dough, thinking it's a good investment. You put him on his feet. You hand out ideas that can't be bought for love or money—the Stormer's retractable landing gear, for instance. All right. You give him all that. What have you got left? Nothing! Not a damn thing! The navy's dropped the ship like a hot potato. And you're left holding the bag!"

Bill's fists clenched. He said evenly, "Take it easy, Shorty. You're worked up. So am I. We can get into a fight in a second if we don't watch ourselves. Let's talk this over—quietly. Hold your temper."

"O. K."

"You mean that you think Dick Cobbs may be linked with the theft of the machine? That perhaps he arranged the whole business, waited until the Commander was all set and then gave the signal for the snatch?"

"That's about the size of it," Shorty growled.

Bill's face was bleak. "I know Dick Cobbs. I know he's straight. I'd never have put my money back of him otherwise."

"And I know Paul Gerbano," Shorty said. "He's white. He's O. K."

Bill leaned back and ran his fingers through blond hair. He was silent for a long minute. The room grew utterly still.

Sandy looked apprehensively from Shorty to Bill. He broke the silence with a frightened, "You guys can't fight. You're pals—"

Bill's expression didn't change. He said, his words flat, "We'll get Cobbs and Gerbano out here this afternoon. We'll thrash this thing out right here in this room. And we'll stay here until we do."

"Hell, you've heard Gerbano's story a hundred times, Bill," Shorty said. "Hearing it again isn't going to do any good."

"You're afraid to have him come out?"

Shorty looked at Bill, a strange expression on his face. He said quietly, "I'll phone him right now."

He crossed the room to a telephone stand, took up the instrument, called a number. He talked quietly for several minutes.

When he finally came back to his chair, he was frowning. "Gerbano isn't there. I talked to Mrs. Gerbano. She's worried. He left the house yesterday morning and hasn't come back."

Bill's lips tightened. "So?"

Shorty flushed. "You think he's taken a run-out powder, huh?"

Bill shrugged. "Seems funny that he'd leave now—of all times."

"Gerbano's not like that. Something's wrong. Mrs. Gerbano said he's been sunk ever since the mess. Figured he'd never get work again. A week before he took the testing job he had answered an ad in the *Free Press*. Hadn't heard anything more about it. Then, yesterday a reply comes asking him to come to an address in Jersey City. He went. She doesn't know the address, hasn't the letter. That's all."

Bill nodded. "And that seems to be that."

Shorty came angrily to his feet. His voice was harsh. "All right, damn it. I'm going to fly in, right now. I'll find him. I'll bring him out here." He started for the door. "I'll be back by three o'clock this afternoon."

But Shorty wasn't back by three o'clock that afternoon, nor the afternoon after that, nor the afternoon after that—

III—THE MESSAGE

ON THE third afternoon—Saturday—at 3:30, Bill called a meeting of his pilots in his office. The carrot-topped "Red" Gleason was there; the lank Texan, Cy Hawkins; the soft-spoken Bev Bates; the youthful Sandy Sanders. There was another, a young, finely featured man—Richard Cobbs. He sat apart from the others and said nothing. But the dark eyes behind his glasses were alert.

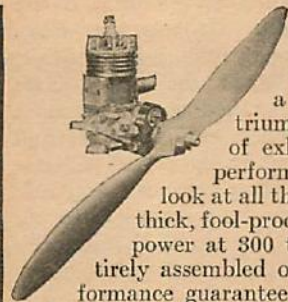
Bill was at his desk, his face wearing the stamp of fatigue and worry. He told them everything. He went slowly, methodically, from the beginning to the end—the argument with Shorty and the harsh words.

A flush crept into Cobbs' cheeks.

Bill ended up with, "I'm sorry for the things I said to Shorty. I can't tell you how sorry—now. I was unreasonable. We both lost our tempers. I'd sunk a small fortune in the Commander and— But that doesn't matter now. It's Shorty. He left in his Snorter, de-

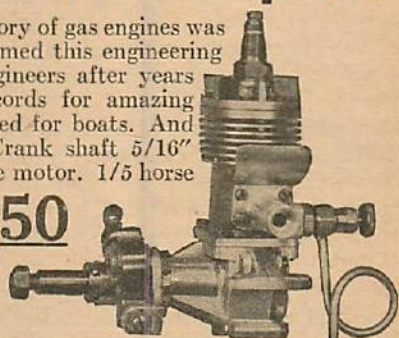
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terminated to find Gerbano. And he hasn't come back.

"I've followed his steps up to a point. He landed at a small private air field near Gerbano's house in Jersey. He talked to Mrs. Gerbano. She showed him the ad her husband had answered. It had appeared regularly in the *Free Press* up until a few weeks ago."

Bill looked down at a newspaper clipping on his desk.

PILOTS—DO YOU NEED WORK?

Experienced airmen wanted for dangerous secret mission. Highest salaries paid. Only those willing to take risk need apply. Box 2919.

He read the advertisement out loud, then said, "Shorty took this ad and went to the offices of the *Free Press* in Newark. He forced officials there to tell him the name of the advertiser. It was Abner Jones and an address in Jersey City was given. Shorty then left, apparently heading for this address. That's where the trail ends.

"I went to the address in Jersey City myself and found an empty house. There was nothing to indicate where its former occupant had gone. Late on the night Shorty was in town, his Snorter was flown away from the private field. No one saw who the pilot was.

"I hold myself to blame for Shorty's

disappearance. He was plenty mad and willing to go to any lengths to find Gerbano and prove his point. Right now I'm stumped. The kidnaping angle has brought the G-men in. Steve Drake's in charge. But nothing has developed.

"There it is. I wanted you all to know. If anything turns up, I may need your help."

And something did turn up that night when a telegram was delivered to Bill at eight o'clock. It read:

COMING ON AIR LINER
FROM BUFFALO TO-NIGHT
STOP LAND NEWARK TEN
PM STOP MEET ME THERE
STOP LIFE OR DEATH STOP
PAUL GERBANO

IV—BLACK SKIES

THE CLOCK in the radio room showed eight forty p. m. as Bill, bulky in his winter flying clothes, waited impatiently beside Tony Lamport. The radio operator was hunched forward, ear phones over his head, his right hand on a dial. He said suddenly out of the corner of his mouth, "I got 'em now. Wait a sec."

Red Gleason and Cy Hawkins came into the room and hurried over. Red said, "Lancer's set, Bill."

"O. K."

Red rubbed his jaw. "Hey, don't you figure one of us should go along? This set-up doesn't look so healthy."

"I can handle it," Bill said decisively. "Don't worry. I phoned Steve Drake in New York. He'll have his men at Newark. You guys will wait here in case anything happens. I've got time to meet the Buffalo ship in the air and fly in with her—just as a precaution. Tony's listening to her radio now."

Cy Hawkins moved his wad of gum to the other cheek. "You reckon this'll give us a lead on Shorty?"

Bill said quietly, "We can only hope so. Gerbano should know plenty—"

Tony Lamport swung around, yanking the phones from his ears. "She's riding the beam at six thousand, Bill. On schedule."

"O. K. Shouldn't be hard to pick her up. Keep tuned in and let me know any changes." He tugged on a fur-lined helmet and started for the door. "I'm leaving."

Outside, the December night was bitterly cold. A light fall of snow had powdered the expansive Barnes Field earlier and an icy northwester brought the threat of more to come. Flying particles of snow stung Bill's leathery cheeks as he swung up into the forward cockpit of the poised Silver Lancer. He banged the overhead hatch closed, re-

ceived the signal from the control building and blasted the shimmering amphibian down the lighted runway and into the air.

Dead into the wind he held the bullet nose, climbing until the altimeter read six thousand feet. He leveled off, checked instruments and charts and opened the throttles. The indirect light from the instrument panel came up to play across his face, deepening the lines of worry.

That telegram! The first break in the maddening silence since Shorty's disappearance. If Gerbano had sent that wire, the message implied that he knew something, something dangerous. About the Commander? About Shorty?

The Lancer drilled on through the Long Island skies. At intervals, to Bill's ears, came Tony's reports on the progress of the Newark-bound air liner. With Drake's G-men waiting at the New Jersey airport, and the Lancer acting as escort to the liner, every precaution seemed to have been taken. Bitter experience had taught Bill that the best armor against trouble was to anticipate and prepare for it.

Long Island was passed. Manhattan, glistening like a *lavalère* of tiny diamonds, swam away. The Newark Airport showed and was gone. Bill radioed Tony. "I'm switching on the beam receiver. Anything new?"

"She's at the same altitude, on beam."

"O. K. Now call Newark. Tell 'em I'm going to meet their ship and come in with her. Tell 'em to notify her pilots."

"Right."

Bill put the radio beam receiver into operation. A confusion of code signals rattled the ear phone. He nudged the Lancer slightly to the west until the reception cleared and he could hear only one series of *dot-dashes*—a series that meant he was now riding the beam. He eased back and looked ahead.

Far away, in that black sky, the Buffalo transport was coming, thundering down that same invisible skyway. And the Lancer, at the same altitude, was racing to meet her—two metallic birds coursing through the night, their noses aimed dead-on, though hundreds of miles intervened.

Twenty-six minutes later, the alchemy of modern science worked, and Bill saw lights—a pin prick of red; a pin prick of green. They grew larger, moved farther apart. The Buffalo liner!

Bill quickly altered his course to swing away from the oncoming transport's path. She was close now. He could see the lighted windows of her passenger cabin. He blinked his navigation lights, once, twice.

The air liner answered. Good! Her pilots had been told to expect him.

Bill's lips tightened. The wire had said Gerbano was on that ship. He would be seated at one of those win-

dows. Gerbano—the sole witness to the theft of the costly Commander. Gerbano—the man Shorty had gone seeking. Gerbano, who seemed to hold the only key to the mystery. Where had he been? What did he know?

Bill felt excitement mounting. His unaccountable distrust of Gerbano had not been lessened by Shorty's violent reaction—had rather increased since the stubby ace's disappearance. He would have to talk fast and talk straight, this Gerbano.

But the jinxed pilot, Paul Gerbano, was destined not to talk at all. And the mystery, instead of clearing, was to become deeper, blacker.

V—ABOVE

BILL brought the Lancer around, maneuvering her until she was running on a parallel course to the right of the liner. Across the four-hundred-yard chasm of black sky that separated the two ships, he could see only the cabin lights and the green and white gleams that dotted the nearer wing tip and the tail. His experienced eye filled in the gaps until he had a visual picture of the entire nine-ton monoplane.

Then—while his eyes were right on her—it happened! It was incredible, as utterly fantastic as if a page had been torn from the future and dropped into the present. There was no trace of warning.

Only four hundred yards away, Bill rode in a superfast plane, equipped with every conceivable defensive armament—and yet, he could do nothing. It came and it went in the space of three quick breaths.

From a point above and forward of the monster transport, a funnel of light knifed out. It was dime-size at its source. It radiated out until the entire wing span of the liner was bathed in its blazing redness.

The sudden luminosity struck into Bill's eyes, blinding. But through it he caught the impression of another airplane up above. The cone of light was coming from it, from beneath its tail section.

A searchlight? No! A stream of scarlet was pouring down from it—like water from a hose! Flames!

Fire—a torrent of fire spraying down. It engulfed the transport. A fiery cloud—a veritable fog of flame!

The transport was lurching, staggering.

Bill acted with instinctive rapidity. He kicked the rudder. He threw the stick. The Lancer spun on wing tip, started its wild charge across the gap that separated it from the disaster.

In that second, the stream of fire from the third plane was abruptly stopped. But not so the torrent of flames gripping the transport. She was a jagged thing of leaping scarlet, her wing and

body deckle-edged with fiery tongues. The Lancer, Diesels screaming, was across that gap, was now tearing up past the winged inferno in savage pursuit of the attacker. Bill caught a horrible glimpse through the windows of the transport's cabin. He was that close. He saw passengers milling in the aisle, fighting, banging at the heavy plate glass while fire seethed around them.

Then, the Lancer was past, her hull burnished bronze by the reflection. She pelted into the ebon heavens. And Bill, agonized that he was powerless to aid the trapped victims, searched frantically for a glimpse of that murder plane. But he saw nothing, only the blackness. The attacker was gone. And her victim?

Bill looked down. The transport was a raging inferno. She was yawing drunkenly. Somehow, her pilots were holding her in control. She was heading down—down. Bill caught the acrid smell of smoke.

He snapped on the radio, bellowed out a call to Tony. His words were a blistering torrent. He ended up, "Tell Newark. Quick! She's gone. She's heading down. She's a mass of flames. He'll never land her. She's going out of control now. Her nose has dropped. Good Lord! She's in a spin—a spin! Tell Newark! Tell Drake! I'll land. I'll do everything I can."

But there was nothing he could do when he finally landed the Lancer in a field brilliantly illuminated by the pyre of burning wreckage. He knew that no one could have come through that ordeal and escaped with his life.

And no one had.

VI—DAWN

"THEY WERE ALL burned to a crisp," Bill said four hours later as he sat in his office in the administration building. "There wasn't a hope of identifying any one."

Flame-wrapped logs snapped and hissed on iron dogs in the fireplace, sending rose-tinted warmth into the room. There was no other light. Red and Cy were there in front of the fire, and Bev and Sandy. The dancing reflection played across their tense faces.

Bill still wore his heavy flying clothes; his helmet and goggles lay on the floor where he had dropped them. He drank deeply from the cup of steaming coffee that the airport chef had prepared.

"And that's the end of Gerbano," Red said quietly. "Some one must have wanted to close his mouth awful bad."

Bill nodded, but said nothing.

No one spoke. From outside came the shrill whining of the wind and the windows rattled as driving snow bombarded the glass.

Bill had remained at the scene of the disaster until the authorities had arrived. He had told and retold his eye-witness

account to Stephen Drake, to the local police, to the air-line officials.

Then, at one o'clock in the morning, he had wearily climbed into the Lancer and headed for Long Island and home. And the elements, as if deciding that he hadn't had enough, had opened up. Snow had been falling when he had left New Jersey. By the time New York City had been passed, it had increased. He had thrown the engines wide when Tony's report had come that a blizzard was on its way down from the north and would strike at any minute. Thereon, the flight had been bad. Somehow, he had landed at his home field, with the ground lights almost obscured by the driving snow.

And now the downfall had increased tenfold. The velocity of the gale had stepped up to forty miles an hour and was going higher. The voice of the

used—I don't know. But it was devilish stuff. I tried to examine the wreckage on the ground, but I couldn't get near it. The transport was a ball of molten metal and was still burning when I left. That suggests thermite. It has a flame that can't be extinguished."

His face grew bleak. "To think I was right there, waiting for something to happen—and I couldn't do a thing when it did."

"Aw, gosh, Bill," Sandy said. "Don't be that way. What could any one have done? You aren't to blame."

Bill's gaze was centered on the spluttering logs. "No—I'm not to blame, kid—not *very* much. I just got so worked up over losing some money that I sent Shorty out to—to whatever's happened to him. I suggest that Gerbano is a double-crossing rat. Then, the guy goes to his death trying to bring me a mes-

Please. I'll follow in a few minutes. I want to—think."

His pilots left, collars upturned against the facing of the blizzard. And Bill, intending to leave for his bungalow and bed, didn't. Utter exhaustion came over him, stifling his troubled thoughts, and he slept where he sat.

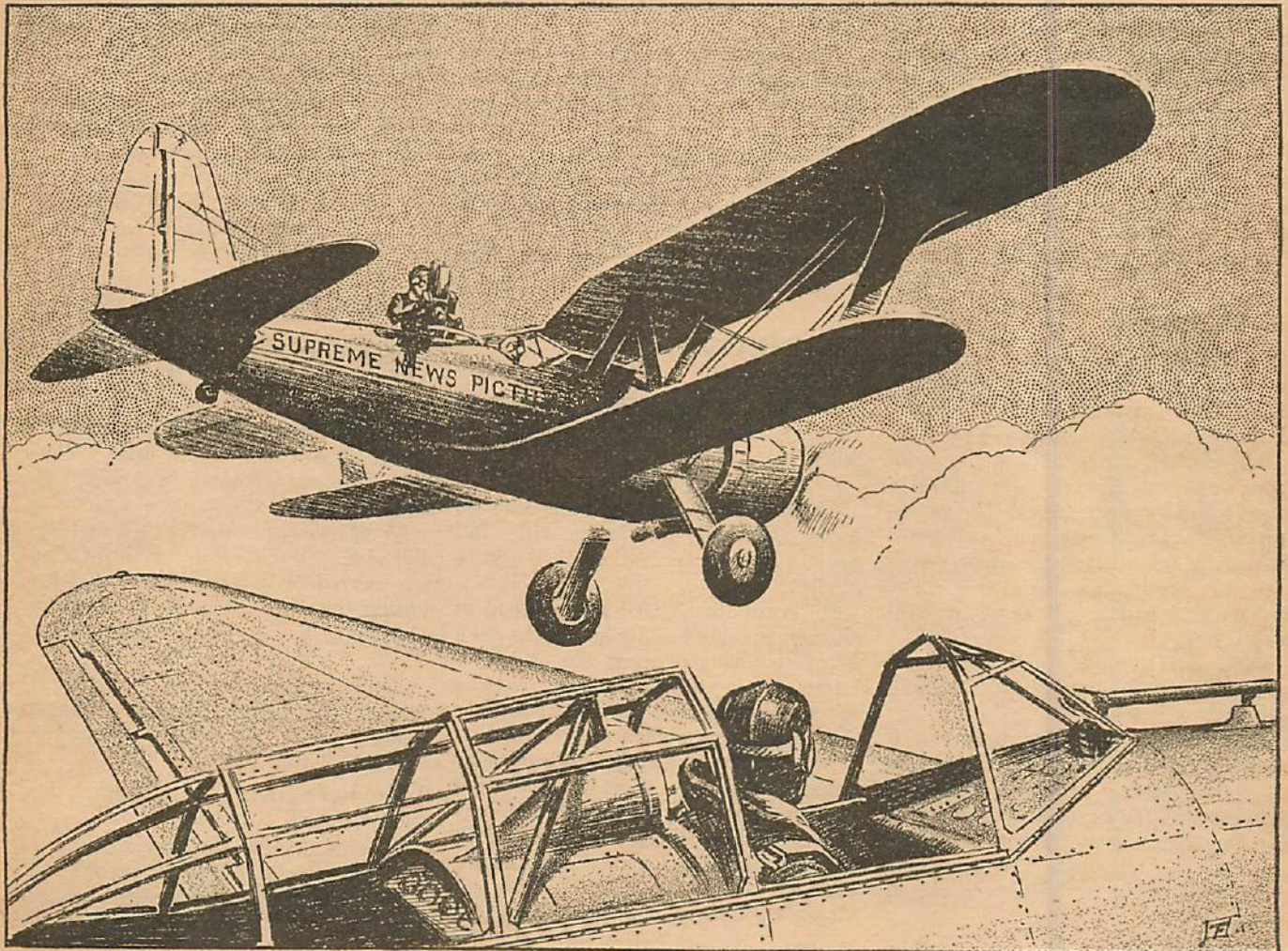
The logs became ashes. The rosy light faded. The room grew dark and cold.

IT WAS the icy cold that finally awakened him. He sat up, startled, scarcely knowing where he was. A vague light was filtering into the room from the snow-rimmed windows.

Dawn!

He shivered, got to his feet and stiffly crossed the room. He rubbed a pane of glass clear of frost and looked out upon a white world.

The blizzard had wreaked its fury and



The man was grinding a camera—and the navy didn't want pictures taken!

blizzard rose to a shrill scream. Visibility was cut down to zero.

Bill shivered and bent closer to the fire.

The silence was broken by Bev Bates. The Bostonian said, "What about this flame-throwing ship, Bill? It's a new one on me."

"On me, too." Bill shook his head grimly. "What incendiary liquid was

sage." His voice was bitter. "No, I'm not to blame, Sandy. I'm just one swell guy who always guesses right."

He drew a hand heavily across his face. "You might as well get to bed, fellows. There's nothing we can do right now. Whatever Gerbano had on his mind, we'll never know. As for Shorty —" He let the sentence trail off into silence. Then, "Go ahead, fellows.

was gone. The air lay still and bitterly cold. Snow was everywhere. The landing field, with its crisscrossing runways, lay buried under a heavy, white eider-down. The apron and roads had been obliterated. Snow lay in giant molds atop the hangars and field buildings and was piled halfway up the exposed sides.

Night was slowly giving way before the advance guard of dawn. The black-

ness of the star-sprinkled sky was gray-
ing. And the brightness of the pure-
white snow reflected and magnified the
small light so that Bill could see half-
way down the landing field.

He stood rubbing warmth back into
his hands, feeling cramped and aching
from his unnatural sleep. Then he went
closer to the window glass, his eyes in-
tent. The sky was lightening more and
more and through it he saw, or thought
he saw, a black shape far down by the
northern boundary of the field. He
cupped his hands over his eyes, pressing
against the glass. Yes, there was some-
thing, something that shouldn't have
been there. It was sticking high out of
the snow.

With a sharp intake of breath, he
realized that it was part of an airplane
—the upended fuselage of a plane. He
snatched up binoculars and hurried out-
side.

Standing knee-high in snow, he put
the binoculars hurriedly to his eyes, ad-
justed the thumb screw. The powerful
lens brought the object leaping into en-
larged, clear focus.

A crashed airplane—the nose and
wings lay buried in the snow, the
fuselage pointing skyward. Bill recog-
nized the design; saw the numeral "3"
painted on the side.

It was a Snorter—Shorty's!

VII—BURIED

THE night radio operator had come
out the door of the administration build-
ing. "Oh, it's you, Mr. Barnes," he said.
"I thought I heard some one—"

Bill whipped around. "Get the crash
crew! The ambulance!" He jabbed a
finger into the north, tossed the binocu-
lars at the bewildered man and broke
into a run. He heard the radio man's
gasp, "A crash! I'll be a—" The
slamming of a door cut short the sen-
tence.

Bill raced through the heavy snow,
past the control building into the land-
ing field.

Shorty's Snorter! How long had it
been there? The fact that the men on
night duty hadn't heard its engine or
the sound of the crash proved that the
ship must have come down during the
worst of the blizzard. The screaming
of the wind might have drowned out all
other sound.

But was Shorty in the ship? Had he
been hurt? Where had he come from?

A torrent of questions—and no an-
swers.

The alarm siren shrieked out from the
administration building, tripled in in-
tensity by the absolute quiet of the
dawn. Bill didn't look back. He ran
faster. The snow came up to his knees,
threatening to trip him at every stride.
He found himself short of breath and
tiring before half the distance had been
covered.

But the sight of that canted fuselage,
silhouetted against the lightening sky,
drove him on. There was no sign of any
human, no movement around it.

He plunged nearer. He could now see
the trailing edge of the wing protruding
from the snow. A huge drift covered the
engine, the forward section of the pon-
toon, the rest of the wing.

He reached the wreckage. The white
blanket of snow lay unmarked by hu-
man footprints. Quickly, Bill climbed
up on the broken wing, swung up on
the fuselage. The hatches above both
cockpits were open. He looked fear-
fully inside. The forward cockpit, the
rear, were empty except for the drifting
snow that was up to the seat level.

Bill dropped to the ground, his eyes
puzzled. Some one had brought that
ship in. Where had he gone—or they?

Then, five yards south of the Snorter,
his moving foot struck something solid
beneath the snow. He stumbled, almost
fell.

Kneeling down, he scooped the snow
away from the obstacle with both hands.
Before he saw it, his hands told him
that it was a human body.

He saw clothing—a flying suit. He
saw a bare hand, blue and stiff, the
fingers clenched. He swept the snow
away from the face.

He saw—not Shorty—but the dead
face of—Paul Gerbano!

VIII—THE DISK

GERBANO!

But he had been aboard the Buffalo
air liner! He had perished when it had
fallen!

Gerbano—not Shorty!

The man was dead, had been dead for
hours. His body was frozen stiff. Bill
made a hasty examination, then got to
his feet.

He heard shouts, and saw a group of
his men running heavily across the field.
From the hangars came the whine of
a tractor being revved up. The machine
appeared, dragging a snowplow, to clear
a path for the ambulance.

An ambulance wasn't necessary now
unless—unless— Bill left the dead
Gerbano where he lay and began hur-
riedly shuffling through the snow, feel-
ing with his boots for another concealed
obstacle.

Had Shorty come with Gerbano? Was
he, too, lying somewhere beneath that
white blanket?

The vanguard of Bill's men came up.
The airman stopped all questions with
a harsh, "Search the snow all around
here. There may be another—body."

But there wasn't. In an hour, snow-
plows and men with shovels had cleared
the entire area, and found nothing. Only
then was Bill satisfied that Gerbano
had come alone in the Snorter. From
where—how—why—went unanswered.

It was only after Gerbano's body had

been taken to the administration build-
ing and the authorities notified that the
small circle of frozen blood was found in
the small of his back. He had been
shot.

In Bill's office, as they awaited the
coming of the police, the airman talked
to his pilots. "I see it this way: Ger-
bano had planned to come on the air
liner. Then, realizing that his enemies
were wise to his scheme, he must have
changed his plans. The airliner was
wrecked in order to kill Gerbano. But
he wasn't on it. Somehow, he got hold
of Shorty's Snorter and probably got
shot doing it. He was weak from the
bullet wound but made it here in the
worst of the blizzard. He crashed. He
managed to get out of the ship and
start across the field. He must have
fainted from exhaustion and loss of
blood. The cold did the rest. He was
frozen to death."

Bill opened his right hand and dropped
a piece of shining silver metal on the
desk top. He said, "I found this
clutched in Gerbano's fingers."

It was an identification disk with a
metal wrist strap. Engraved on one
side of its curved surface was:

Private Timothy M. O'Connor
127th Battalion
C. E. F.

And cut into the other side was:

CORPORAL T. M. O'CONNOR
R. C. M. P.

Cy picked up the disk, examined it
and handed it to Bev and Red. "Who's
this hombre O'Connor anyway?" the
Texan asked.

"You know as much about it as I do,"
Bill said. "But it's evident that O'Con-
nor served with the Canadian forces
during the War. The C. E. F. means
Canadian Expeditionary Force. And
the R. C. M. P. stands for—"

Sandy cut in excitedly: "Golly, I
know. The Royal Canadian Mounted
Police."

"Right," Bill said.

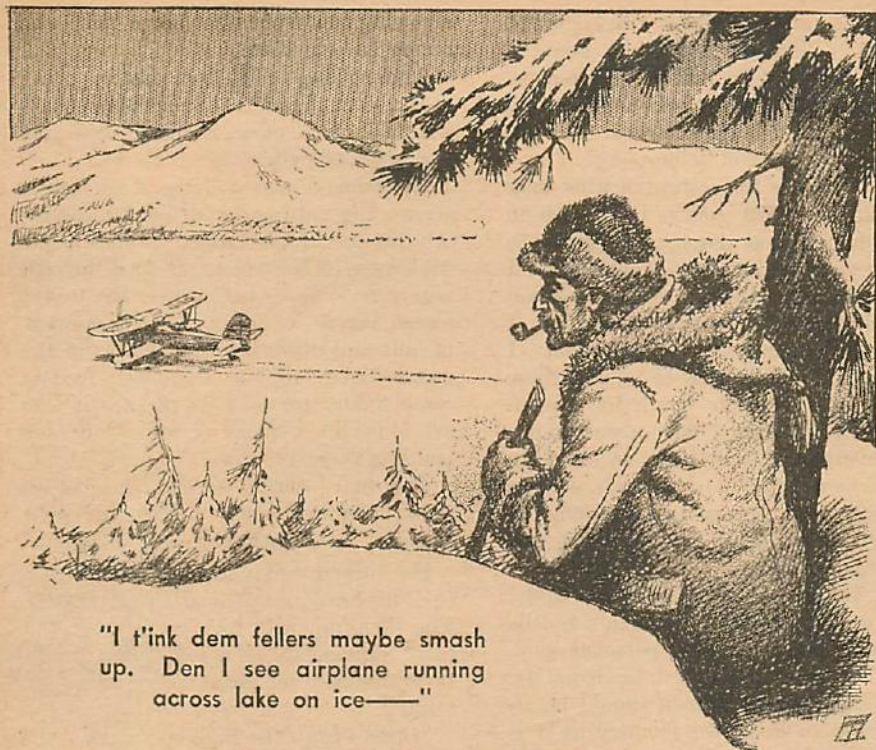
Red looked up. "The Mounties! Say,
what the hell is this all about?"

Stephen Drake, the special agent of
the Department of Justice, brought the
partial answer late that night—an an-
swer that was to send Bill far into the
Northland to unearth a strange mystery
from those frozen wastes.

IX—INFORMATION

IT WAS eleven o'clock that night
when Drake made his second visit to
the airport. He had been out earlier,
supervising the investigation into Paul
Gerbano's death, and had returned to
New York, taking the identification disk
with him.

And now, he and Bill were closeted



"I tink dem fellers maybe smash up. Den I see airplane running across lake on ice—"

in the airman's secret study with a large, detailed map of northern Canada unrolled on the desk.

Drake said, "I got the dope on O'Connor. Washington's been in touch with Ottawa. Corporal O'Connor is a member of the Royal Mounted and is now out on patrol. This is the area he covers." He retraced a penciled line on the map around the district of Keewatin, extending from the sixty-degree line north to the arctic circle.

Bill whistled. "Plenty of territory! One man's job?"

"Yes. Nobody up there much except Eskimos and Indians and a few trappers. But the law functions." Drake indicated an X on the map. "Ottawa says O'Connor should be here at this time. There's a patrol cabin there."

"Any way to communicate with him?"

"None. Been up there since the freeze-up. Won't be heard from until May or June."

"What're his means of transportation?"

"Dog team, I guess. Snowshoes—"

"In other words, he can't get out if he wants to."

"Well—no—unless he mushes way down here to Churchill on Hudson Bay. There'd be radio communication with the outside there."

"Hmmm." Bill rocked back in his chair. "Listen, Steve: It doesn't take a mind reader to see that the center of this murderous business is up there in Keewatin. Gerbano must have come from there."

"Now look—say this Mounty stumbled on something too big for him to handle alone, yet he didn't dare leave. He'd look for some way to send word to his chief, wouldn't he? All right. Suppose he contacted Gerbano. How

—I don't know. He persuaded Gerbano to fly to the outside for help. Perhaps he told him to go to Mounty headquarters and gave him his official identification disk so the big shots would be sure to listen. Instead, Gerbano came here. Why? Could it concern Shorty—his friend? It must! He used Shorty's Snorter."

Drake said, "Perhaps— Yes, perhaps you're right."

"And if I am, Shorty's up there!" Bill jabbed a finger down on the X.

Drake leaned closer and said softly, "And so?"

"And so—I'm going up to get him!"

The government agent frowned. "Wait a minute. You don't know for sure that Shorty's there just because Gerbano used his Snorter. You've already gotten in enough hot water over Gerbano. If you leave the country now, it might be interpreted the wrong way, Bill."

"What do you mean?"

"Just this: Ever since the Commander was stolen, you've received plenty of bad publicity. That transport smash and Gerbano's death aren't going to help things."

"Publicity!" Bill snorted. "You mean that tripe Silver's been dishing up?"

"Partly. And don't kid yourself that he'll overlook your part in the air-liner disaster. He'll go into that in tomorrow's paper—or I miss my guess. Silver's got a way of twisting facts to make them look black. Remember, you were right up there beside the transport when it happened. You were the only eyewitness. It's just your word."

Bill started. "You think I know more than I'm telling?"

"No. I know you're all right. But for the love of Allah, go easy. This Sil-

ver is dynamite. He influences more people than you think. And—well, the truth is, Bill, that my superiors are getting a little worried about you."

"I'll be darned," Bill said heavily.

"That's not so unreasonable as it may sound. The whole mess, starting with the theft of the Commander, has been centered around you. You're under suspicion. So is Richard Cobbs. So is everybody who's been connected with the Commander. I don't mind telling you that the department's stumped."

"Who stole that attack bomber? Who wrecked the transport? Who killed Gerbano? Who got Shorty? I don't know. You don't know. Silver's wild charges of spies and intrigue and impending aerial attacks on New York may read like fiction, but they're as good as any one's. Crazy stuff—sure. But his accusations are stirring things up at headquarters. The pressure on me has been jacked up. And not only that—the rest of the press is following Silver's example. They're howling for action."

"That's why I say, if you leave now—it'll look bad. I'm doing everything in my power to help you. Always have. Always will. But—well, go easy."

Bill's lips tightened. "Steve, you've helped me plenty—true enough. And I've done you favors. I'd hate to pull anything that'd get you in wrong. But"—he hesitated—"Shorty's my friend. I'm going to find him. And Silver and all the rest of the windbags can say all they want to. I'm heading north—pronto!"

Drake's hands gripped the arms of his chair tightly. Then he shrugged and leaned back. "All right, Bill," he said quietly. "I have the authority to hold you here. But I won't. I'm probably a fool. You can go. But remember this: If you don't solve this thing—if you don't come back—I'll be through in the Department of Justice."

Bill looked at the agent steadily. "Don't you see, Steve, I've got to go! There's no other way!"

And all that night the hangar lights burned continuously as mechanics and technicians labored at top speed to prepare the Lancer and two sleek amphibian Snorters for their long dash into subzero skies.

X—THE PAPER

RICHARD COBBS drove out to the field at eight the next morning. He found Bill in the mess hall eating breakfast with Cy, Red and Sandy.

Bill motioned him inside. "Sit down. Just a second while I finish up with Sandy here." He turned to the boy. "Either you leave that monkey here or you aren't going. He'd freeze to death up there."

Sandy scowled. "Well—O. K. But, gosh, who's going to see that Alphonso gets his vitamins while I'm gone?"

Charles, the chef, had overheard. He stuck his head out of the kitchen and said, "Leave the monk with me. I look after him."

Sandy agreed uncertainly. "But be careful, Charley. Remember, he can't eat any lemon-meringue pie. He gets indigestion awful bad."

Cobbs took a chair next to Bill. His voice was anxious when he spoke. "When're you taking off, Bill?"

"In an hour."

"I'm going with you," Cobbs stated.

"You said that over the phone last night. And I told you you weren't. I haven't changed my mind, Dick." Bill drained his cup of coffee. "I've worked out all the details. Sandy's coming with me. Red and Cy are flying their own ships. You're staying behind."

Cobbs said quietly, "Have you seen the *Free Press* this morning?"

"No." Bill's expression became bleak. "Has Silver got—"

"Yes." Cobbs took a folded newspaper from his pocket and handed it to Bill.

The pilot opened it to a full column of solid text under General Murdock Silver's name.

True to Drake's prediction, Silver had seized upon the transport crash as the focus of his attack. And without mentioning Bill by name, he cast blazing suspicion not only on his part in that affair, but also on the circumstances attending Gerbano's death.

The article had been cleverly written with an obvious strict regard for the libel laws. But it needed no superintelligence to realize that Silver was pointing the finger of guilt at Bill Barnes and, by linking the theft of the Commander with the air-liner tragedy and Gerbano's murder, he accused Bill and Richard Cobbs of selling out to a foreign power.

A flush spread over Bill's face as he read. But it was the second half of the article that drew his full attention.

When he was finished, he looked up. "He's gone stark, raving mad! He says New York is going to be attacked from the air. Listen to this, you guys!"

Bill read out loud:

"Information has reached the writer through secret channels that the appearance of the mysterious airplane and its flame-throwing work of destruction was but a foretaste of what may be visited upon New York City very soon. It is believed that there will be a sudden devastating air raid on this metropolis by a squadron of superfast bombers equipped with liquid-fire throwers.

"The raid will be carried out with cunning thoroughness. Demolition bombs will wreck our water supply; will smash all bridges, tunnels and transportation arteries. Power

plants and refineries will be wiped out. New York will be helpless. No water! No power! No escape! Fire and deadly poison gases will eddy through the canyons. Disease and plague will follow.

"There is the picture of what may happen. For years I have been hammering at our torpid officials to prepare for such an eventuality. I have been ignored. And now I am taking my very life in my hands by divulging this information. I am fully aware that to publish these facts is to invite death for myself. Yet I do. And I solemnly warn our government that this is no idle talk. It is not too late to rush defense measures. I appeal to the common people to rise up in their wrath and demand action.

"There are traitors in our midst who are working with this hostile force for their own personal gain. They must be seized immediately. No prominent airmen should be allowed to leave the country as it is reported a certain one is planning to do—"

Bill lowered the paper, his eyes glittering. "There's more—but that'll give you an idea. What'd you think of it?"

"The guy's screwy!" Sandy said indignantly.

"Or drunk," Red put in. "Of all the cockeyed stuff!"

Cobbs said, "Don't you see how I feel now, Bill? He's jumping me as well as you. And I'm the one who really got you into all this mess. I have to see it through. I have to go."

Bill shook his head. "No. What I said stands. Nothing's going to be changed because of that madman. But I wonder how Silver ever knew I was planning to leave the country?"

Cy was scowling. "That hombre's been hollerin' about air raids so long that he's finally convinced himself. Nobody's going to swallow that hokum."

But it was apparent to Bill that some one had when he was called to the telephone two minutes later and heard Steve Drake's hushed voice.

"Bill, have you read that Silver thing?"

"Yes."

"Get this and get it fast: It's reported that Silver's been shot—kidnaped!"

"What!"

"Got no details yet. But it's the worst thing that could have happened. Gives credulity to his wild story. Listen—I shouldn't do this—but within half an hour, orders may be on my desk to hold you and your men for investigation. If you're going North—go!"

Bill did. Within fifteen minutes, the two Snorters were already distant specks in the northern sky and the Lancer was

arrowing up from the home field and racing to join them.

And racing also, but faster, much faster, with the incredible speed of sound, went a radioed voice, a voice of warning—a voice of evil.

It streaked across New York State, across the international border, across Ontario and Manitoba and into the white wilderness of Keewatin. It sped through sub-zero skies, over timberlands and frozen lakes. It swooped up a rampart of hills and down into the depths of the dread Valley of the Demons. And it came finally to the ears of a man who sat alone in a room of an old mining building there.

The man listened, a microphone in his right hand held ready. Then he spoke into it. "Yes, excellency. Immediately."

He turned, snatched the ear phones from his head and pressed a push button. The door opposite him opened. A tall man, immaculate in a well-tailored military uniform of green serge came in, saluted.

"Orders from the high command," the radio man clipped out. "Gerbano got through, the swine. Barnes and three men have left, headed north. Thought to be coming into this region seeking Corporal O'Connor." The man's lips twisted. "But they'll never find him! They'll find death instead! Listen—"

XI—MEN OF MYSTERY

TIMOTHY O'CONNOR of his majesty's Royal Canadian Mounted Police lay on his bunk in his prison cell and eyed the feeble trickle of light coming through the window high in the stone wall. For twelve days he had lain prisoner in that cell, without a chance of escape. He wondered if Paul Gerbano had been able to get through to the outside for help. It was the only hope. For without help, these strange men in their green uniforms would put their fantastic plot into operation.

He had been a fool to allow himself to be captured. Yet, he had had no chance. He had put up a good fight, but the odds had been too great. And poor Pierre had done his best and had lost his life by so doing.

It had been O'Connor's first night in the patrol cabin when Pierre had staggered inside. The little trapper's scraggly beard was covered with frost and blood seeped from his lips. Quickly, O'Connor lifted him to the bunk, parted his clothes. His examination showed that Pierre was dying from gunshot wounds. The man spoke in breathless broken English.

"The Valley of the Demons, m'sieu'. Fellers shoot Pierre. He escape. His good dogs, they bring him here—The Valley of the Demons, m'sieu'. You know—"

O'Connor knew only too well that

strange valley far to the north. A place feared and shunned by the Indians as the haunt of devils. An unearthly place where a freakish Nature had cut narrow passages in the surrounding hills, causing the wind to be sucked through with increasing velocity until it raced out across the valley, a screeching gale. Its everlasting screaming could be heard for miles around, rising and falling in weird cadence. Yes, O'Connor knew it well.

And after that the corporal had to hold his ear close to the little trapper's graying lips to catch the details of the astonishing story.

It was a story of strange happenings in that strange valley. That afternoon, Pierre had been visiting his trap lines.

"I see suddenly an airplane, m'sieu'. She fall straight into valley. I tink dem fellers maybe smash up. I go to top of hill. I look down into valley. Den, I see airplane, running across ice on lake. She go right smack into dem old mining buildings at end. I curious, m'sieu'. Dem buildings been dar for ten, twelve year. No one use. I leave dogs and go down. I get close. Den I see many mans like soldats in green uniform. I see many airplane inside. I say to myself, 'By Gar, dees is strange.' I try to see more. Den some one shoot. I run uphill. Dey shoot some more. Once, twice I get bullet in my back. I fall on the sled. The good dogs run. Dem men, they come after me. I know you here. I come queek. I know I die. You my good fr'en, m'sieu'. Dem bad fellers up thar."

A sudden uproar from the dogs outside cut short the trapper's fading voice. O'Connor leaped to his feet, his hand grasping his heavy service revolver. Pierre tried to sit up. He said in anguish, "Dey track me here, m'sieu'! Dem fellers!"

The trapper had been right. And now, even as the vivid scene flared before O'Connor's brooding eyes, his hand went up to touch the bandage around his head. There had been a fight, a ferocious fight, at the cabin. One man against a dozen, for life had left Pierre even as the first shot had roared.

Desperate, spurning the shouted ultimatum to surrender, O'Connor had doggedly held off his attackers until his ammunition had been exhausted. Then, with his gun clicking empty, he had pitched forward into black unconsciousness as a bullet had slashed across his right temple.

They had brought him to the Valley of the Demons and imprisoned him down in the depths of the old deserted mine building. That had been twelve days ago—

And what of Paul Gerbano, the pilot who had blindly joined this mysterious organization, only to regret it when he had learned of its diabolical purpose? What of him? He had come secretly to

O'Connor, had told him his desperate plan to escape to the south to seek aid. And on Saturday he had made good his escape. And now this was Monday—and nothing had happened.

A sharp, tapping sound broke into O'Connor's reverie. He sat up quickly. That would be the other prisoner, the American airman, Hassfurther. He was being held in another cell somewhere on the same level. The two men had not seen each other but they had found a means of communication by way of an old steam-pipe line that passed through both cells.

O'Connor put his ear to the pipe, tapped against it with his ring. He heard a faint, muffled voice say, "They're coming after you, O'Connor. I overheard their voices."

Heavy footsteps sounded outside. O'Connor had just time to rap, "Thanks," then he leaped back to his bunk and was lying full length when the door was flung open. A powerful ray of light was played directly on him. He looked up, blinking.

Two broad-shouldered men came inside. One of them said, "Your clever plan almost worked, redcoat. Gerbano got through to Bill Barnes. But he didn't talk. He was dead. It was very crafty, my friend, giving him your identification disk. Our spy in the Department of Justice has informed us about that. If it hadn't been for your disk, we would have been saved a lot of trouble."

The man stood over O'Connor. "Now Bill Barnes and others are heading up this way. They're coming to meet you, my friend, at the cabin. And they'll meet a Corporal O'Connor. He'll be there, dressed in a scarlet tunic and yellow-striped breeches. They'll meet Corporal O'Connor all right—but it won't be you. Now strip off that uniform and give it to me!"

But they had to pommel the Mounty into half unconsciousness before the treasured trappings of his majesty's Royal Canadian Mounted Police were ripped from his body.

Fifteen minutes later, the radio operator carefully inspected a man trimly dressed in the scarlet and gold of the Royal Mounted.

"You'll do, Jansen," he said finally. "Barnes will never get wise if you keep your wits about you. You know your instructions. Use Hassfurther as bait and lead Barnes into the trap if it's the last thing you do. Now climb into your parka and stuff and get going. O'Connor's dog team is outside. Make it fast down to the cabin. Barnes can't be there much before five to-night—if then. But he might make better time."

XII—THE CABIN

BILL had made better time—much better. His chronometer showed four

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o'clock when he circled the Lancer high above the lone cabin in the sparkling field of virgin snow. And even then, he had spent forty-five minutes in intensive search before he had spotted the little log building.

"That it?" Sandy asked through the intercompt telephone.

"Must be. Only cabin we've sighted. We'll go down for a look-see, anyway."

The Lancer had long since outdistanced the two Snorters. While Red and Cy had made a brief stop at Ottawa to pick up a Mounted Police inspector, Bill and Sandy had come straight on until Churchill on Hudson Bay had been reached. There they had momentarily sat down.

Wise to the dangers the extreme arctic temperatures held for aircraft, Bill had made thorough preparations before leaving Long Island. Not only had the engines been conditioned for the cold and the undercarriages prepared for snow landings, but he had, by radio, rented heated hangar space at Churchill from the Polar Airways Co.

Upon landing at the ice-locked little seaport, Bill had quickly inspected the housing accommodations, seen that the ordered supply of fuel was at hand, and then, within the space of fifteen minutes, the Lancer had taken to the air again and resumed its northward flight.

And now—this cabin below. Was it the one they sought—the RCMP patrol post? Was Corporal O'Connor inside?

Bill guided the big amphibian down in wide circles, then straightened out. The conditioned undercarriage took to the snow surface evenly and the Lancer swept to a stop on a level stretch before the cabin.

Bill got out, jerking the heavy parka hood over his flying helmet. It was bitterly cold and his breath showed in twin jets of white from his nostrils. He shot a quick look at the sky. Daylight was beginning to fade before the early approach of the Northern night.

He said to Sandy, "Keep the mills turning and stay with her. I'll be right back."

He walked across the heavy crust of upper snow toward the cabin. When he was within ten yards of the building, a voice broke sharply through the air. "Halt! Who are you?"

Bill saw a blurred, human face at a small window and caught the gleam of a revolver barrel. He held his hands away from his body. "Corporal O'Connor?"

"Yes. Who are you?"

Bill told him.

There was a silence, then, "Keep your hands in sight. Advance."

The portal opened to reveal a man wearing a scarlet tunic and dark breeches. A gun was held steadily in his extended hand.

Bill recognized the uniform immedi-

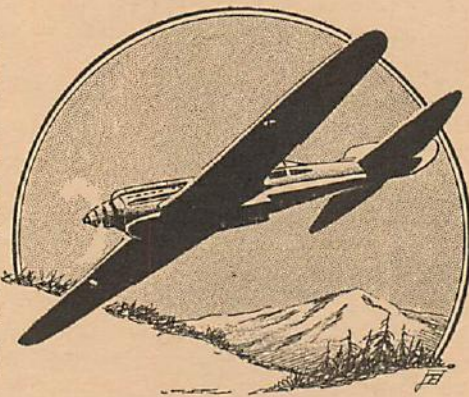
ately. He said eagerly, "It's O. K., corporal. I'm Bill Barnes, the American pilot. I've got to talk to you!"

The man in the doorway surveyed him coldly as he approached. "What's your business?"

The revolver didn't waver, and Bill read suspicion in the gaunt face and the hard eyes. A different type of man than he had expected to be in the Mounted Police. Yet his extreme caution would be only natural.

"My business concerns a man by the name of Gerbano. You know him, corporal?"

"What about him?"



The Lancer circled above virgin snow.

"He brought me your identification disk. That's why I'm here."

The man's expression didn't change. "Have it with you?"

"Yes."

There was a long silence. Bill felt the other's eyes probing into him. The redcoat's apparent distrust had to be overcome. Bill said impatiently, "Snap out of it, O'Connor. I've come to help you. I've got your identification disk in my pocket. That'll prove I'm O. K."

"Toss it here. One false move and I'll shoot."

Bill tugged off his heavy mittens, pulled the disk from an inside pocket and tossed it to the man in the doorway.

He caught it expertly with his left hand, looked at it briefly, then said, "Come inside."

But when he had entered the crudely furnished cabin, Bill found the redcoat still eyeing him suspiciously and keeping his gun in hand. It was only after Bill had laid credentials before him and told about Gerbano's death that the man put his revolver into its belted holster. But he didn't relax.

"You seem to be O. K.," he said stiffly. "Couldn't take any chances. What're you doing here?"

"Hunting for one of my pilots, Shorty Hassfurther. Is he up here? Have you seen him?" Bill's words were intense.

"Hassfurther? No— Wait a minute. A friend of Gerbano's?"

"Yes."

Slowly, as if choosing his words, the

redcoat said, "Think I know where he is. Gerbano told me. The gang's holding him prisoner."

"He's alive!" Joy and relief were intermingled in Bill's voice. "Quick! What gang? Where are they?"

The man moistened his lips, hesitated, then went on in harsh, clipped sentences. "Bunch of men up North. Have a fleet of fast airplanes. Come and go at night. Mysterious. High-powered crooks, likely. The gang Gerbano joined and then bolted. I helped him get away."

"Tell me everything, for Heaven's sake," Bill said anxiously. "Is Shorty all right—uninjured?"

The redcoat walked nervously across the room. "Have to get him out. Last chance. Help didn't come. I figured Gerbano hadn't gotten through. I've arranged to rescue your friend to-night. Most of the gang's flying south. Won't be back for hours. Only a few left at the hang-out. A couple of trappers will help me. Hassfurther knows we're coming. One of the gang's been bribed. We strike at midnight. To-morrow they're going to kill your friend. You'll come with me?"

"I'll do anything to get Shorty," Bill said. "But tell me more about this gang. Where are they? What're they doing?"

The man didn't answer Bill's questions. He went on, speaking in a monotone. "We'll go by dog team. Meet the other men. Have to strike quickly, silently." He went to the window and looked out. The steady drumming of the Lancer's idling engines could be heard. "Better get your man to run the plane out of sight under the trees. Hope the gang didn't see you fly in. Better cut her engine. Leave her there for the night."

Bill shook his head. "She'd freeze solid. Listen, corporal: Two of my ships are heading for Churchill right now, bringing a Mounted Police inspector. I'd planned to fly you there for a conference to-night and then act to-morrow with my full force."

The man looked startled. "No!" he said loudly, then moderated his voice. "That won't do. Your friend would be dead. What I've planned has to be done to-night—or not at all."

Bill was silent, his eyes thoughtful. The whole set-up was vague and this noncommittal police officer apparently wasn't going to enlighten him further. Somewhere, the missing Shorty was being held prisoner by a gang of crooks. The main objective was to secure his release. There was nothing to be done but trust in the redcoat's judgment. He must know what he was doing or he wouldn't be a member of the highly efficient Royal Mounted.

"When do you figure we'll get back with Hassfurther?"

The man seemed almost annoyed at

being questioned. "Five or six in the morning," he said tersely.

Bill made a decision. "O. K. I'll stay here and go with you to-night. I'll send Sandy back to Churchill with the Lancer. My three planes will be back here at dawn to-morrow to take us out."

The redcoat's eyes brightened. "Good!"

Bill went outside into the cold and spoke at length to Sandy. "You understand all that, kid? You and the rest get up here at dawn to-morrow. Think you can find it all right?"

"Sure— But, gosh, Bill, you shouldn't go into this thing alone. You don't know what it's all about. Why don't you wait?"

"O'Connor seems to know the set-up. I don't. Anyway, Shorty's life's in danger."

The boy frowned. "How about me staying here with you then?"

"No. You have to look after the machine. If we left the Lancer parked out in the open all night in this temperature, she'd never run again."

"We could let her engines idle all the time."

"Sure—and run out of fuel. Now get going so you'll hit Churchill before dark. You'd better radio Red and Cy as soon as you get off. Tell 'em the details."

"O. K. But I don't like it."

Bill stood back, watched the boy take the big machine gracefully into the air and vanish into the south, beyond the spruce-tree horizon. Then he hurried back to the cabin.

XIII—THE TRAIL

THE GLOOMY INTERIOR was illuminated only by the flames from the big fireplace. The redcoat had begun to prepare a meal. He said gruffly, "We'll get a snack, then leave. Have to hurry. Long way to go."

Bill stood by the fireplace warming his hands. The man's abruptness was disconcerting. If he'd only thaw out and talk things over. Yet, as the sole representative of the law, he would naturally be accustomed to making his own decisions without unnecessary discussion. The fact that he knew where Shorty was—and how to rescue him—was the main thing.

Bill watched as his companion awkwardly fixed the food and noticed that the fellow's right hand was forever in the vicinity of his service revolver.

Bill said, "This thing's got you pretty jittery, O'Connor."

The redcoat looked at him sharply, then forced a laugh. "Just habit, Barnes. In this business you can't tell when some one's going to jump you." He gestured to the rough table. "Come on. Eat."

The meal was badly cooked and utterly tasteless. Bill secretly wondered

how a man who had to rely on his own cooking day in and day out could exist on such fare. It was while they ate that Bill noticed the bullet holes in the log walls. He pointed to them. "Look fresh."

His companion sipped his tea and made no comment. Then he said finally, his eyes hard. "Indian went crazy. Came in here and tried to shoot the place up. Had to kill him."

"You did!" Bill said in surprise. "I thought you Mounties tried to avoid that sort of thing, that you took prisoners instead. The force of the law—"

Bill thought the man started. "Sometimes we got to kill them."

There was no more said on the subject. Nor on much else, although Bill tried to break down the fellow's reserve by forcing the conversation. He asked him again of the plans for the night sortie; the nature of the mysterious gang's work; their hide-out. But the redcoat remained uncommunicative and answered in gruff monosyllables.

The blackness of night had fallen and the increasing cold probed into the cabin. Bill shivered as he thought of the impending journey.

After the meal the man took a rifle from the rack by the fireplace and rubbed its barrel with an oil rag.

Bill caught the gleam of the identification disk on his wrist and, still doggedly determined to warm up his companion, said, "I saw by your disk that you served with the Canadians during the War." A sudden thought struck him and he added, "Say, you must have been mighty young."

The redcoat dropped the oil rag, then kicked it into the fire. "Yes," he said without looking up. He got to his feet, swung the rifle with telltale military precision up on his right shoulder and started for the door. "Time to get going. I'll harness the dogs."

Bill said abruptly, "Do you always carry your rifle on your right shoulder?"

The man had the door open. He looked back briefly and said, "Always have." Then he went out.

Bill sat down on a crudely made chair, his forehead wrinkled. From behind the cabin came a ferocious yapping and snarling. And, intermingled with the noise, was the sound of heavy blows falling and the shrill yelps of pain from the dogs. The man was cursing loudly.

His last remark still rang in Bill's ears. He always carried his rifle on his right shoulder. That would be natural for an ex-American soldier. But a man who had served with the Canadian forces? No. The Canadians carried the rifle on the left shoulder like the English.

It was Bill's first flare of suspicion that the redcoat wasn't what he presented himself to be. And then, in quick procession, came other doubts—the man's

nervousness; his unwillingness to talk; his constant, armed alertness; the inexperienced preparation of food; the unnatural story of the shooting of the crazed Indian; his youthfulness to be a War veteran.

The flare of suspicion now broke into open flame. Corporal O'Connor? But was he? Was he a Mounty? Or was he an impostor, masquerading in O'Connor's clothes? And this vague plan of rescuing Shorty—

Thoroughly alarmed, Bill got to his feet, his right hand going down to his revolver. He'd get the drop on this redcoat and then ask his questions.

But he didn't get the drop.

Before Bill's fingers closed on the butt of his gun, the door had inched open and a stab of crimson thunder leaped through!

The bullet ripped through the clothes on Bill's right arm, missing the flesh. But the terrific impact spun him backward. His legs hit the chair; he fell.

Half stunned, he heard running footsteps, saw the face of the redcoat hovering over him. His still-smoking rifle was upraised. It came crashing down on Bill's head.

Before he plunged into unconsciousness, the airman heard the man snarl, "That'll fix you, wise guy!"

XIV—EN ROUTE

WHEN Bill came to, he found that they had left the cabin and were under-way by dog team.

The sharpness of the icy wind cut into his face and cleared his numbed senses. He was lying half reclined on his back in a low sled. He was wearing his parka, the hood pulled over his head, and furs were piled around him. His arms had been drawn behind his back, the wrists securely lashed together by rope.

A prisoner!

Ahead, a line of harnessed dogs in single file was rapidly pulling the sled across the white ground. Bill half turned, saw the redcoat standing on the runners at the rear of the sled. He was holding to the gee bar and swaying with the motion of the sled. A whip was in one hand.

The man noticed Bill's movement. He leaned forward and said, his words wind-blown, "Keep quiet and you won't get hurt."

Bill said, "What's the idea, O'Connor?" "You know I'm not O'Connor."

Yes, Bill knew that all too well now—now that it was too late.

Bitterly he cursed his own stupidity. He had been taken completely in by the distinctive uniform of the Mounted. In his anxiety to get to Shorty, he had not only walked blindly into a trap but had dammed any hope of immediate assistance by his orders to Sandy.

"If you aren't O'Connor, who are you?" Bill asked.

"It doesn't matter."

"Where're you taking me?"

The man laughed shortly. "To the last round-up with your pal, Hassfurth. You sure fell for this monkey suit, Barnes. Now cut the talk. Try anything and I'll plug you. The chief wants you alive, but I don't think he'd lose any sleep if you weren't."

"Who's the chief?"

"Shut up!"

The man threw the lash of the whip far ahead and cracked it with the sharp report of a fired gun. The huskies increased their speed, straining at the harness. The sled raced smoothly through the dark night, the hard layer of top snow taking the metal runners without breaking through.

Bill lay back, his head aching, his bound arms sore. He tested the strength of the wrist ropes, found, with a sinking of his heart, that there was little give. His fur mittens had been pulled on but the tightness of the bonds stopped the circulation of blood and his hands were already numb from the cold.

A swell way to rescue Shorty! He'd have to escape somehow!

Escape? But how? First thing was to release his hands. He managed to get off his fur mitts. He again tested the knots and found they had been yanked tight. If he could only find a sharp edge—metal. But his exploring hands felt nothing behind him but the softness of fur. He mentally reviewed every possibility. There seemed to be no way. Then, suddenly, he realized that there was an object that might do the trick—the metal buckle on his belt.

The buckle was of strong metal construction and the prong that went through the perforations in the leather was sharp. He had scratched himself on it too often not to be sure of that.

Quietly, Bill worked his hands up under the parka until he could feel the leather belt at the back. The swaying of the sled and the piled-up fur blankets screened his movements from the man behind. Then, pulling on the belt, he worked it around his body, jerking it through the loops until he felt the cold metal of the buckle at the small of his back.

After failing a half dozen times, he finally raised the sharp prong until it was jammed against the ropes. Grimly holding it in position, he carefully moved his bound hands back and forth. Time and time again the metal prong fell back and he had to go through the whole procedure again.

He had no idea how long they had been on the trail, or how long before their mysterious destination would be reached.

The huskies' steady speed kept up, the sled streaking across the snow, through open timberland and across frozen lakes.

There was no further conversation

from the man behind. And Bill worked on, desperate now with the thought that there couldn't be much more time left. He could feel the metal prong digging into the ropes but he had no idea how much progress he was making.

The little cavalcade swung down to a frozen stream and followed its winding path, mile after mile. The tree-packed banks whipped past in monotonous review. The awful stillness of the North was over everything, only broken by the groaning and snapping of the trees under the extreme cold and the steady *eeekkkk* of the steel runners as they slid swiftly across the firm surface.

Bill's hands were numb but he worked with increasing vigor. Every thought, every atom of strength directed upon the one end—freedom.

He found his breath freezing on the fur fringes of his parka hood while his whole body radiated heat from the silent struggle. Again and again he jerked against the ropes. They stayed firm and unyielding. But no! Now there was a little play between his two wrists.

Excitement spurred him to greater effort. It was then that he heard the man behind curse loudly.

Bill looked around. His companion had drawn his rifle from the sled scabbard, and was staring to the rear. The airman followed the direction of his gaze and saw a scattering of small, moving shadows in the night-darkened snow behind.

The redcoat whirled back, bellowed a command at the dogs.

"What's up?" Bill asked.

"Wolves!"

The dogs hadn't needed the touch or sound of the whip to increase their speed. They were now straining desperately against the harness to get away from their wild brothers behind.

The moon had struggled through heavy clouds, and the wolf pack could now be plainly seen. Bill made a quick estimate of their number—fifteen, maybe twenty. They were spread out, coming on in swift silence.

Desperately he renewed his attack on his bonds. He had to win his freedom, now more than ever. He felt a rope strand give, then another and another.

The forward speed of the dog team abruptly slackened. A strange, frightened murmur came from the huskies. Bill looked up, started. Now there were wolves in front as well as behind, and the two sections of the pack were rapidly closing in on their quarry.

The driver snapped out a command to the dogs. They stopped at the edge of some heavy underbrush and sank down, whining, their bellies flat against the snow.

Rifle in hand, the man stepped away from the sled without a glance in Bill's direction. He put the gun to his shoulder, took careful aim at the animals in

front and pulled the trigger once, then again.

The double blast crashed through the silent night like a thunder clap. Bill saw one of the wolves leap high in the air, then fall with a ferocious shriek. Immediately, the others converged on the victim in a snarling, fighting mass.

The rifleman coolly pumped two more shots into the savage mêlée. With howls of terror, the forward half of the pack turned and raced away into the blackness.

Bill counted the rifle shots—four. Four out of six. In a moment his opportunity would come.

The ropes were giving more and more. Another strand snapped under the furious sawing. Then, with a herculean wrench of his arms, Bill broke the two remaining ones—and he was free!

XV—ASSAULT

FRANTICALLY Bill massaged his numbed hands to restore the circulation. There wasn't much time left. With the routing of the one section of the pack, the wolves to the rear had stopped their advance and were sitting on their haunches, watching cautiously.

The driver's back was to Bill as he swung around to level his rifle at the pack behind. In one quick glance the airman took in the situation. His eyes centered on the holstered revolver at his captor's side. And he knew then that to carry out his plan successfully he had to get that weapon.

Two more shots and the rifle would be empty. The man would have to reload. Bill waited until the blast of the next shot crashed. Five! Then, throwing back the furs, he stepped clear of the sled.

His captor had missed, but the wolves were now slinking away. Cursing, the man jerked the bolt. The next cartridge was in position—the last one.

Bill crept noiselessly across the snow. He knew every move he'd have to make. The attack would have to be timed to the split second. A smash to the man's jaw with his left hand, while his right snatched the revolver from the holster. Bill knew exactly what he would do but he forgot one thing—that the cold had almost paralyzed his fingers.

The rifle cracked again. The wolves raced for cover in howling retreat. And before the echo of that explosion had died, Bill was within two yards of his unsuspecting enemy. He crouched. His eyes never left the belted revolver.

Then, as the man lowered the rifle and reached in his belt for a fresh clip of bullets—Bill acted.

He was beside the rifleman in one soundless bound. His cocked left fist smashed into the man's exposed jaw. His right hand snatched for the butt of the revolver protruding from its holster.

His fingers closed over it. He jerked—but the gun stuck in the leather pouch.

Bill's terrific left blow had carried dynamite. His captor went down, half turning. But it wasn't a knock-out. The man yelled something in surprise. He dropped his rifle, twisted around to grapple with his assailant.

And Bill, his numbed fingers unable to tug the revolver free, was dragged down. The two men fell into the deep snow. And then it was a fight for possession of that gun—a fight to the death.

Bill saw the redcoat hovering over him. His rifle was raised.



The details of the struggle were never clear in Bill's mind. His hope of easy victory was gone. The man was fighting savagely, one hand fastened on Bill's throat, fingers digging in, the other clawing for the revolver.

The two men rolled across the snow, staggered erect, locked together. Bill felt his weak fingers losing their hold on the slippery surface of the gun butt. With a supreme effort he wrenched upward. The revolver came free of its holster.

Then it happened. How—Bill never knew. The gun was jammed between their two straining bodies. The driver grabbed for it, jerked it from Bill's grasp. There was a muffled explosion. Bill felt the recoil of the revolver.

The man gasped. His grip on Bill loosened. He staggered away. His right hand held the gun by its smoking barrel.

Horrible, bubbling sounds came from his lips. He pressed his left hand to his stomach. He reeled back, back across the snow. His legs hit the side of the sled, and he fell into it like a sack of meal.

As if a command had rung out, the huskies jumped to their feet and lunged

into action. The sled was jerked forward.

Surprise held Bill momentarily paralyzed. Then he bellowed at the dogs, ran after them. But the sound of his voice only seemed to spur them on. They raced faster. The sled swayed precariously. Then team, sled and man vanished behind a screen of jack pine.

Bill looked after them, then retraced his steps to where his former captor had thrown the rifle. It was only after he had picked up the weapon that the full realization of his predicament struck him. He was alone in this unfamiliar wilderness of ice and snow, completely lost, with an empty rifle as his only means of defense.

And then horror came—for slinking shadows had again appeared on the white snow. The wolves were back, were greedily closing in. And he had no ammunition for the gun!

XVI—THE CIRCLE

OUT of his element as he was, Bill realized that his only hope of salvation lay in building a fire. But, if he had never known terror before, he came very

close to knowing it now as he ran into the underbrush and hastily gathered an armful of dead branches. His hands shook as he stacked them and struck a match. A dried piece of cedar took the tiny flame avidly. Bill piled other wood on top. Then, with the flames licking high, he went back and brought out stack after stack of additional wood, piling it near the fire. He crouched down beside the blaze, suddenly cold.

While he had worked, the wolf pack had slunk nearer, until now he was completely surrounded by a circle of gleaming green eyes.

Shivering, he threw more wood on the fire. And then, never relaxing his vigilance, Bill mentally counted his chances of rescue. The pseudo-Mounty would never come back. He had been mortally wounded—perhaps was already dead. But the members of his mysterious gang? Would they come searching? That chance was slim. The only real hope was that the next morning Sandy or Red or Cy would fly overhead and see him. Might—

The circle of eyes mocked him and his puny hopes.

Time went on. The wolves waited. Bill kept piling on more wood. The intense cold was striking into him now so that the heat from the fire scarcely helped. But he watched the ferocious circle, and whenever one of the animals moved closer, he yanked a flaming log from the fire and hurled it into their midst. They snarled and leaped back, but always they returned nearer—a little nearer.

Gradually he felt a horrible drowsiness stealing over him. And, like a man delirious with high fever, his mind began to play tricks. He saw Shorty, heard him say, "You got me into this, Bill. Now get me out. I'm going to die."

He saw Stephen Drake, and the G-man's last words rang in his ears, "If you don't come back—I'll be through in the Department of Justice." He saw Richard Cobbs, who had been left behind, who would bear the brunt of the false accusations if he didn't return.

And the very eyes of that horrible circle bore into him and seemed to say, "You've muddled everything, Bill Barnes. You've done nothing right. Now this is the end. You haven't a chance."

He tried to fight off the sleep. He knew if he once closed his eyes—it would be the end. But, fight as he did, his drugged senses couldn't be held back. His chin sank on his chest. His eyes closed. And the wolves moved in soundlessly.

IT WAS twelve o'clock midnight when a man burst into the radio room of the mining buildings in the Valley of the Demons. He threw aside his furs, gasping for breath.

The radio operator swung around, "Find them?" he asked.

The man pulled his mittens off and held his hands over the radiating Quebec heater. "Found Barnes. No sign of Jansen and the dogs."

"What!"

"I came on ahead of the rest to tell you. They're bringing Barnes in. We struck down the trail Jansen was to follow. Couldn't find a thing until we saw a fire. Barnes was there, with a pack of wolves just about ready to make mincemeat out of him. We drove them off." He gulped for breath. "Barnes said he and Jansen had a fight. Jansen got shot, fell into the sleigh. Dogs pulled him off somewhere. Looks like curtains for him."

"Well, what the hell!" The operator shrugged. "The main thing is he trapped that damn flier— The chief flew in while you were gone. He'll want to see Barnes."

XVII—HEADQUARTERS

THE CHIEF was a tall, sparse man in a superbly cut military uniform of green serge. Gold wings were embroidered above his left breast pocket. He was faultlessly groomed, and the leather of his Sam Browne belt and his riding boots gleamed in the light. A small hood of green cloth with eye perforations covered his head.

He stood behind a broad desk in a luxuriously furnished office in the mine building. A bright flame crackled in a fireplace. In front of it was a gate-legged table supporting a tray of steam-heated dishes.

Two uniformed guards brought Bill Barnes through the open doorway, saluted their chief, then disappeared, closing the door quietly after them.

"Sit down, Barnes," the chief said, indicating the chair at the gate-legged table. "I left orders that you were to be brought here unharmed. I'm delighted to see they were carried out. But you've had a most harrowing experience—Come, I've ordered dinner for you."

Bill crossed the room. "Who are you?" he demanded.

The man shrugged. "We'll go into that later."

"Is Shorty Hassfurther here?"

"Yes. And Corporal O'Connor. They're both quite unharmed—yet. You will see them soon. But now you'd better eat before your dinner gets cold. You must be famished."

Bill was. And the sight of the food on the table made him doubly so. Without comment, he sat down at the table, took up knife and fork and fell to. He

needed all the strength and nourishment he could possibly get for whatever lay ahead. The ordeal he had just gone through had exhausted him. He fully realized his narrow escape. The wolves had been almost on him when the members of this gang had miraculously appeared. He had been taken an easy prisoner and brought north to this valley, which seemed forever swept by shrieking winds. The piercing wail came to his ears now, like the cry of a banshee.

The chief watched him as he ate the excellently prepared dinner. There was no more conversation until Bill had finished and a uniformed man had whisked away the tray. The door had closed behind him when the chief spoke.

"You wanted to know my identity? Well—look."

He ripped off the green hood. Bill saw a gaunt face, piercing, gray eyes, coal-black hair. He started from his chair, "General Murdock Silver!" he exclaimed.

Silver laughed quietly. "Delighted that you recognize me."

Bill had, from memories of news pictures. "But you were supposed to have been shot—kidnaped!"

"Merely a ruse, my friend, to get away from New York."

Quickly Bill's surprise turned to sudden anger. "You're the guy who's been writing all—"

Silver put up a hand. "No physical demonstration now, please. It would be most unhealthy. Marksmen are concealed behind these walls. Just control yourself. I have much to tell you."

Bill sat back. General Murdock Silver—the chief of this strange, green-uniformed force! Immediately a hundred questions teemed in his mind.

And Silver answered them before they were spoken. He told Bill everything, his cool voice growing into a gloating frenzy. And as he talked, his slate-gray eyes became brighter, as if hidden jets of flame had been ignited far inside them.

"You wonder about me? Why I am here—what I am doing? I had you brought to the Valley of the Demons alive so that you could hear and see what I have done. You, of all people, will appreciate it, Barnes."

"Listen: I was thrown out of the army air corps because I wouldn't fall into line with those stupid fools who were my superiors. I was convinced that our country needed an independent air force; that our coastal defenses and our cities should be protected against alien air attacks. I worked for years to try to make those idiots see. And all I got was laughter and sneers. So what did I do, eh?"

He laughed—if the harsh, grating noise that came from his lips could be called laughter.

"So what did I do? I formed an in-

dependent air force—myself! I had money—a fortune—and I spent it. I put advertisements in the papers for experienced pilots. They came in droves. I had plenty to pick from—and I picked carefully. Gradually I recruited a perfect personnel. Perfect—until that fool Gerbano— But leave that.

"I had long ago inherited the mining property up here in the Valley of the Demons. I decided to make my base here. The extreme isolation was ideal. I brought in machinery, made hangars, machine shops. Crude oil was found on the property, and I put in a refinery. I did it up right, Barnes."

"I went after the most modern war planes. I bought some, ostensibly for a foreign government, and those I couldn't buy—I stole."

Bill's eyes narrowed. "You stole the Cobbs Commander?"

Silver chuckled. "Yes. Of course I did. It is now out there in the hangar, my special plane—my flagship. I took it partly because I needed it. But I had another purpose. I took that plane so that I could strike at you and the navy and all the other stupid fools—"

"Yes, I include you in that bracket, Barnes. You symbolize aviation to the nation. You and I together could have made our citizens see the glaring need for a large air force and for defenses. But you didn't back me up—and I hated you for it. That's why I made you the object of my newspaper attacks. I knew that if I could convince our people that you—our premier airman—had sold out to a foreign power, my argument would be won. They would then listen to what I had to say."

"But my campaign didn't have the sweeping effect I had counted on. I should have known better. No one can see into the future as I can. No one realizes the awful danger in which our country stands."

His voice fell suddenly to a whisper. "I had played my cards, Barnes, and still they laughed and sneered at me. But I have one card left—my ace. And when it is played, the country, the entire world will know that I, General Murdock Silver, was right— And I am playing that card. Before dawn breaks to-morrow I will lead the forty ships of my command into the air. New York City is going to be attacked, as I warned—and I am going to do it!"

XVIII—THE PLAN

BILL STIFFENED. "But you can't do—"

"I can't, eh? You fool—listen! For months I have drilled my pilots for this. There is no possibility of error. Every word I said in my *Free Press* article was true. I've warned the country of what is coming. Will they be prepared? No!"

"The majority of my men believe that

the attack is to be just a demonstration, that dummy bombs will be used. That was the original plan. Just ten of my most trustworthy pilots, besides myself, know that every bomb will be packed with high explosives. That incendiary liquid will be in the flame throwers—that New York is to be blasted from its foundations!"

Horried, Bill stared at the man. "But innocent people will be killed. It'll be a massacre—"

"Yes, they will be slaughtered in droves. Blood will overflow the gutters. The victims will go screaming to their death, screaming for help—for help that has been denied them. The army and navy air forces will be useless. And then they will know—they will all know—that General Murdock Silver was right!"

The man was crouched forward in his chair, his hands white-knuckled as he gripped the arms. His voice was now raised almost to a shout. Bill saw the terrible intensity of his eyes and saw the leaping flame in their depth. He shuddered. For it was only then that he realized that General Murdock Silver was insane!

The man was now on his feet, wildly pacing the floor. "What are a few thousand victims compared to the millions that will die if we have no defenses when the real enemies come. Guinea pigs in the test tube of the master scientist."

"You'll be a murderer, Silver," Bill said. "You'll be hunted down and sent to the chair."

"You're wrong, my friend. No one will accuse me of murder—because no one will know that I was responsible. Only those ten pilots of mine know my true identity. Gerbano knew, knew about the attack. That's why he fled—that's why he died. But my other men don't know. That's why I wear my mask. This attack will be my last effort. My men have been paid generously. Upon the completion of our offensive, my air force will disband. Each man has been given his own plane."

"And I? I will continue in my former rôle. I will write for the newspapers. But this time they will listen to me. They will put me in high command of our national defenses and our air forces. I will be where I should be."

Bill's eyes were steady. "But I will know the truth, Silver."

"And so will your friend, Hassfurth, and Corporal O'Connor." He smiled secretly. "There will be no witnesses, Barnes. No witnesses. My squadron will leave here before dawn—in a few hours. Every man in my command will go along. This base will be deserted and will never be used again. For after the last plane has left, a detonating charge will reach a store of dynamite. These buildings will disappear in one terrific blast."

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SKYWAY MODEL AIRCRAFT SUPPLY CO.

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"I have said this base will be deserted when the explosion occurs. I correct myself. There will be three men left here—you and Hassfurth and O'Connor."

XIX—THE FLEET

AT THAT MOMENT, far down in the blackness of the first level of the old mine, Shorty Hassfurth was talking excitedly to his fellow prisoner, Corporal O'Connor, via their secret communication system.

"Bill's here! One of them just said so. They've got him prisoner. But he'll get us out! He'll stop Silver. He'll do it!"

"But how?" O'Connor asked. "How?" And as if Bill had heard the Mounty's voice, the same question hammered into his brain as he sat in the office facing General Murdock Silver. How could he rescue Shorty and O'Connor? How could he stop this madman? How? How?

It wasn't just the saving of his own life and the other two prisoners'. It went beyond that. Before dawn, the ships of this murder fleet would wing away on their awful mission. They had to be stopped. And again and again came the tormenting word—How?

Another hour passed without the frantically sought answer coming to Bill. And in that hour he was led, heavily guarded, on an inspection tour of that sinister arctic airport. He saw hangars full of planes—bombers, attack and pur-

suit ships—up-to-date war planes ready for instant action, their pilots and crews merely waiting for the word. He saw the Cobbs Commander, her sleek surfaces painted a solid green like the rest of the fleet and, emblazoned on her wings and her rudder, was the now-familiar red triangle on the square of white.

Silver said, as they stood beside the Commander, "I want to thank you for the perfection of this ship. Her super-charged engine and her oxygen equipment will enable me to fly high and fast. I will stay far above my fleet and direct them by radio. The master mind in the heavens, eh, Barnes?"

But Bill made no comment. He couldn't trust his voice. For as each minute passed, the anguish, the fear, the horror mounted within him.

Everything was in readiness for the take-off. And still the answer of how to stop this maniac and his scheme didn't come.

There seemed no way. For everywhere he went, two grim-faced guards followed, revolvers ready, eyes alert. Escape? There was no chance yet—no earthly chance.

It was two o'clock in the morning when they returned to the office. The two guards came inside and remained.

Bill said, "When do I see Shorty and O'Connor?"

"In a little while," Silver said. He gestured to a curtained window. "You will stay here and see some of the take-off, my friend, before you go below. You

will find it interesting— And now you must excuse me. There is much work to be done. I have given orders for your guards to shoot, if you're fool enough to try anything." At the door he added, "I will return shortly."

But he didn't return until three hours had passed. Three hours of living hell for Bill. Three hours in which he strove to think of some way to stop the mad plan; some way to escape—and found no answer.

He tried to talk to his guards; tried to win them by playing on their emotions, by describing the death and wanton destruction that would follow the air raid. He tried everything from outright bribery to threats of retribution. But the two men eyed him coldly and answered not at all.

He was conscious of every passing minute during that awful interval. He watched the hands of the desk clock race on. Sometime before dawn, Silver had said—sometime before dawn the fleet would leave. And there he was, sitting helplessly, having no plan, no hope, not even knowing where Shorty and O'Connor were held prisoners.

Then, on the dot of five, General Murdock Silver reappeared.

He came in rubbing his thin hands. He sat down in a chair beside Bill. "Everything is in readiness," he said. "Nothing can stop me now, Barnes. General Murdock Silver's hour of majestic triumph has almost come."

He signaled to the guards. "Pull those curtains."

One of them obeyed.

Bill found himself looking through a plate-glass window. The area in the foreground was brilliantly illuminated by floodlights. And lined up, wing tip to wing tip, glittering under the light, were three mammoth bombers.

Silver said, "The first of my ships to leave, Barnes. They will take off across the frozen surface of the lake. It makes an excellent field, my friend. The constant wind keeps it clear of snow, and I have had the ice heavily covered with gravel. This permits the use of wheel equipment instead of ski. Clever, eh? And that strong wind facilitates landing and take-off— Ah, now watch!"

Bill didn't need to be told. His eyes were already on the men who were now climbing into the bombing planes. The thunder from the accelerated engines drowned out the screaming of the wind. Silver's fleet was getting away.

Scarcely knowing it, Bill had leaped to his feet, his fists knotted. They had to be stopped.

But the sudden feeling of a cold circle at the back of his neck quickly brought him to his senses. He heard the guard growl, "Sit down!"

Silver looked annoyed. "Be sensible, Barnes. There's nothing you can do— There they go. Pretty, eh?"



The icy wind cleared his senses. He was lying bound in a moving sled.

Bill sat down. And outside, the bombing machines, one by one, raced out of the circle of light and into the darkness. The voice of the wind swallowed their thunder.

Silver was chuckling. "The first of them gone. Loaded down with General Murdock Silver's calling cards. And those pompous fools in the States laughed at me for my ideas. But they'll learn. They'll learn from the smoking ruins and the groans of the dying— Watch, Barnes. More of my planes! Look! Look!"

Bill looked. He couldn't help himself. He saw more bombers leave. Then, with scarcely a pause, triads of sleek pursuit ships were wheeled out—and then were gone. Attack bombers followed—plane after plane after plane.

Silver was leaning forward, his gaunt face pressed close to the glass of the window. The mad light was in his eyes.

Bill said, more to break the terrible strain of watching that awful procession of winged death, more to bolster up his

own faint hopes, "You'll never get through to New York, Silver. Army and navy squadrons will meet you. They'll battle your ships down. You have only forty. Your article in the paper will have warned them."

The man sneered. "My article warn them? Don't be a fool! They're still laughing at it, those wise men in Washington. Still laughing at the man who wrote it! No, they won't be prepared. New York won't have time for that when tons of bombs are crashing down. My scheme is to strike fast. Each plane is detailed to one individual objective, to dump its load—then fade away. It will be over and finished before the service planes even appear. I have planned it thus—for that is how the foreign fleets will strike in the near future."

The room door opened and a man came through. He strode over to Silver and briskly saluted. "Your flagship is ready, excellency."

Silver said, "Ah, good. I will be right out." He stood up and faced Bill. "Now I, too, must leave, my friend. I have enjoyed having you beside me to witness this great scene. My triumph is at hand, Barnes. General Murdock Silver, the madman, the radical, is on the threshold of his final victory. I am only sorry that I cannot take you with me to see the final act as the gleaming steeples of New York topple. But that is impossible."

He turned to the guards. "Directly I have taken off, escort Mr. Barnes below. Lock him in one of the cells. Then return. Be careful."

Silver was standing erect, his shoulders back, his head held high. And again Bill saw the stark madness in the gray eyes.

"And now, good-by, Barnes," Silver said. "Only fifteen or twenty planes remain to get away, so the period of waiting for death will not be long. Before the final ship leaves, taking the last of my men with it, the fuse leading to the dynamite will be set. You will die quickly and painlessly, Barnes, and with your last thoughts perhaps you will be able to vision me, riding in the Cobbs Commander, leading my fleet to great victory and vindication."

General Murdock Silver strode from the room.

XX—THE SHAFT

THE GUARDS immediately moved closer to Bill.

But the airman had no thought of attempting a break then. Already, in his mind, he had calculated that the time to strike would be when he was taken to the cells below.

And so he waited. Then, through the glass, he saw the familiar Cobbs Commander wheeled into position. He saw Silver, bulkily dressed in heavy flying

clothes, come out to the machine. The man was going alone. And just before he climbed into the cockpit he wheeled around to face the window and Bill. His right hand came up in a salute. Then he swung into the ship.

The hatch was closed, and with a blast from her engine, the Commander raced away, to be swallowed by the darkness.

Bill stared after it until the muzzle of a gun prodded the back of his neck and one of the guards said, "O. K., mister. Come on."

Bill stood up. His parka and outer clothes lay on a chair where he had long since discarded them. He was ordered into them.

"Hurry it up," one of the guards said. "I don't want to be left here when that damn charge goes off."

Bill hurried, the sound of more planes leaving spurring him on. He said, "Why the clothes? Where're you taking me?"

"Gotta go outside to reach the mine shaft. You'll be taken down by elevator to the first level—then locked up. Come on." The man took a ring of keys from a desk drawer.

As Bill started for the door he saw, with a stab of excitement, that only one of the guards was coming with him. From now on he must watch for his opportunity.

But it didn't present itself until after they had gone outside and were striking across an icy stretch of ground toward the little structure that housed the mine shaft.

THE ONLY LIGHT came from a scattering of low-powered electric lamps strung on wire overhead. Bill walked three yards ahead of his guard. They passed alongside the main building where its low, sloping roof extended almost to the ground. Then Bill, looking ahead, saw something hanging down from the edge of that low roof—something that glittered in the rays from the swaying lights. An icicle—an icicle a foot long, thick at the top and tapering to a dagger point.

A dagger!

His long-sought opportunity had come!

The surface underfoot was slippery. Bill purposely slid, recovered his balance, and then, when he was directly beside the hanging icicle, he threw up his hands wildly and fell. And as he went down, his flailing right hand grabbed the icicle and wrenched it free.

He lay where he had fallen, holding the icy weapon close to him, and waited.

But the guard was wary. He stopped a yard away and said, "Get up, damn you!"

Bill obeyed, fearful that the man had seen him obtain the icy dagger. But apparently he hadn't, for he growled, "Get moving!"

Holding the icicle hidden in the folds of his parka, Bill went on. They reached

the shaft building and, under command, Bill pushed through the door. Lights burned within.

He took the situation in at one quick glance. The building was small, simply a housing over the shaft to hold the elevator machinery. The four rods that marked the corners of the shaft extended upward to a framework at the roof, where the cable drum and mechanism were installed. And level with the floor was the elevator platform.

A man wearing thick glasses was seated outside the platform. Beside him were the operating controls. He came to his feet, startled.

The guard said, "Another prisoner, Dave. I have to go down with him. First level, where those other birds are. Now, for the love of Heaven, don't leave me there."

The man spat. "You could come up by the ladder." He jerked a grimy thumb at a series of rungs in the side of the shaft.

But Bill scarcely heard. The operator of the elevator didn't ride on the platform, but controlled its movements from above. Only the guard would accompany him below. That would be the time to strike. But, no! For even if he did overcome the guard, he'd be trapped in the elevator, at the mercy of the operator above.

Desperately then, Bill's experienced eyes fastened on the switchboard, on its pillar above the operator's head. It controlled the circuits leading to the elevator mechanism, controlled the lights in the place. He saw the two-pole switch of the main power-knife switch on the board. If something could be placed across those two poles, the entire system could be short-circuited. Complete darkness would follow. And then he might have a chance.

The icicle! The icicle would do it! If he could possibly toss it against the board so that it would land across both poles—

The guard said, "Sure, I could come up by the ladder, and by that time all the planes would have left. Make it fast, Dave. Step on that platform, you."

He gave Bill a shove with his hand. It was now or never. Bill took one step toward the platform, until the switchboard was directly in front of him. Then, taking careful aim, he swung his right hand upward and released the icicle.

It landed athwart the two poles, spanning the gap between. Instantly a spluttering arc of blue flame leaped out from the board. The circuit breaker went off with the bang of a shotgun. And the building was pitched into utter blackness.

XXI—THE LADDER

BILL acted before the flash of blue light had died. Before the two men

could have recovered from their surprise he spun on his heel. His right hand streaked in a ferocious uppercut for the guard's jaw. It landed with a crash.

The man was blasted back through the darkness. Bill heard his body smash against the wall. The airman dived after him, groping for the gun that the guard had held. He felt the weapon's cold metal, wrenched it free from the unconscious hand, then leaped to his feet.

The elevator operator had emitted a shrill cry of fright. The sound gave Bill the man's position. Then Bill was on him, the revolver held by the barrel. Savagely he whipped the gun down on the man's head. The operator slumped and fell.

Now that his opportunity had come, Bill worked with cold swiftness. He reached up for the switchboard, clearly remembering the position of the circuit-breaker handle. His fingers gripped it, threw it over. The icicle had melted in the terrific heat—and the lights came on.

Bill looked around. The two men lay where they had fallen. Blood was seeping from the elevator operator's slashed head.

Bill stood poised, listening. Had any one noticed the brief interval of darkness? Had the noise of the conflict been heard? But the only sound that reached his ears was the whining of the wind and the roar of airplane engines.

Now to get to Shorty, to O'Connor!

Using the elevator was out of the question. He'd have to go down by the ladder. He dragged the limp body of the operator onto the elevator platform, then ran back to where the guard lay. Quickly he took the ring of keys from the man's pocket, pulled his victim to the platform and laid him alongside the other.

He stepped back, released the brake handle. The platform sank from view down the shaft. Bill waited momentarily, then pulled the brake back, leaving the unconscious men marooned in the shaft. If they came to, there would be no way for them to escape, to raise an alarm.

How much time was left? How many planes had yet to take off? Bill ran to the ladder, jamming the gun in a pocket. Hastily he went down, rung after rung. There couldn't be much time! When the last plane left, the charge of dynamite would go off.

He risked a call, at first cautious, then louder, "Shorty! Shorty!"

Then, a distant voice, coming from far down the shaft, answered. "Here!"

It was Shorty! Bill shouted, "It's Bill! I'm coming!"

He scrambled down the ladder faster. He saw an opening—the first level. He swung over to it. Again he called. Two voices now answered, near at hand. The sound guided him. A single light illu-

minated the narrow passageway. Bill raced along the uneven, rocky floor until he was opposite a door. Shorty's voice was coming from within.

Bill took up the ring of keys, fitted one of them to the lock. It failed to work. So did another, and another. But with the fifth one, the bolt shot back. He wrenched the door open. A man stumbled out. Shorty!

In the dim light Bill could scarcely recognize the bearded face, the heavily clothed figure.

"Bill! I knew you'd come! I——"

Bill gripped him tightly. Then, "Where's O'Connor? Quick! We've got only minutes left!"

O'Connor's voice was coming from down the corridor. They ran to the door of his cell. Another maddening delay until the door was wrenched open and O'Connor plunged outside.

Bill cut short the two men's talk. "The whole place will be dynamited when the last plane leaves. Come on!" He started down the passage for the shaft. "We've got to get one of those planes. Our only chance."

They reached the ladder, went up it. The climb seemed endless. Then they were at the top. Bill rushed to the elevator control, threw the handle over. The mechanism purred and the platform began to ascend the shaft. At least the two men on it would now have a slim chance of escape. It was all he could do.

Bill quickly joined Shorty and O'Connor at the door. He said breathlessly, "We're the only ones who can warn New York. We've got to get a plane—get away—get to Churchill, to the Lancer's radio! Now—follow me!"

They left. They ran across the open stretch, reached the end of the main building, sprinted around it. At the corner Bill stopped abruptly. On the other side of the building was the lighted take-off area.

Two low-wing attack bombers were lined up, engines running. A third was being wheeled into position. A half dozen men were hurrying around.

Bill's gaze centered on the nearest ship. Her cockpits were still empty. He said to Shorty in a tense whisper, "Make for the nearest one! I'll pilot. You and O'Connor in the rear cockpit." He peered across at the buildings. The hangar doors were wide open and he could see inside.

"There's about ten ships still to go!" he said. "We've got to stop them. If we get away, I'll swing back. You dump the bomb load when I signal."

"O. K.," Shorty said.

Bill gripped the revolver tightly. "Now—come on!"

The three men raced around the corner. The darkness momentarily concealed them from view. Then, as they plunged into the blinding area of light, some one saw them—shouted.

Bill ran faster toward the selected plane. Two of Silver's men were beside it. They whirled around. Bill brought up his gun, fired—once, twice. His aim was deadly. The two men went down.

Others were now pouring from the building, shooting. An alarm siren sounded. Bill reached the machine, whirled, and emptied his gun in the direction of the building. O'Connor had swung into the rear cockpit. Shorty was following. Bill vaulted up on the low wing, threw himself into the front seat. His feet jammed against the rudder pedals. He released the heel brakes, jerked the throttle open.

The attack bomber leaped forward.

Bullets smashed into the ship as she moved ahead. A machine gun had opened up. Bill crouched over the controls. The plane pelted faster and faster.

They were getting away!

Out of the area of light the roaring machine streaked, down across the pebbled ice of the lake. Then Bill tugged the stick back—and the monoplane tore into the blackness above.

Escape!

XXII—THE BLAST

IT SEEMED incredible to Bill that it had happened. They had made it! The ship was zooming away from the valley. Then—he remembered the load of bombs.

He banked steeply and dived the machine back across the valley toward the mining building. Down below, men were now scrambling into the other two machines. Other ships were being rapidly hauled outside. Bill waited until he was directly overhead, then signaled to Shorty.

Shorty was watching. He threw the bomb release. The monoplane lifted as the load of shining cylindrical objects dropped from it.

Bill had the throttle wide open now to get away from the blast.

It came quickly—a series of crashing explosions! A column of scarlet shot up from the mining building.

A direct hit!

The concussion from the blasts threw the monoplane up on a wing. Bill righted her, his eyes glowing. Ten or more of Silver's planes would never join in the raid now. The madman's force had been cut to thirty or less.

Now to get to Churchill and the Lancer's radio! Now to warn New York and the nation of what was coming!

Bill looked back, regretting the annihilation of the misguided men below. But it had been unavoidable—the fate that comes to those who make war.

Then, even as his eyes were on the burning wreckage—it happened.

A flash of light came from the valley—but a thousand times more powerful

than before. A deafening crash split the heavens wide open. The mining building vanished. The very hills seemed to lift as the whole Valley of the Demons erupted.

The bombing had touched off the powerful store of dynamite—the dynamite that was to have murdered Shorty, O'Connor and Bill!

A cyclonic blast of air picked the monoplane up bodily and flung it across the sky.

Bill fought desperately for control. Flying debris streaked through the sky, peppering the whirling machine. Something smashed into the right wing. Another object landed with a terrific crash against the under side of the engine.

The smooth thunder from the engine stopped. A fiendish chattering followed. Smoke began to well back. The engine sputtered—and went dead.

Bill cut the switches.

The ship had been hit—badly damaged. They would have to land!

Despairingly, Bill jerked the staggering machine into a glide, his fingers fast on the control column.

They had escaped—they had destroyed the Valley of the Demons and Silver's base—they had wiped out ten of his planes—but at what a price! The only hope of saving New York, of saving thousands of lives, lay in getting to a radio at far-away Churchill.

And now the machine in which they rode, in which Bill had planned to race at top speed to Churchill, was hopelessly disabled.

Shorty was shouting. Bill turned around, bellowed back, "She's through. Have to land. Take her in on her belly, wheels up."

And he did, after extending the glide as far as possible toward the south. The machine was now close to the ground, swishing through the blackness of the morning. Bill saw a level stretch ahead. He nursed the machine down, until her fuselage was scraping the snow. The ship settled. Suddenly the right wing tip dug into a drift. The monoplane was wrenched around like a top. Her left wing smashed against a spruce tree and buckled. The nose dug into the snow. The fuselage arched skyward. And the attack bomber came to a shuddering stop.

XXIII—THE SEARCH

THE MORNING SKY was bright when Sandy, flying alone in the Lancer, finally located the RCMP cabin where he had left Bill the night before. It was ten a. m.

He spoke excitedly into the microphone. "Hey—Red, Cy. I found it! I'll land. You follow."

"About time," came Red's voice.

Sandy looked back and saw that the two Snorters were now winging toward

him. He closed the throttle, sent the landing gear down into position and circled.

Obedient to Bill's instructions, the boy had flown back to Churchill the night before, arriving to find the Snorters already there. He had repeated Bill's orders to Cy and Red and then had met McCall, the Royal Canadian Mounted Police inspector, who had flown up from Ottawa with Red. The following morning the three planes had left Churchill at the first crack of the late winter dawn.

Sandy put the big monoplane down smoothly on the level stretch of snow in front of the cabin. He was frowning in perplexity. Bill hadn't come out from the cabin. Was he there? Was something wrong?

Sandy jumped to the ground and quickly approached the little log building.

By the time the two Snorters had landed and Red and Cy and McCall had climbed out, Sandy was running wildly back toward them.

"Bill isn't there!" the boy gasped out. "And the Mounty's dead—lying on his sleigh—dogs still in their harness."

The group ran to the cabin. In front of it was the dog team, still harnessed to the sled. The huskies snarled as the men came up. And lying on his back in the bottom of the sled was the stiffened corpse of a man.

McCall took one look at the dead man. "This isn't O'Connor!"

Sandy started. "It is. It's the same man that met Bill yesterday afternoon."

The inspector bent over the corpse, parted his furs. The dead man was wearing the scarlet tunic of the Mounted. McCall looked over the dogs and the harness, then turned to face the pilots. "I've never seen this man before. He's not a member of the force. But this team belongs to O'Connor, judging from the name plate on the harness. The dogs apparently brought the sled back here. That would be natural—Something's wrong."

Something was decidedly wrong. Red took command. The cabin was thoroughly searched for any message that Bill might have left. But nothing was found.

Red finally called the men together. "Looks like Bill walked into a trap. He isn't here. Only thing to do is get upstairs and search the whole area. Come on."

The three machines took off.

Sandy zigzagged the Lancer across the sky at four thousand feet, his young eyes staring down at the white wilderness below. But he saw no sign of a human. Gradually he worked his way northward, swinging back and forth across miles of territory. Far to the east and west, Cy and Red were maneuvering their ships in wide circles.

And it wasn't until ten thirty that

Sandy saw the black dot away to the north. He headed for it, sending the Lancer lower and lower.

The dot broke into three separate specks.

The big amphibian roared down in a steep dive, nearer, nearer. They were men. Sandy could see that now. Three men.

He bellowed into the microphone to Red and Cy, "Sighted three men below. Going closer."

Sandy swooped the Lancer to within fifty feet of the three humans in the snow below. They were waving their arms frantically at him. The boy banked, roared back even lower.

"Looks like Bill and Shorty and some one else!" he shouted into the radio. "I'm landing."

He did, on a level stretch of snow. The three men were running wildly toward him before the Lancer had come to a stop.

"Sandy!"

It was Bill's voice. Sandy could see Bill now as he ran closer. And Shorty was with him!

XXIV—WARNING

BILL didn't waste words as he reached the Lancer. All he said was, "Sandy! Get out of that cockpit. I have to use the radio. Move!"

There was no time to talk; no time for Bill to tell of the awful hours they had spent trudging through the snow after the crash; no time to ask Sandy how he had discovered them. All that mattered was that the Lancer was here—and she had a radio!

The boy slid out of the cockpit, and in a flash Bill was in the front seat. He took a flying helmet from the locker, jammed it on his head. The wires were connected and he called desperately into the microphone. "Tony. . . . Tony. . . . Calling Tony Lampport!"

Again and again he repeated the urgent words. Then the answer came, and he heard the voice of the radio operator.

Bill gripped the microphone tightly. "Bill speaking! Get this fast! Fleet of thirty planes converging on New York! Bombing raid! General Silver in command. Must be within seven hundred miles of their objective now! Call out all army and navy squadrons. Enemy fleet attacking from northwest. No time to lose!"

Tony was getting the message. Bill could hear him relay it on to some one else in the radio room, heard him say, "Call Washington—immediately! Then Steve Drake!"

Bill spoke again. "They'll reach New York before two o'clock! Powerful fleet! Every available plane must meet them. Get Bev Bates. Tell him to get every stick of flying equipment at the field into the air! Situation desperate!"



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He signed off, whipped around in the cockpit. The two Snorters had already landed down wind from the Lancer.

Bill called the men together, clipped out orders, his voice harsh. "Cy—take McCall and O'Connor in your rear cockpit. Land them at Churchill. Then take off. Take your ship for New York as fast as she'll go. Silver's got to be stopped—Shorty, you go with Red! Head for New York! Sandy, come with me. Get in!"

The boy obeyed. The others raced to their machines. Bill saw that Sandy was settled, then, with a bellow from the Diesels, he took the Lancer screaming into the sky.

He aimed her bullet nose into the south—dead on for far-away New York—dead on for the killer fleet!

And the mad race was on!

STARK DESPAIR was on Bill's face as the machine arrowed through the winter skies. Would the army and navy squadrons have time to intercept Silver's fleet? Would they be strong enough to stop it? Would the Lancer, even with her superspeed, ever be able to catch up with the murderers?

The Lancer sped on. The two Snorters were now left far behind.

Bill watched his maps and instrument board—both above all he watched the time hands of his chronometer. Ten thirty! And eighteen hundred miles to go!

He took the throbbing machine higher and higher, tersely ordered Sandy to seal the cabin and turn on the oxygen. The terrific speed increased. An hour passed. The Lancer was over upper Ontario.

Every nerve in Bill's body was hammering, straining to increase the already-terrific speed.

The murder fleet had to be stopped before it reached New York!

Tony reported over the radio. "All air forces rushing preparations. Squadron leaving from navy carrier down coast. Everything's being done."

Twelve o'clock. And still hundreds of miles away.

Twelve thirty!

Again Tony's excited voice rang in Bill's ears. "New York preparing for raid. Martial law proclaimed. Citizens ordered to subways. Silver's fleet sighted at Pembroke, Ontario. Army planes now in the air. Navy and marine ships following!"

Would they stop that murder fleet? Would they—could they?

One o'clock!

And Tony's report, "Enemy ships sighted over upper New York State. Our planes rushing to meet them!"

One thirty!

Bill quickly estimated his position. He was over Lake Ontario now. His excitement mounted. Nearer—nearer—"Enemy fleet engaged in combat!"

Tony's voice rapped out. "Over Albany. More navy squadrons heading up there."

No word of how the battle was going! No word that Silver's planes had been stopped. Some of them would get through—some of them!

Then, at a quarter to two, a shout was wrung from Bill's dry lips. The



They came in swift silence.

sky was clear of clouds and far ahead he saw a mass of moving specks.

Planes!

Bill checked the cannon's magazine, checked his machine guns. He shouted to Sandy, "Stand by the rear gun!"

The whole sky ahead now seemed packed with weaving, circling planes.

The battle!

The furious struggle was taking place at a low altitude. Bill pushed the stick forward, reduced the throttle. His eyes were glittering. He would now have a chance—a chance to save New York.

Quickly he whipped binoculars to his eyes, focused them. The powerful lens brought the dramatic scene closer. He could see the insignia on Silver's planes and the circle and star of the service ships.

Planes were plunging out of the conflict, flaming torches. Silver's fleet was far outnumbered. The army and navy pilots were battling them to a standstill.

Bill looked beyond. Had any ships of the killer fleet managed to get through? He saw nothing as he swept his glasses across the sky. Then he tensed.

Far away, at his own altitude, was a plane. Under the power of the binoculars he recognized her design. She was heading straight down the Hudson for New York.

It was the Cobbs Commander!

General Silver!

XXV—PURSUIT

WILDLY Bill tugged the Lancer into level flight. The heel of his hand banged the throttle open.

Silver had made use of the Commander's supercharger and oxygen equipment. He had gone above the service ships' absolute ceiling. That's how he had gotten through.

Independent of his own fleet, the madman was driving toward his objective—New York!

Bill lowered the binoculars; the distant Commander became pin-point size.

The Lancer screamed on in the final lap of the awful race. And slowly, too slowly, the distant Commander increased in size.

The terrific pace kept up. Mile after mile whipped away. And Silver was still far ahead.

Bitter anguish gripped Bill. Would he catch the maniac before he could dump his load of death? Would he?

Then, in the distance, Bill saw the gleaming towers of the Empire State and the Chrysler Buildings. The island of Manhattan—and he hadn't overtaken the maniac.

The Commander was now diving toward the Hudson River, and the Lancer howled after it. Straight down the watery border of Manhattan the two planes rocketed.

The Washington Bridge was passed. They were at lower Manhattan. And Bill was closer; closer, but still far out of firing range.

The Statue of Liberty off the Battery was reached. Suddenly the Commander whirled on a wing tip and streaked back across New York harbor. She was diving precipitously, her cowed nose dead on for the massed skyscrapers of the Wall Street district.

Bill followed. His fingers were now on the trigger of the cannon. His eyes ranged down the gun sights.

Horried, he saw a mass of pear-shaped objects drop from the belly of the Commander. Bombs!

But Silver had pulled the toggles too soon. The terrible load of death smashed into the water off the Battery. A column of foam and water leaped skyward.

Bill had no time to see if any damage had been done. His gaze was on the madman in the plane dead ahead of him. Silver had come out of his dive within a hundred feet of the ground, and was tearing straight up the man-made canyon of lower Broadway.

Bill's grip tightened on the controls and he followed the same crazed route. His fingers tensed on the trigger. He was almost within range.

Then, suddenly, a column of liquid fire spewed back from the Commander's tail section. The flame thrower!

Panic engulfed the pedestrians in the street below as the fiery fog swept over them. Bill had a fleeting glimpse of people rushing for cover. Then he was within range of the madman's ship.

But, even as his fingers tightened on

the trigger, Bill hesitated. The shells that would spew from the Lancer's cannon would instantly destroy the Commander and its maniac rider. But what of the innocent citizens below when the flaming wreckage fell?

And Silver, paradoxically enough, solved the problem for Bill. For abruptly the Commander zoomed, banked dizzily and headed toward the East River.

Bill knew he had him—had him cold—this man whose crazed mind had conceived the whole murderous scheme. He had to be shot down, like the mad dog he was.

And—Bill pressed the trigger.

Shells pumped from the cannon in the Lancer's nose, pumped across the short gap that separated the two planes, and smashed into the Commander. A torrent of death!

Just before the deadly stream reached the maniac's ship, Silver looked around. Bill caught one last glimpse of the mad-

man's contorted face. Then the shells found their mark.

The Commander was torn asunder as if it had been paper. A ball of flame burst around the tangled wreckage, completely swallowed it. And then the plane, still carrying its rider, plunged for the East River.

XXVI—HOME

BILL was still circling his machine high above New York when Tony radioed. The man said, "Enemy force completely routed, Bill. Just got the report. Almost wiped out to a man. Army and navy suffered bad losses." Then he added, "One enemy ship was reported as getting through to New York."

"I got him," Bill said. He added anxiously, "Have all the fellows reported O. K.?"

"All O. K.," came Tony's laconic reply.

Later, as Bill was guiding the Lancer

back across the familiar terrain of Long Island, he heard Sandy speaking through the intercockpit system.

"Guess your worries are all over now, Bill," the boy said.

"Yes. Shorty back alive—and Silver's been stopped. Everything's worked out, peewee. And I wouldn't be surprised if the navy takes up the Cobbs Commander now. She sure showed her stuff under fire." He paused, then added, "If Dick Cobbs does get that navy contract, half my profits will go to the wife of a swell guy—Paul Gerbano."

Sandy was silent for some minutes, then Bill heard him mutter, "Gosh, I only wish mine were."

"What're you talking about, kid?"

"I wish *my* worries were over."

"What under the sun have *you* got to worry about?"

"Well, gosh, Bill," Sandy said. "I've been worried about Alphonso ever since we've been away. I hope he got his vitamins. You know, he gets indigestion awful bad."

NC711

(Continued from page 22)

Rickley yelled across the room: "What's the matter with you, Jerry?"

The chief pilot jumped out of his chair. He stood a solid six feet, had a square chin, straight-line mouth, straight nose, gray eyes, ruddy face. Straight and square in all his dealings with his pilots—that's the way he wanted to be. He remembered the bulldogging he gave Garibaldi three days ago. His lean, shadowed jaws quivered. "I was up there," he confessed, "trying to help out Old Garlic."

"Didn't he tell you to stay out of his plane?" Rickley said. "He'll get down safe if he has to. Been forced down before." He twirled the small points of his sharply waxed mustache.

Dorn looked hard at the super. It was a long time since Rickley had taken a ship off the ground. He did all his flying in a wing-clipped swivel chair. He had a big waistline now and a double chin, a mustache shaved down to a whisper. Proud of the rigid schedule he maintained. Yes, he'd done his share of pioneering. He had been one of the first in the game, flying the mail for the post office. The long, thin scar over his right eye, running from his nose to a point over his right temple, was his souvenir of a bad smash and eight hours of unconsciousness strapped in a crushed cockpit.

But there was a big difference between herding the slow old DeHavillands and the modern liners that landed hot at seventy miles. He could sit here in his comfortable office and say without a ruffle: "He'll get down safe," just like ordering ham and eggs.

But Dorn knew better. The super was just trying to appear calm. His hand was already gripping the telephone, ready to call the hangar to order a ship on the line. His nostrils were dilated.

Dorn winked broadly at Hamilton and Reeves, pilot and co-pilot of the ship due to leave in forty minutes for the north, who stepped in from the pilots' waiting room. Over their heads he glimpsed Elaine Elkins, their stewardess, fear in her enormous blue eyes and her face ghastly white.

Suddenly Garibaldi's voice froze the blood in their veins: "Port engine smoking! Seven eleven. Seven eleven. Both engines off! Seven eleven going down!"

Rickley yelled at the radio operator: "Get his position!"

"He isn't tuned in to receive!" replied the operator.

Dorn raced into the radio room. Rickley followed.

Then the position of the ill-fated plane came in: "Over Devil's Peak. . . . Garibaldi. . . . Twelve thousand feet."

With the engines silenced, and the microphone strapped close to Garibaldi's mouth, everything he said and every sound in the cockpit came clearly over the air. His instructions to Fred Hauser sounded as if he were right in the administration office.

"Fred, get back into the cabin. See that all passengers' safety belts are buckled tight. Tell them we'll land safe. Tell 'em anything."

"I'm sticking with you, Nick."

"Get the hell out of here! No use both of us being crooked in here—"

That was all.

Dorn whirled upon the superintendent. "Got the passenger list?" he demanded.

"Yeah. Just a minute." Back at his desk Rickley furiously jiggled the telephone. "Get me the hangar chief. . . . Esparto? Get a ship on the line! Number thirty-one. On the line! Garibaldi is down. Toss in some stretchers, blankets. We're shoving right off!"

"We'd better take Doc Sandbourne along," Dorn suggested.

"He's coming right over. Now, here's the passenger list. There are eight—five men, three women. Then there's Garibaldi, Hauser, and Gallway, the stewardess. That makes eleven. If you can get down to them there'll be plenty of room for all in thirty-one."

"You're not coming?"

"You think I'm going to sit here twiddling my thumbs?" Rickley answered. "Sure, I'm with you!"

"O. K." Fitzgerald Dorn grabbed up his helmet, goggles, gloves, fur-lined leather coat in one sweep as he rushed outside. The big passenger liner, of the same model as the seven eleven, was on the line, her two three-bladed props just starting to turn over. He got aboard and stepped up front where Esparto himself was nursing along the two engines, warming them up.

"It happened where?" Esparto asked.

"Over the Hump."

The rotund mechanic whistled. "You know, Nick says to me before he shoves off: 'I feel funny. There's a bug in this crate some place. You couldn't find it if you looked for a million years. But it's here.' Well, I stops the engines and goes through them again. Not a thing wrong. But he knows. He was a great guy."

"He is a great guy!" Dorn savagely corrected. "He told me a long time ago he had a hunch some day he'd be forced

down on the Hump and he had a spot all picked out to get into. Plenty of room there to land safe. And his hunches are something."

"You said it," Esparto nodded, his face tragic. "Tough that you can't ride with him, so I guess you won't be bringing him back in thirty-one."

"Come on, blast the engines open!" shouted Dorn. This talk about Old Garlic being gone gave him the jitters. Then he was on the ground again, talking to Doc Sandbourne.

"I'm confident," Sandbourne said, "that with Old Garlic at the controls they're all safe. He's a competent pilot."

"I see you're prepared," Dorn nodded toward the two heavy medical kits and bags of supplies. That was the difference, he told himself, between men of Esparto's breed and the surgeon. One lived closer to the ground and said what he thought and felt, while men of Sandbourne's type used more subtle expression.

"In case they're down in a spot where we won't be able to land," Sandbourne added, "I've prepared these bags for dropping."

Dorn helped the surgeon carry the medical supplies to the plane. Everything was stowed aboard. Rickley came on the line bundled to his ears in flying clothes. He and Dorn went up front to the pit, while Doc Sandbourne settled down in one of the cabin chairs.

"She's ready," Esparto said to Dorn. "Everything checked. Good luck." He ran down the cabin aisle, jumped to the ground and closed the cabin door.

Dorn climbed fast to hurdle the Livermore hills. Presently he was over the flat Sacramento valley, with his narrowed eyes on the distant horizon. The foothills were purple. Above them, in a gradual rise, the towering, snow-covered peaks of the High Sierra stabbed the clear March sky like polished lance heads.

"We're halfway there!" Dorn shouted to Rickley, who occupied the co-pilot's chair. He pointed to the clock on the instrument board. It was one fifteen.

The big liner passed over the snow line. Dorn climbed steadily. It was cold at nine thousand feet—zero on the thermometer. Straight for Devil's Peak he held his course.

He saw Rickley was beginning to search below. The super sat with his face pressed against the cold cockpit window. Dorn looked down. The country was rugged and formidable: huge granite knobs sticking up, deep canyons, treacherous gorges, precipitous sides with sheer drops of more than two thousand feet, not a spot around flat enough for a picnic. Here a forced landing meant destruction to the airplane and almost certain death for crew and passengers.

Dorn shrugged off the creeping sense of disaster. He knew that queer things

happen in the flying game. Sometimes a pilot got a break.

He switched on his radiophone for sending, called for the station and said: "Over Devil's Peak at ten thousand. Don't see anything yet. Will drop to eight thousand and make a big circle. Call you later."

To Rickley he said, "Keep your eyes peeled through the windows. Old Garlic is around here some place."

Dorn squinted hard to bring out sharper details at long distance. Even seventy-four feet of wing spread isn't easy to pick out in the snow. And it might have vanished completely in a nose dive into a huge snowdrift.

Then he heard Rickley shout. The super's tight fingers clutched his arm. For a moment Dorn forgot himself. As he followed the pointing finger he stood up. His chest struck against the control wheel. The plane nosed over sharply. Down they plunged, until they were almost over the two madly jumping figures. On the fuselage the upside-down black letters "CAL," with the red arrow shot through, stood out plainly.

"They're all alive!" Rickley shouted.

Dorn's voice rang through the air to the airline office: "We've found them! They've landed on the shoulder of a mountain south of Devil's Peak. The plane's over on its back. Garibaldi and Hauser waving. Will shoot a landing."

The cockpit door opened and Sandbourne leaned in. "You can't get in there" he said. "Better tell the boys to have rescue parties sent by dog sled from Summit. I'll drop the supplies."

"I think I can make it," replied Dorn. "You'll crash!"

Rickley said: "He can make it, doc. Jerry flies as if wings were fastened to his shoulders."

Sandbourne glared. He said to Dorn: "Well, you're the chief pilot. You know what a crack-up down there will mean to all of us. Think it over first."

Dorn passed low over that snowy shoulder and carefully looked it over. There lay the NC711 like a mountain eagle whose heart had stopped in full flight. The great wings were thrust outward above the snow, and the two black rubber wheels stuck up like folded talons. On the right, the mountain sloped sharply far down to meet the canyon floor. On the left, it rose like a shaft to meet the sky.

In his mind he reconstructed the disaster that had overtaken the NC711. Old Garlic had seen that he was going to overshoot and there was the precipice at the other end—a good twenty-five hundred feet to the bottom of the canyon. That would have meant death to all. So he had slammed the brake on one wheel for a vicious ground loop and the plane had flipped over on its back. The margin by which he had averted the horrible plunge into the abyss was small,

indeed, for the nose of the craft and the two heavy engines extended over the rim.

The closer view of the two figures threw an uneasy doubt into his mind. They didn't look like Garibaldi and Hauser. Old Garlic was short and stout, while Fred was tall and slender. These two appeared to be about the same size, and they were wrapped, like Indians, in blankets. Then, the sound of a rescue plane naturally would have brought the others outside. But only these two came out. Were they the only ones able to stand on their feet? Were the others too badly injured to move? He said nothing to Rickley about these thoughts.

The thing to do, Dorn decided swiftly, was to squash down to the rough, hard-packed snow. He must land. In the storm due to-night they would all perish before rescue parties could reach the place. He must get them out. He motioned the super to buckle his safety belt tight.

"Take it easy," said Rickley. "Nurse her in. Nick had a heavier load and he had to come in faster, so he overshot."

Dorn roared around the peak, then throttled the engines. The wheels crunched through the snow. Only once the heavy craft bounced, came down tail first and lashed halfway around in the crosswind skid to a stop about fifty yards back of seven eleven.

Dorn cut the switches. With the back of his glove he wiped the moisture from his forehead. The cold beads still dripped down his armpits. Then he peered overside at the two men who came up running. His fears were confirmed. They weren't Old Garlic and Hauser. They were two of the passengers. He felt something inside of him go *thump*.

Rickley stood up so abruptly that his head rammed against the cockpit glass. "Why," he said, "they aren't our boys. Something's haywire. Come on!"

Sandbourne was already on the ground. The surgeon had his medical kit in hand.

One of the passengers said: "I guess we're all alive, that's about all I can say." The left side of his face was bruised and swollen, and he limped.

"Both of you get in this plane," Sandbourne said. "I'll look you over later."

The three went ahead. Dorn peeled off his gloves. It wasn't uncomfortable at this level. They saw the door of the plane swing open. Another man stepped out. Then shouts reached them.

"Sounds like Hauser," Rickley said.

Now the words came clearly. Shriill words: "Everybody please fasten safety belts. Pull them tight. We are forced to land. You, over there—stay in your chair. Good gosh, we're going over!"

They entered the upside-down plane. It was a queer sight, with all the chairs

hanging from metal sockets. Hauser was standing in the center of the ceiling, raving—out of his mind. The others were huddled silently in blankets.

Fred was completely out on his feet. The right side of his face was gashed open, and the right eyebrow was torn and hanging over his right eye. Dorn held him while Sandbourne shot in a hypo to quiet him. They carried the co-pilot to the rescue plane, where the surgeon finished the emergency bandage. The opiate had done its work and Hauser was asleep.

Then Rickley said: "I don't see Old Garlic around. I've a hunch he's—" He stopped suddenly at the trailing edge of the wing.

Dorn peered ahead. He saw red streaks along the inverted cockpit. The sight kicked the props from under him. The thing he had feared all along.

"I'll take a look," Rickley finished. The super was gone only a second. When he came out again it was plain that he was shaken by what he had seen. "He's gone," he whispered. "I've told Sandbourne. Told doc to look the crowd over as fast as he can. We better go in and help him."

Sandbourne was beginning his work when one of the women said: "Better attend to the stewardess first, doctor. I think she's badly hurt."

"I can wait," said Myrtle Gallway, the stewardess. She sat tight-lipped against the bulkhead.

Sandbourne found both her forearms fractured. "You darned little fool," he muttered, "why didn't you tell me at once?" Gently, he put the arms in emergency splints. Dorn and Rickley carried her out.

They returned with a large thermos bottle of hot tea. Rickley served the tea in corrugated paper cups. Dorn helped the doctor.

"Mostly minor bruises and shock," Sandbourne finally told Dorn. "It is fortunate that all the passengers were strapped tight in their chairs at the time. Hauser and Gallway certainly did their jobs well."

When all passengers had been transferred and made ready for the dangerous take-off from the shoulder of the mountain, Dorn started back to the wreck. There was one mission, he felt, he must perform himself—one that he was not to forget as long as he lived.

He entered the now empty tunnel-like fuselage and proceeded forward. He tried the small cockpit door. It was tight. With a quick wrench he flung it open.

Dorn was, in a way, prepared for what he was to see, because Rickley had told him what was there. Yet he felt something crawl up the back of his neck and up over his scalp.

Old Garlic was still strapped up to his chair, and he was hanging down. Only,

his head was jammed up against the wheel so that it was held higher than the rest of his body. Apparently he had curled himself into a ball around the wheel when the plane turned over.

Dorn stepped across the bulkhead partition. His mission was to bring out the body of his friend. He reached up and unsnapped the safety-belt buckle.

Then he stood rigid, as if his feet had frozen to the floor.

As Old Garlic's heavy body dropped, the plane commenced to teeter. It was then that Dorn realized the desperate plight he was in. The craft was hanging on the very edge of the precipice. The heaviest section, the long nose and two engines, was over the edge. Before, there had been ten persons—the eight passengers and Hauser and Gallway. That had been the bulk of the weight. While in that position the craft had become slightly frozen to the snow and held there fast. But the force of the blow as Old Garlic dropped had jarred the craft loose.

With supreme effort, Dorn lunged for the doorway. His foot caught and his shoulder struck the partition wall. The blow spun him halfway about. He felt a little sick at his stomach.

The little door started to close.

He must get out! There was nobody to fly the other plane. Hauser was too badly hurt. Rickley hadn't piloted in



years. The storm due to-night from the northwest would freeze them all to death. It would sweep the transport off the precipitous slope to destruction. All this came into his mind in the space of a single heartbeat.

He lashed out with his fist and smacked the door open.

The trapped flier thrust one leg back across the partition. He could feel the tail of the perilously balanced craft begin to settle back to solid earth. He wanted to shout for sheer relief at his miraculous escape from that plunge to eternity.

Instead, Dorn heard a hoarse shout. It came from the outside. He paused to listen.

In that fraction of a second the rudder post struck and—bounced up again!

The momentum of the rising craft remained unchecked. Higher it rose. And he himself slid back a little.

Again he heard the frantic warning, Rickley's excited voice: "Jerry! Come out of there! Hurry up! She's slipping over!"

Higher tilted the transport. There was a sickening jar as it inched down.

The sudden move threw Dorn farther back. He bent over double as his long fingers clawed for the jamb. The little cockpit door swung shut. The warning cry outside sounded fainter. His throat tightened.

A ghastly moment of inaction followed.

Then it seemed that the bottom of the world dropped away from under Dorn. He was falling. He found himself pitched against the instrument board, sitting breathless on the cockpit glass covering. Why, here was Old Garlic, his head lolling on his shoulder!

Riding together! And Old Garlic warned him never to step into his plane. Dorn laughed wildly. What the hell was he going to do about it now? Get out and walk?

"Boy," he shouted, "and what a ride!" He socked his flying mate. Meant to strike the shoulder. Hit Garibaldi's face, instead. Then he stared. Suddenly he slapped Old Garlic again, harder this time. He'd have sworn he saw the eyelids move. He grabbed the shoulders with both hands and shook savagely. The eyes popped open.

"Nick!" cried Dorn. "You're not dead! Say something!"

He saw the lips barely move, but couldn't make out the words. The NC711 was gathering speed. The air stream howled through the side window. Dust swirled around from the floor boards, choked him. Straight down in a nose dive. He felt himself forced up into the narrow aisle between the pilot's and co-pilot's chairs. His grip on Garibaldi tightened.

Before Dorn's eyes danced an array of queer gadgets. Instruments. He found himself facing the instrument panel. Force of habit riveted his eyes first to the air-speed indicator. The needle was flickering around one hundred and ten miles an hour. His dazed brain was able to register one vital thing—

Flying speed!

He wasn't falling any longer; he was flying. But he was flying straight down—diving to destruction!

Dorn forced himself up behind the wheel. He stood on the rudder pedals. There was air pressure. Then he tried the wheel. Pressure there, too. The tail-control surfaces weren't totally dis-

abled. That single thought swept his mind clear of fear. He was in his own element—flying. He was flying the old bus. And Old Garlic with him. Their last ride together. All his old skill rallied to him.

One hundred and thirty miles an hour air speed.

Dorn was cool now. His nerves were steady. He was standing on the pedals, shoulder to the wheel. Over the nose his eyes measured the distance to the bottom of the canyon. About a thousand feet. Another five hundred to build up more speed, to glide farther.

One hundred forty.

Over to the right the curving slope of the great mountain flattened out. He saw something moving down below there—something black. Dogs—dog team. There was a man behind the sled.

One hundred sixty-five.

Dorn heaved back on the wheel. Up into the sky soared the NC711. But it headed for the opposite canyon wall. The echo of beating air was deafening. Swiftly, he banked to the right. The wing tip seemed to graze projecting bare rocks.

Below him now was the mountain slope. He skimmed the sugar pine tops. There was the man with the dog sled waiting in the open space. He'd get close to him. Gradually the speed slackened. He held off as long as he could. The speed died quickly. He kicked into a skid up the slope. The craft plopped down safe in the snow.

Instantly Dorn twisted out of his seat. The only thought in his mind was Old Garlic. He kicked open the cockpit door and pulled the limp figure into a comfortable chair. His ear, pressed close to the chest, heard heartbeats. Still alive! He remembered the man with the sled. An emergency drink would help to revive and keep the wounded pilot

warm until they reached Doc Sandbourne in the other plane.

Outside there was a shout.

Dorn stepped into the snow.

The man was a forest ranger, one of the few he knew remained in that desolate country throughout the year. He said, "Hello!"

"I saw this plane slip off the cliff," the ranger replied. "Didn't know anybody was aboard until it turned this way. Heard the calls on my short-wave set when it first got into trouble and I saw it go down. You two certainly pack lucky horseshoes, especially your friend."

Dorn whirled about. The ranger had nodded to somebody in back of him. He expected to see Old Garlic standing in the cabin doorway; but for a moment he stared speechless.

"Rickley!" he cried. "How the devil did you get here?"

"Flew down." The super grinned. He was leaning against the fuselage.

"Yeah! I suppose you'll say next you took one long hop-down here on skis!"

The ranger said: "He's telling the truth. I had a time prying him loose from the tail part."

"I thought my weight would pull the tail down—up there—so I jumped on," Rickley explained. "Lucky thing I was able to hook my arms over the stabilizer or I'd have been tossed off. I've had lots of wild rides in my day, but believe me, fella, this one stops 'em all. And when I present you with a medal you're going to get kissed on both cheeks!"

"And you'll get smacked on the kisser!" retorted Dorn. To the ranger he said: "Got a drink?"

"Sure."

"Don't want it for myself," Dorn added quickly. "There are two things you can't do at the same time—if you want to live long enough to grow whis-

kers and get bald—and that's drink and fly."

"Right you are," the ranger agreed. "I was on my way up with supplies. Got extra snowshoes, too. Figured somebody got hurt. Anybody killed?"

"One," answered Rickley, reaching for the bottle. "Garibaldi, the pilot of this plane. And he's still inside. We came with the rescue ship."

"Wait," said Dorn. He grabbed the bottle from Rickley. "Old Garlic needs this worse than you do."

"You're crazy!" snapped Rickley. His frozen mustache quivered. "Old Garlic's wings are folded. I saw him myself!"

Dorn merely said: "Step inside."

The super, without a word, ran a hand over Garibaldi's head. "Slight concussion," he said. "Fliers have shockproof heads. That's why I'm still alive."

They watched anxiously as the warmth of the drink spread through Garibaldi's veins. The glaze lifted from his eyes; a light shone, finally recognition. His first words knocked Dorn for a loop.

He muttered: "Dorn, you riding in my plane again?"

"If he hadn't," blazed Rickley, "you wouldn't be here! We'd all have been crooked. Your bus was balanced right on the edge like the scales of justice. We got the passengers out, then Jerry went back to get you, to give you a decent funeral. Your bus slipped off. And here we are on the bottom. What are you beefing about?"

Old Garlic quickly glanced out the window. There was a grin on his face as he held out his hand. "Here's the latchkey to my bus, Dorn," he said. "Anything you say goes."

"You got a break this time," Dorn answered. "Forget it."

Rickley growled: "We all got a break. Let's get going!"

WING LIFT

(Continued from page 25)

shown in drawing No. 4. The resulting increase in lift at ordinary landing angles would be quite satisfactory. The N. A. C. A. has calculated that such a suction device could be operated with less than 3 per cent of the engine power and still permit a substantial reduction in landing speed. It performs the work of the slot with few bad aerodynamic effects. There are mechanical difficulties in the installation of such a device, but they can be overcome by clever design.

A wing with variable area is also held by some to be the solution to our problem. By increasing the wing area, take-offs and landings could be accomplished in easy style. Then, by decreasing the area in flight, the maximum in speed and efficiency could be obtained. One way of changing the area is to slide

auxiliary wings outward from the tips of the main wing. When retracted, the small wings fit inside the main wing. The experimental Makhonine monoplane produced in France is an example of this arrangement.

Another method under development by a French designer, Guerin, in his "Varivol" biplane, is construction of a flexible wing surface that can be "rolled up" to permit high speeds. (See AIR TRAILS photo, August, 1936.)

The structural limitations of both these methods are apparent. In the first method it means the inside of the hollow wing must be free from any obstructing members to permit the smaller wing to slide in and out. This is exceedingly difficult with present construction methods. In the second, making a wing strong enough to withstand high speeds and flexible enough to be "unrolled" for an increase in area is a problem few designers have been willing to tackle.

Changing the camber of the airfoil is another way of boosting lift. Wings with thick camber produce much more lift than thin wings. Yet thin wings are capable of higher speeds than thick wings. If both these types could be incorporated in a wing of variable camber, the problem would be solved.

But this idea is beset by many mechanical troubles. The shape of the ribs must be variable so the camber can be increased or decreased while in flight. The covering on such wings would have to expand and contract to take care of the varying rib shape. With these two fundamental difficulties to overcome, the variable-camber wing falls into the same impracticable category as that of the variable-area wing.

The monoplane which can be converted into a biplane at low speeds is still another method of increasing lift. In full flight, the bottom wing would be

drawn up into the upper wing to form a conventional type of monoplane wing. For low speeds, the bottom part of the wing could be extended to form the lower wing of a biplane. This arrangement is aerodynamically efficient, and present successful methods of landing-gear retraction might be further developed for use in converting a monoplane into a biplane.

Efforts have been made to tie together the low landing speed characteristics of the autogyro and the high speeds of the airplane. One such arrangement tried in the Herrick "Vertiplane" (AIR TRAILS, August, 1936) consists of a biplane in which the upper wing may be held rigid, or allowed to turn as a rotor. While such a plane would have a wide range of speeds, there are several disadvantages. The change from airplane to autogyro would be difficult to accomplish. This is true not only from a me-

chanical viewpoint, but in operation, as the plane would probably perform some hair-raising maneuvers until the rotor was revolving at a speed sufficient to produce helpful lift. Building a fair-sized rotor of sufficient strength to serve as a wing would be a difficult problem. This is even more serious than first appeared, since the rotor would have to be a cantilever structure free from any outside bracing.

In summarizing the problem of increasing wing lift for slower landings and higher speeds, it seems the wing flap will continue to be the favorite solution. The ease of installation and operation are attractive to designers. There is a growing tendency, however, to try the intricate lift-increasing devices that are more effective. It's very likely we'll see substantial improvements in landing and take-off characteristics as a result.

CANNED DEATH

(Continued from page 30)

ORIOLE, OKLAHOMA was new and rough, and packed to the brim with two-legged trouble. The pine shacks were staggered along both sides of the rutty section of road that was Main Street; eating houses, second-hand furniture stores, saloons, two dance halls. Dan Cooper dropped from the back of the pipe truck that had brought him through the forest of black oil rigs and drew the air into his lungs in a great gulp. The place was practically the last frontier, and it literally stank of adventure.

A barrel-chested man with a small horseshoe scar across the corner of his grim mouth stepped out of a group that loitered before an eating house called The Twin Rig. He swaggered up to Dan Cooper and ran one thick finger across the wings on the flier's old leather coat.

"Flying man?" He bit the words out. Dan nodded.

"I work at it some."

"Dawson man?"

"Maybe."

"Well, that's just an idea, see?"

The scarred man's left hand was lightning fast, and he hooked it to the jaw like a professional. Cooper rolled his head with it, but he was off balance. He felt skyrockets letting go in his brain as the hamlike fist brushed his chin.

A million miles away some one laughed, and he knew that he was sitting in the rutted road. He shook his head groggily and struggled up. He saw a vague figure in front of him. Then he was hit again.

Instinct took over this time. He rolled with his chin against his chest and fumbled into a clinch. He felt the bulky body straining against his. There

was too much of that body; it was flabby fat for all of its bulk. He whipped his right hand up and felt it sink into rolls of flesh. Then something thudded against his ribs, and as he rocked back on his heels the man's right hand came booming over.

Dan Cooper felt himself falling through miles of black space. He flailed out with both hands in the grabbing motion of a man who falls. He could feel blows landing on his body. It was more like hearing them than feeling them, because there was no pain, no sensation.

He was pumping his own arms, and he was feeling occasional thuds against his knuckles, but he didn't know what it was all about. If he did any thinking at all, it was to wonder dully at the fact that he was still on his feet. A hoarse voice kept bellowing through the fog in his brain.

"Put him away, Tex!"

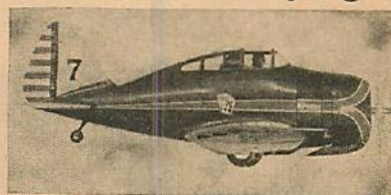
"Tex" was the other fellow. Dan Cooper shook his head. It was nice to know that the other fellow had a name. When you couldn't see a man with whom you were fighting, it helped to have a name for him. It convinced you that he really existed.

He saw a blur in front of him that might be a man. He drove his right fist hard into it. The blur was as solid as a brick wall, but it went over when it was hit. Cooper felt movement at his back; a blow glanced off his neck. Several other blows landed from several different directions. He tried to cover up. Then he heard a voice that was like the quitting whistle of a steel plant.

"You dirty scum!"

He felt, rather than saw, that men were being tossed around. He threw punches blindly for luck at every blur that he saw. His experience of a few minutes ago had convinced him that

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blurs were men. The last punch that he started was caught.

"Hold it, son. You're hitting your own side."

Dan Cooper rocked on his feet, but it was good to get his hands down. He felt himself being steered by the elbow. When his vision came back to him he was sitting across a cracked and greasy table from a man who looked like a slab of human concrete; a bronzed, square-jawed son of battle whose lips were a straight line and whose eyes were hard. The man was pounding the table with a gory hand that bore testimony to punches that hadn't missed.

"Guy," he said, "you belong. The way you threw knuckles back there was the way that I like to see them thrown. My name's Jim Dawson, and if you ain't just wearing those wings for an ornament you've got a job with me."

Dan Cooper's hand dropped instinctively to the pocket where he carried the letter of Major Loring. The hand dropped away; a grin parted his bruised lips. There wasn't any percentage in using drag to get a job that you'd already landed.

"The wings aren't an ornament," he said. "There are fourteen hundred hours behind them."

"Good enough, but you'll need more than hours with me, guy; you'll need guts—lots of guts." Dawson was still pounding the table. "What you stepped into is just a sample. Tex Bundy and his crowd work for one of the three big outfits that are fighting Lou Bannister. Bannister controls the best leases, but he's got too many of them. He has to make holes fast; the big boys can take their time."

"Where do you come in?"

"With Bannister. He hires me." Jim Dawson seemed to be holding something back, something out of which he got a lot of secret amusement. "We'll go out to the field," he said.

Dan Cooper sensed that he was supposed to ask questions, so he didn't ask any. It had been his experience that a man who tried to draw a lead would lead himself if he didn't draw one. Dawson's lead wasn't immediately forthcoming.

They walked the three quarters of a mile in silence. They were well out of town and on a rutted, sidetrack road. The field itself was brown and level and hard-baked. "My field," Dawson nodded. "That's one of my boys coming in."

Dan Cooper looked up with interest. There was a black-and-red low-wing job coming into the field as gently as though it were landing an old lady on her first flight. The red markers stood out plainly, but the pilot flashed a set of four red lights on and off and on again as he dropped the retractable landing gear. There wasn't another ship visible,

and the hangars were two wooden structures set far apart and well back from the flying field. Cooper frowned.

The mechanics were hanging back gingerly. There was an awkward self-consciousness about them that wasn't natural. A grease ball is normally the least self-conscious creature alive. Jim Dawson chuckled.

"Soup," he said. "Nitro ship."

"Nitroglycerin?" Dan Cooper's head came up. He had a sudden impulse to



get the hell out of there himself. The ship was almost in. In another minute the wheels would roll, and nitro was one of the trickiest substances on earth. A jolt or a jar—and a small bottle of the stuff would wipe out a town. He did not know how much the plane was carrying, but he had an idea that it would carry enough.

"Here she comes——"

Jim Dawson seemed to get as much delight out of the moment as a fisherman who is reeling in a fighting bass.

Dan Cooper felt his scalp tighten, his skin crawl into knots. The ship rocked just a little as it settled, then it touched and rolled along a packed field that was as smooth as a dance floor.

It was a small job as ships in the freighter class go; single engine and built to carry five passengers before the compartment was converted to the peculiar needs of Jim Dawson's business. It had landed under 50 m.p.h., and was now swinging toward the nearest hangar.

Jim Dawson relaxed. The high moment was over, and he was his old grim self again. "Soup, kid," he said. "That's what we're flying. It takes guts to fly it, but it's more precious than gold down here. Wells don't come in by themselves in the Bannister field; they have to be blown in. That's a soup job——"

"I thought they trucked it on the

Standing there, Dan could see it; the big liner—his old ship—racing through the night; fog over the mountains; Tony looking for a hole. Human lives against a pilot's skill——

back roads." Dan Cooper was frowning. He'd just seen a shipful of nitro roll in and land, but he wouldn't want to watch soup ships landing every day. A man would grow gray too soon. Jim Dawson made a sweeping, fatalistic gesture with one hand.

"I told you that Bannister was an independent with three big outfits fighting him," he said. "Soup trucks headed for Bannister had too many accidents."

There was a grim story wrapped up there in a single statement; the story of hazard added to hazard, of accidents caused where accidents were already too liable to happen. Jim Dawson let the statement sink in, then he turned suddenly.

"Nothing's happened to any of my ships yet," he said, "but I've just started. Still want a job?"

Dan Cooper met the hard, probing stare levelly. "Tell me what I have to know besides knowing how to fly," he said, "and then show me my ship."

Jim Dawson smiled a tight, hard smile. "You've got to know more than you imagine," he said, "but you'll do."

LESS THAN AN HOUR later, Dan Cooper climbed into the mate of the black-and-red ship that he had seen come in. Jim Dawson stood beside the plane, his grim mouth bracketed with lines.

"Son," he said, "there are three hundred miles of plumb easy flying ahead

of you, and Bannister has to have soup. The chances are that some of these high-binders will try to stop you or trick you. Use your own judgment, but don't kill yourself for any boss, me or any one else. The thousand bucks that you draw for the hop ain't half enough."

"It's plenty."

Dan Cooper's teeth flashed white against the copper tan of his skin. Jim Dawson's twisted smile answered him. There was something behind the smile that he didn't fathom, some hint of what he had felt before; that Dawson was holding out on him. He waved his hand, tooled the ship around into the wind.

He was conscious of the deserted appearance of this field in contrast to the crowds who generally saw the flying liners get away. The meager ground crew, as hard-bitten a bunch of humans as he had ever seen, were clean off the field. His grin became a little mechanical, his jaw clamped hard.

These boys didn't know anything about his flying, and they weren't taking any chances. Well, they'd see. He pointed his nose to the wind and listened to the rev-up of the engine. He was terribly conscious of the cargo at his back as he raced down the runway. The entire freight compartment was a carrying case for sudden death; copper-lined to catch any possible overflow from the ten-quart containers of nitroglycerin.

The containers themselves were fitted into a rubber framework like eggs in a crate, snugly fitted and insulated against ordinary shock. The copper-lined case itself was suspended upon rubber-covered springs, and there was a lever in the cockpit which floated the case in its cradle of springs when landing.

"And it will still blow hell out of things for no reason at all. That's why soup fliers draw a thousand dollars a hop."

Jim Dawson had laid it on the line with him, and here he was. He felt the wheels spurn the earth, and he was climbing up on a long slant out of the dead flat billiard table of prairie. The sky had a red glow westward; and it was dusk at ground level. He'd be landing his load in the dark.

The lonely field with its two hangars dropped behind him into ground haze. He flew wide around the town of Oriole, Oklahoma. He'd be flying around towns all the way down. There was legislation pending against flying soup, and it would take only one accident or a few stiff complaints to swing the law that would put Jim Dawson—and perhaps Bannister as well—out of business.

Beyond Oriole he picked up another field. There was a fast-looking gray ship taking off; a three-place, open cockpit biplane. He frowned and swung farther eastward off his course, then poked his nose southwest toward his objective. The biplane was climbing rapidly and correcting its own course to cut his.

"I'm getting jitters; kidding myself maybe—"

He was keeping his speed even at a little better than 150 m.p.h. and getting used to the load of destruction at his back, but the other ship bothered him. It had climbed above him now, was jockeying into position behind him. He watched it and remembered the unprovoked fight back at Oriole.

Men killed most often for profit—and killers could be hired for money.

Slowly, steadily, the other ship crept up on him, synchronizing its speed to his. It had a thousand feet or so on him in altitude, and he could see the dark outline of a man half out of the front cockpit looking down.

He flew thus for several minutes, his mind groping for an explanation of that other ship, his muscles tense with expectancy. He was remembering his load again. The few independents who had trucked soup gave it up because of the high percentage of accidents. It was easier for accidents to be caused in the air. He increased his speed; the biplane moved up a notch with him. It was the faster ship, no question of that, but it wasn't interested in being faster than he was.

Then suddenly it happened.

The dark figure above leaned farther out of the cockpit, and something flashed from his hand, something that spun over darkly and lined downward like a plummet. Dan Cooper's heart zoomed into his throat and stuck there, beating.

The human hand couldn't move fast enough, nor the man-made mechanism respond in time to avoid that missile. He swung the stick hard over and walked on the rudder, but he knew that he was going to be hit—knew that a falling body has an astonishing rate of acceleration, and knew that even a ship bearing ordinary cargo can be seriously damaged by an object dropped on it from above.

There was a split second of agonizing suspense, a glancing blow against the fuselage, and an explosion that seemed to rock the universe.

Death folded his mantle close about Dan Cooper in that moment. His mind accepted death when the roaring explosion banged against his eardrums. The ship heeled over, the controls felt soggy, dead, unattached.

It was seconds more before Dan Cooper realized that the ship was still intact, still all in one piece; a spinning ship, but not a ruined one. He shook his head and swore grimly through stiff lips.

Instinct and habit took over the job of pulling the ship out of the spin. He centered everything, dived for flying speed and roared out with the engine, his brain paying no attention whatever to the job that his body was doing.

"That was a grenade of some kind,"

he muttered. "It glanced off and exploded under me. I was banking and it rolled me over. But why?"

He swore again. Why hadn't an explosion powerful enough to roll the ship been powerful enough to explode the nitro? He looked aloft. The biplane was bearing down on him again. He straightened out and roared straight away.

The biplane, however, was diving like a pursuit ship upon a bomber. It had the speed and the maneuverability, and he had the dangerous load. The bomber of war time, however, could jettison his load, get rid of his bombs and take whatever chance his speed gave him. Dan Cooper couldn't get rid of that load of soup.

He wanted to half roll away from that diving ship with its handy grenade thrower. Some flag in his brain was warning him that where there were grenades there would be machine guns. One burst or two from a machine gun would accomplish what the grenade had failed to accomplish. But so would a half roll.

He compromised on a climbing turn and prayed when he held the stick over. The ship responded and he climbed. The biplane buzzed around him like an infuriated hornet, bouncing out of its dive on some invisible cushion of air and zooming up past him again.

"Keeping their respectful distance, in case I actually blow."

The thought gave him confidence. They were serious enough about their diving to force him into swinging his load around, but they didn't want to share his fate if the load of soup let go.

"I wonder just how dangerous it would be to other ships in the air."

On sober reflection, he didn't know. There had been Zeppelins blown to kingdom come in the War that blew attacking ships out of control when they exploded, without destroying the ships. There was nothing confining the explosion up here, nothing to throw the force of it outward.

"One cinch is that they'd never find any of me."

He was flying straight again, and fast. He didn't believe in the machine gun any more, either. No commercial ship would be permitted to mount one, and it had been demonstrated long ago that angle firing out of a plane was no good.

He felt a little better. But when they strafed him again he maneuvered out of the way, the sweat heavy on his body with the strain of anticipating the wave of annihilation that would erase him as a living entity between two ticks of a fine watch.

It was black dark now on the earth below, but up here there was a moon and a million stars. His foe was a black ghost that fought him grimly across a world that held no other living thing

save the two ships. Dan Cooper was crouched in the cockpit like a fighter, past reasoning the whys of the savage attack and concentrating solely upon guessing ahead of the ship that sought to destroy him.

The biplane dived again, then veered off and dropped back.

Dan Cooper's shoulder muscles bunched. So far he had been taking it, shivering in his boots and trying to stay out of the way. If he kept on jockeying back and forth with these boys, he'd never cover the three hundred miles to Bannister—and he'd burn his nerves out.

"We'll see if they can take it!"

He swung the red-and-black monoplane around and hurled it nose-first for the biplane. A tense, crouching figure at the controls, Dan Cooper rode the Juggernaut, lips flat against his teeth.

"I'll ride through them before I pull out. I swear I will—"

He was fed up, and his mood transmitted itself to the ship. Six hundred gallons of nitroglycerin, according to Cooper's own count of cylinders, was hurtling across the sky, collision-bound.

The pilot of the biplane loved life too well.

He rolled out and dived away upside down, a blur in the night sky. Dan Cooper laughed aloud, a reckless, triumphant laugh that vented the tension and the pressure of tortured nerves.

"Surprised them!" he shouted. "They never figured that a man with a load of death would be such a damned fool."

The days of the precise flying of schedules, the neat uniforms, and the deadly monotony of perpetual safety seemed far in the past. This was the kind of fantastic flying that adventure-mad cubs in flying schools dreamed about. He was doing it, and it was hard to believe it—hard to believe in the reality of that load of death behind him and the vicious biplane in the dark sky.

Where was the biplane?

For a few moments he thought that he had discouraged them; then they were creeping up once more, well off to his right and synchronizing their speed to his again. He flew steadily and poured throttle, watching them warily out of the corner of his eye.

They were keeping their distance, but there was something nerve-shattering about the steady matching of speeds. He dived to break the grim monotony of it, and the biplane dived with him.

When he leveled off it was still with him, stalking him, waiting—

Waiting for what?

The answer came in a sharp, singing whine that carried through the beat of the engine. He caught the glint of moonlight on metal across the front cockpit of the other ship just before the singing impact. His body jerked like a body that feels the jolt of electric current.

He was cold and then he was hot with the rush of blood in his veins. The man in the other plane was shooting at him.

There was another flash, and another vicious *pin-n-n-ng* that was like the ten-penny whistle of doom. He was a cinch target. With the two planes side by side like this and synchronized in speed, a rifleman couldn't miss.

He dropped off on one wing and dived to get out of the shooting gallery. Another slug pinged into him as the nose of his ship dropped. He passed the back of his hand across his forehead.

"Those bullets hit the ship. In Heaven's name, where?"

He had heard the bullets strike, but he was still alive, and there had been no explosion. His hand was a trifle unsteady on the stick, but his jaw was set grimly. Luck had been with him. If he was riding a lucky streak, there wasn't anything that could happen to him.

There was one thing that he could do, and he was going to do it.

He dropped his nose on a long slant. The muscles were standing in ridges along his jaw line. The country below him was flat. He had to find an area free of towns, had to gamble on a set-down in some open field, had to bet that he could guess successfully at the workings of another man's mind.

The biplane was staying with him, but the gun was silent. They couldn't synchronize with him now. He was seeking a landing. Beneath him the prairie spread flatly. He was clear of the production fields, out in the stony, barren Indian country that defied cultivation and did not support towns of any size.

He picked a field, and once he had made up his mind, he went into it fast. He sloughed altitude in a hurry and cut his speed only when he was actually coming in. The biplane was dropping down behind him, but he kept his eyes front.

He was betting his life that they would neither try to drop a grenade on him nor attempt shooting when he was grounded, that they would prefer capturing him and, perhaps, flying his ship off to some place where it could be either looted or destroyed at leisure.

"We'll see about that. If—"

He was almost in— He stiffened suddenly in the cockpit. He had forgotten the lever in the cockpit that would float the load in a cradle of

springs for the landing. He remembered now, too late. Landing on the rough and uncertain field that he had selected was taking all of his attention. If he fooled around with levers now he might do a bounce landing, and not all of the levers in Christendom would save the load from blasting him to smithereens.

The field came up to him out of the darkness; he hit hard, and for a second his soul seemed to float between life and eternity; then he was rolling and still intact. Behind him the biplane was coming in—

He brought the monoplane around and measured the other out of narrowed eyes. They were coming in to hold him up with guns and take his ship away, were they? Well, they'd need more guts than they had shown upstairs.

He swung the plane around and brought it out across the field like a horned turtle, slowly, but with grim, dogged inevitability. Squarely into the path of the landing biplane he taxied it, holding the speed down—courting collision.

The pilot of the biplane had brought his ship hurtling in. He had no chance to gun it now for another circle of the field. A waddling load of terrible death loomed suddenly in his path, and he did what Dan Cooper had bet his every last blue chip that he would do; he ground-looped to avoid a collision—and cracked up doing it.

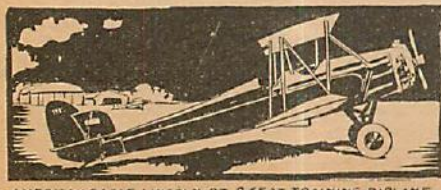
There was a rending, splintering crash as the biplane went over on one wing, smashed that wing and hit the dust upside down.

Dan Cooper was out of his cockpit like a flash. His lips were pressed against his teeth, his fists were clenched. Men usually walked away from crack-ups like this one, and he was not forgetting that these men were armed, and that he was not.

A lean man was extricating himself from the wreckage when Dan Cooper charged down. He was shaking his head groggily, and his movements were sluggish as he turned to meet the charge.

Dan Cooper swung from the hip. The lean man took it in the stomach. Cooper didn't have to watch him fall. When they were hit like that they were well taken care of for a while, and no further bother.

The other man was crawling out of the wreckage of the wing that had cracked. He was not dazed; he was cursing. Dan Cooper's eyes narrowed



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to slits. It was almost too good to be true.

The barrel-chested, unshaven, scar-mouthed husky was the one man in Oklahoma that he preferred to meet right now, preferred to all others, in the mood that he was in. He was Tex Bundy, the tough guy of Oriole.

Bundy recognized him in the same moment, cursed and spat in the dirt. "You, you—I—"

Dan Cooper's left hand cut the tirade in half, and his right hand was close behind the left. Tex Bundy backed up, then came on with a roar. He landed twice. Then Dan Cooper caught him with a booming right that landed in the rolled fat below his heart.

Tex Bundy took a backward step. That was the pay-off. All of the impotent fury that had racked him aloft was in the punches that Dan threw, all of the nerve tension and the rage and the cold fear.

He drove his fists like motor-driven rams, and the bigger man melted before them. Tex Bundy rocked back on his heels, missed two swings, took three steps backward under a withering volley of punches, and went down on his face.

Dan Cooper swayed above him for a few moments, then turned on his heel. The thin man was conscious, but he stayed where he was. Dan Cooper let him stay. The men didn't have a ship that they could fly, and he hoped that it was a long walk to help and transportation.

He was swaggering as he walked up to the red-and-black monoplane, and he threw one contemptuous look back at the men he was leaving.

"They looked more dangerous than they were," he said. "Just like this damned soup. I bet I'll fly it off this washboard without hearing a chirp out of it, either."

HE DID fly it off, and he reached Bannister only fifteen minutes ahead of Jim Dawson. Dawson was flying a red-and-black ship himself. He landed it on the isolated field with an exaggerated caution that brought a grin to Dan Cooper's face.

"You should have seen the way I set it in," he said.

"Yeah?" Dawson was stripping off his gloves; his eyes were keenly noncommittal.

Dan Cooper waved his hand. "I had a little trouble," he said.

The two men walked toward the shack beside the hangars. Cooper described his trip. He was proud of that trip now that it was over, and he enjoyed describing it. Jim Dawson nodded solemnly and lighted a cigarette.

"You earned your thousand, kid," he said. "But if you'd been flying soup you'd never do any collecting."

"Huh? What do you mean 'if I was flying soup'?"

"Just like that, kid. Don't feel hurt. Even leaving out the things that they did, the things that you did would have removed you from earth a half a dozen times. No matter how you pack it, son, nitro is nothing to bluff with and make gestures."

Dan Cooper was staring speechlessly.

Jim Dawson slapped his shoulder. "You flew the decoy, kid—cans, but no soup. You kept them busy, and I brought the stuff down. I don't send a greeny out with canned death."

They were entering the shack, and a grizzled man in overalls hailed Jim Dawson.

Dan Cooper swore softly. "Cans," he muttered. "And I sweat blood for a lot of empty cans—"

He broke off suddenly. There was a newspaper on top of a box; an extra with screaming headlines:

MISSING AIRLINER FOUND;
ALL ON BOARD SAFE

DARING PILOT LANDS SHIP
ON MOUNTAIN IN DARK

Dan Cooper had been away in the back country. He didn't know that there was an airliner missing. His eyes leaped through the account. Names and words jumped at him: "Tony Grayson, veteran pilot; Murray Stark, co-pilot; Nan Halliwell, stewardess; heroic action in emergency; passengers praise crew for courage—"

Standing there, Dan Cooper could see it; the big liner—his old ship—racing through the night; fog over the mountains and off their course; Tony looking for a hole, the co-pilot beside him. Who in hell was this guy, Stark?

Suddenly the freighters looked drab. A man flew cans or he flew soup or maybe he just flew nuts and bolts. If something happened, there was a ship less and a pilot less. What the hell? But if one of the big boys went down there were human lives behind a man, living people who had no wings that a pilot didn't give them, people who lived or died on a pilot's skill.

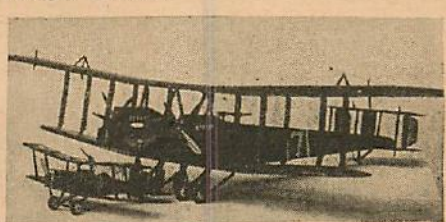
"Good old Tony," he said.

Jim Dawson slapped him on the shoulder. "Don't be down-hearted, kid," he said. "You did a swell job, and you'll make a good man at this racket when you learn the ropes. After a month or two—"

Dan Cooper waved him off. "Thanks, old-timer," he said, "but I never asked for a job till you offered it. You see"—his hand touched the letter of Major Loring, the one he had never given Jim Dawson—"it's this way," he said. "I've got a job. I was just on a leave of absence."

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| 9" Seversky BT-8... | 2.30 | 9 1/4" Bristol Fighter... | 2.50 |
| 8 1/4" Waco Cabinplane | 2.25 | 6 1/2" Spad 13..... | 1.80 |
| 9" Hawker Monoplane | 2.30 | 6 1/2" Nieuport 17..... | 1.80 |
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EMPIRE BOAT

(Continued from page 34)

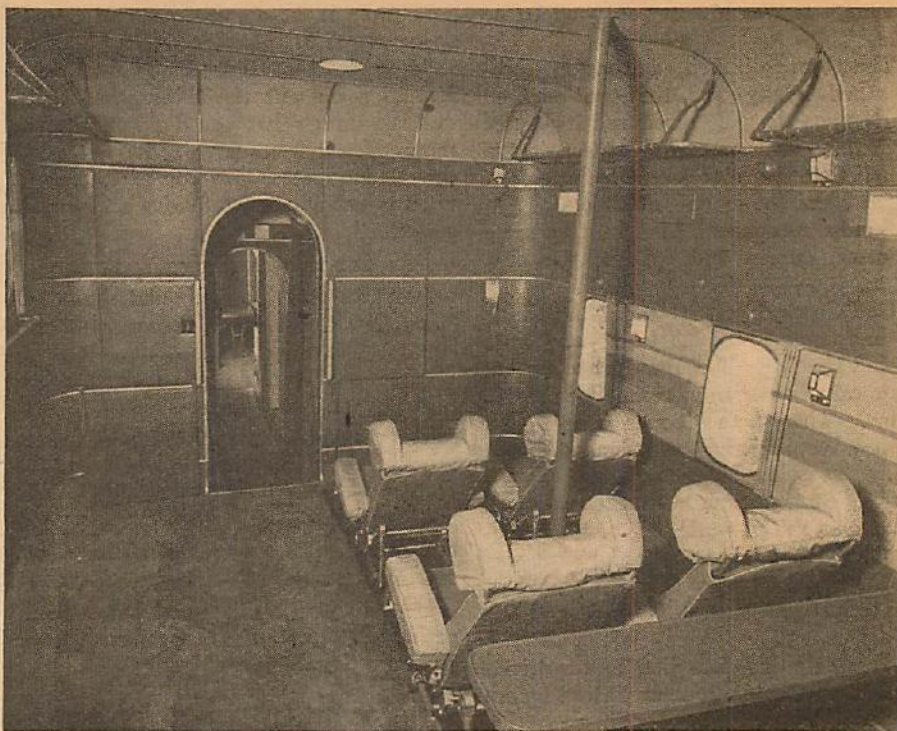
a door in the rear partition and catch a glimpse of the capacious after cargo hold. It is piled high with trunks, cases and mail sacks destined for America.

Moving toward the bow, we again cross the entry and step down into the large promenade cabin which occupies the center section of the boat. A double row of adjustable chairs fills one side of the room. More chairs and a promenade space provided with steadying hand rails occupy the balance of the space. Reading lights, tables and maps are provided for the convenience of the traveler. This cabin accommodates eight passengers during the day and sleeps four at night.

Another move forward and two more steps down bring us into the midship compartment. This is smaller than the one we just left, containing but three chairs. The ever-attentive steward explains, however, that berths for four are available at night.

Continuing our progress toward the bow, we find the main corridor flanked by narrow side rooms. On the port side are two lavatories luxuriously outfitted for the comfort of the voyager. A door on the starboard side opens into the ship's galley.

We notice a vertical ladder fastened to the wall and are informed that it leads to the upper deck. Mounting the aluminum rungs, we climb through a hatch and find ourselves in the domain of the ship's clerk. He is ensconced behind a workmanlike desk covered with ship's papers and files. Behind locked partitions of steel caging, mail bags are stacked up to the ceiling. We step forward through a door into the radio



The Empire Boat's promenade cabin is spacious.

room, with its busy operator and bewildering array of gadgets, and then through another into the pilot house.

The captain and first officer sit side by side, facing the instrument board and dual controls. The Empire boat is provided with every known device for blind flying and with every navigational aid available. During the long hours of routine flying, the ship is controlled by an automatic pilot.

In order to make our survey a thorough one, we then descend a vertical ladder from the pilot house into the dimly lighted mooring compartment. Stumbling over anchors, piles of cable and miscellaneous gear, we pull open the

door that leads aft to the smoking compartment. It is like entering another world.

From the dank darkness of the hold, with its mingled whiff of oil, tar and damp cordage, we emerge into the brightly lighted, tobacco-flavored atmosphere of the cheeriest cabin on the ship. Sunlight streams in through circular portholes below which are ranked more of those comfortable, adjustable chairs we saw in the other cabins.

Let's you and I sit down comfortably to enjoy the balance of the flight—and incidentally, acknowledge a toast to old England and her newest sea-child—the Short Empire air-liner.

"DEAR HARRY—"

(Continued from page 26)

the motor has had time to warm up. Then I walk over to the ship, pull away the chocks and climb into the cockpit, not forgetting to fasten the safety belt securely.

I put one hand on the throttle and push it forward. The motor roars and the plane moves, slow at first, and then fast, plenty fast.

The controls seem awful unfamiliar, I must admit. Even though I know what the throttle, stick and rudder bar are for, they feel strange when I try to use them.

Anyway, I'm roaring down the field in great style when the ship begins to pull to one side. I push the rudder bar. The plane turns the other way. I push again—easier—and the ship straightens out, but now I'm almost at the end of the field and have to cut the motor and

let the plane come to a stop to avoid hitting the fence.

I taxi back, and on the way see a crowd forming in front of one hangar. There is much talking going on. Suddenly one member of the crowd runs to the office. Next second Norwood pops out of the door and starts yelling something. Immediately everybody in the hangar crowd starts running after me.

Making a quick decision, I turn the ship around, making a complete circle the first time because the motor is running too fast and my foot gets tangled in the rudder bar. But what else could be expected when a shouting, arm-waving bunch of wild Indians is bearing down on you?

Wide open with the throttle. Down the field I drive at the approaching crowd. And do they scatter!

I push the stick forward to raise the tail. Whew—the tail rises too fast and the propeller almost digs into the dirt! I yank back the stick and the tail slams

down, jarring me to the roots of my teeth. Again I'm near the end of the field and have to turn back for another try.

The wild Indians are still after me, led by Norwood. Two or three almost get their hands on the wings, but I put on speed and leave them behind.

Third attempt. This time I'll get the ship off the ground or bust, I say to myself. In turning I scrape a wing tip and almost lose control, but the motor is turning over at top speed, so I figure I can be excused.

Down the field at terrific speed. The enemy retreats posthaste and I'm all set. No! One guy—it's Norwood—runs directly into my path and puts up his hands to stop.

The plane is almost on top of him. I pull back the throttle and slam my foot down on the brake. But it isn't the brake! I've forgotten I'm not driving an automobile. My foot hits the rudder bar. The plane swerves.

Crash!

A wing tip crumples. The motor shudders and stops. For a second I'm dazed. Then I crawl out of the cockpit. I am glad to see, anyway, that the ship is not so badly damaged. Only the prop and a wing tip are in need of repairs.

Norwood arrives on the scene.

I draw myself up and start to make a few clear remarks about my opinion of people who run in front of airplanes which are about to take off.

Norwood breaks in on me as though I haven't said a word.

"You blockhead!" he bellows, and con-

tinues on in like manner until his breath gives out and he's forced to stop and gasp in more.

"And furthermore," he roars in conclusion, "you're too dumb to learn to be a pilot in ten thousand years. And who's going to pay for the cracking of this plane?"

That second-last statement stings me to the quick. It had been my intention to inform Norwood that I was leaving his school on the instant, not caring to be associated with such an ill-mannered person as himself. But I change my mind.

"Mr. Norwood," I say, "I'm sorry I

can't afford to pay for the repairs on the ship. But I will work it out for you—doing any work you say. And I have one other remark to make. It is that I will show you I can learn to be an airplane pilot."

With which I walk away.

That's all for now. Watch out for my next letter. Things are going to happen on this field, and—yeah, you've guessed it—the bird who's going to make them happen is

Your pal,

STEVE.

P. S. I managed to snap a picture of the plane and inclose a copy. My first crack-up!

ROCKET SHIPS

(Continued from page 19)

a rocket-propelled sledge 250 miles an hour on ice.

To experiment with different types of combustion chambers—or motors—the German society, with a membership of 1,000, established outside of Berlin the same year the world's first rocket flying field. From these tests—with so-called Mirak—minimum—and Repulsor rockets—emerged the liquid-fuel devices used by most experimenters everywhere today.

Incidentally Valier, continuing his work on rocket automobiles, was blown to bits soon after. In 1933 Reinhold Tiling, a pioneer exponent of powder fuel, and three of his assistants met a similar fate.

Dissension, engendered over the relative merits of powder and liquid for fuel, broke out in the German society; with a handful of friends Willy Ley, another pioneer, went over to the Society for the Progress of Traffic Technique, which was interested in propulsion methods. This organization became the Interplanetary Society of Germany.

With the rise of Hitler to power in 1933, the society fell on evil days. Smelling communism in it and its explosive activities, the Nazis discouraged experiments so that now, if carried on at all, they are performed in deep secrecy.

In 1933, Gerhard Zucker shot some mail over the Harz Mountains, unsuccessfully tried out some rockets in Great Britain, and returned to Germany to be swallowed up, apparently, in a concentration camp. Willy Ley came to the United States. Professor Oberth kept to his native Austria, where experimentation had been sporadic, chiefly financed by Guido Baron von Piquet of Vienna. In 1931 he sponsored an officially recognized rocket postal service, the world's first, which was engineered by Friedrich Schmiedl. Using powder fuel cartridges, he still shoots the mail with special *raketenflugpost* stamps over the mountains between Schockel and Radegund,

near Graz—two miles by air, fifteen by road.

Meanwhile, M. Esnault-Pelterie in 1927 published a great astronautic work called "L'Astronautique," based on a rocket lecture made to the French Astronomical Society. Inventor of the airplane "joy stick," this eminent French aeronautical engineer induced Andre Hirsch, a banker, to found an annual astronautical prize of 5,000 francs.

France, though she has a number of individual experimenters, has no formal society, but her military ally, Russia, has. Taking to rocketry with a passion, the Russians formed in 1929 the Leningrad and the Mos-gird—the "gird" meaning Group for the Study of Reactive Movement. The Russians work quietly, and are understood to be doing things experimentally. The government recently ordered built a rocket capable of a maximum velocity of 2,900 feet a second and an altitude of 34 miles.

In England, interest in rocketry was virtually non-existent until P. E. Cleator, a young engineer, formed the British Interplanetary Society in 1933. As yet no practical experiments have been undertaken there. Australia and India are now organizing societies; the Netherlands formed one recently; in Japan experimenters are rugged individualists.

Thus, after leaving Dr. Goddard and his trail-blazing, we return to the U. S. A. and find much activity going on. The Americans organized themselves in 1930. A group of New York

science writers met one day in a Greenwich Village café and formed what afterward became the American Rocket Society. G. Edward Pendray, science editor of *Today* and *The Literary Digest*, was a prime spirit in molding the group. He is currently secretary. President is John Shesta, young engineer.

This society, the most important in the world, is practically the only one carrying on real experiments. Its membership is world-wide. In 1933 Ernst Loebell, a German society engineer, interested Edward L. Hanna, grandson of the famed Mark Hanna, in forming a society in Cleveland. It once was rumored that Mr. Hanna has set aside \$20,000 for the burial of himself and his wife on the moon in case they die before a voyage to this earth satellite is made.

Other astronautic groups in the United States include the Peoria (Illinois) Rocket Association, the Westchester Rocket Society (New Rochelle, New York), and organizations consisting of seniors and post-graduates in physics and engineering at Yale and at the California Institute of Technology (Pasadena, California). Stevens Institute of Technology (Hoboken, New Jersey) also is contemplating a group. Most of the experimenting among these people has been on paper. The American Rocket Society has a testing ground near Marine Park, Great Kills, Staten Island, New York, where in 1934 it shot a rocket a mile and a half straight up, and another at Crestwood, New York.

All in all, there's no denying that astronautics, the newest of sciences, has gone far. What the future holds remains to be seen. Will the "rocketeers" ever get to the moon? Or to Europe? What kind of rockets will be needed? These questions will be answered in an article to follow, in which the reader will be taken, properly clothed and protected, to the proving ground for a bird's-eye view of rocket men at work.

Next month's article, the second in a series of three, will cover the actual mechanics of rocket flight in current experiments.

September Contest

The following readers were winners in the September "Gullible's Travels" contest with the indicated number of allowable, correctly picked errors:

First prize, \$5—Joe Bloom, Roxbury, Mass., 82.

Five prizes of \$2—Ray Meyer, Louisville, Ky., 80; William Tuerek, Jr., Laurelton, N. Y., 71; L. R. Zerling, Jr., Drexel Hill, Pa., 56; Whitney Meaux, Crowley, La., 54; Richard Clark, Charleston, S. C., 53.

Five prizes of \$1—Tom Pugsley, Cedar Rapids, Ia., 50; William Schaeffer, Philadelphia, Pa., 49; Alfred Moret, Springfield, Mo., 49; Jack Arnold, La Grange, Tex., 48; Linley Wright, Topeka, Kans., 47.

MODEL ENGINES

(Continued from page 57)

Follow the manufacturer's instructions on lubrication, for it's very important.

Getting back to our "trouble shooting," we'll take up the ignition system next, which is the most common source of trouble with miniature motors. To see if the spark plug is firing, screw it out and lay it on top of the cylinder, keeping it connected to the coil, of course. Then, with the switch on and the gas off, turn the propeller over several times.

If no spark jumps between the points, check over the wiring carefully and be sure there are no loose connections. Then clean out the plug with a few drops of gasoline and check the clearance between the points, which, as a rule, should be .015 inches, about the thickness of five of these magazine pages. A cracked or broken porcelain is a common cause of spark plug failure. Sometimes the porcelain breaks just where it enters the base of the plug and the spark will jump through to the base instead of between the points. In such a case, you can usually hear the spark when you turn the propeller over, or you can often see it in a darkened room. A broken porcelain can sometimes be temporarily repaired with model airplane cement, but naturally a new plug should be installed for best results.

The fact that a plug sparks properly when outside the cylinder, however, doesn't always indicate that it does when screwed in tight. A spark will jump the gap much easier in the open air than in the highly compressed mixture inside the cylinder, since the latter offers more resistance to the current. But with a good coil and fresh batteries, the compression won't prevent the firing of the plug, providing the latter is in good condition and adjusted to the proper clearance.

Check your batteries frequently. The faster a motor turns, the quicker it runs down the batteries; to double the speed

of the motor shortens their life about one half.

Now, turning your attention to the timer, inspect the breaker points. If they are roughened or burnt, they should be smoothed off, but not with sandpaper or an ordinary file. That would roughen the surfaces and cause them to burn still more. Use an oilstone or a small magneto file, which you can probably borrow at your nearest garage if you don't already have one.

The spark occurs when the points come apart—not when they come together. Take the spark plug out and hold a small straw or toothpick so that it touches the top of the piston. By this means you can feel the movement of the piston and tell when it reaches top dead center. Now turn the propeller over very slowly and adjust the timer so that the points begin to separate just before the piston starts down. After the motor starts, the spark should be advanced. In this position the plug actually fires a little while before the piston gets to the top. But at high speed this doesn't cause backfiring, because top dead center will have been reached by the time the mixture ignites and begins to expand. The motor can be idled by retarding the spark, but it shouldn't be allowed to run idle very long, for that will cause overheating.

Due to the principle on which a two-cycle motor operates, good compression is even more essential than in the case of a four-cycle type. It's practically impossible to start a miniature motor that loses compression badly. If a mixture gets into the cylinder at all, most of it will leak around the piston on the compression stroke. And, even if it happens to fire, so much power will be lost as the gases blow past the piston that the motor seldom keeps running.

Most of the smaller motors have no piston rings, because they would create too much drag. The lubricating oil forms a thin film between the piston and cylinder which is an effective seal against loss of compression, providing there isn't

too much clearance between the parts. In operation, the piston never touches the cylinder, since the two surfaces are always separated by the oil film. A poor grade of oil, or too light a grade, may become thinned out under high temperatures, causing excessive wear and loss of compression. That's why proper lubrication is important.

The pull required to turn a motor over compression by hand should be about 5 pounds when a 14" propeller is held halfway between the hub and the tip. At the tip, the pull, when on compression, should be about 1½ pounds. When released, the propeller should snap back to its original position, or, if carried over compression, it should be kicked over by the pressure for about a quarter of a revolution or more. Be sure the spark plug is in tight; sometimes there is a compression leak here.

If your motor has been in service for a long time, the main bearing may be worn, allowing air to leak in around the crankshaft and dilute the mixture. When such is the case, successful cranking is difficult and a new bearing should be fitted.

When a motor runs erratically, or stalls immediately after cranking, the trouble may be the fact that the propeller is too light and hasn't sufficient flywheel action. If possible, buy your first propeller from the manufacturer of your motor. Then, if you make your own props thereafter, use the same dimensions and material as the original.

Figure 3 illustrates a typical wiring diagram, showing how to hook up outside batteries for cranking, a couple of plug-in jacks and a single-pole double-throw switch being necessary. Such a system not only saves the regular batteries, but makes cranking easier, since the large dry cells produce a hotter spark. Don't use a higher voltage, however, than that recommended by the makers of the motor. After the motor revs up, the switch is thrown quickly over to the other side and the cranking batteries unplugged.

INDOOR KING

(Continued from page 58)

bend them around the templates. After they have dried, butt-joint them to the spars. The wing should be made and covered in one piece and the dihedral should be put in after the wing is covered. Heat-treat the wing at the dihedral to take out cover wrinkles. Make the clips of .014" diameter wire and cement them in place. Make sure they are perfectly straight when drying.

MOTOR STICK AND TAIL BOOM

The motor stick is bent around a former of the following dimensions: $\frac{3}{8} \times \frac{5}{32}$ " at the center, tapered to $\frac{1}{4} \times \frac{1}{8}$ "

at the ends, 15" long. The blank should be cut from semi-quarter-grained balsa of $\frac{1}{32}$ " stock, $1\frac{1}{16}$ " at the center tapered to $\frac{13}{16}$ " at the ends. Soak the blank in hot water, bend it around the former, and bind it with $\frac{1}{2}$ " tape. After it has dried, cement the seam, angle the front end, and put caps over the front and rear ends. Sand the motor stick smooth with #10-0 and cement the thrust bearing, the rear hook, and can in place. The motor stick should weigh .0175 oz. and should be strong enough to take $\frac{7}{64}$ " rubber.

The boom is bent around a former $\frac{1}{4} \times \frac{3}{32}$ " tapered to $\frac{3}{32} \times \frac{3}{64}$ " and 10" long. The blank is made from quarter-grained stock $\frac{1}{64}$ " thick sanded to a paper thickness, $\frac{11}{16}$ " tapered to $\frac{5}{16}$ "

and 10" long. Soak the blank in hot water and proceed as with the motor stick. It is not necessary to put caps on the boom. Merely pinch the small end together and cement it with a drop of cement. The boom should weigh .0084 oz. Cement the large end of the boom to the rear end of the motor stick. Make sure that the seam is down, and that it has the proper angle.

TAIL

The stabilizer or elevator and rudder are of the same shape as the wing. Make a full-size drawing of them both, pin your spars down and cement the ribs in place. Make a template of the tips (bend them in the same way that you bent the wing tips) and then after they

have dried, butt-joint them to the spars. Cover the tail assembly with light microfilm and attach it to the boom with several drops of cement. Make sure that the stabilizer and rudder are at right angles to each other. The tail pieces complete should weigh .0035 oz.

PROPELLER

The propeller has always been the average modelist's nemesis. Actually carving propellers is not so hard as it is cracked up to be. The art requires only patience, care, and the ability to follow instructions.

If your impatience is likely to get the best of you, finish a semi-carved prop. Not only will it take less time, but it will be more accurate.

If you use a semi-carved prop, get one of 17" diameter and a pitch-diameter ratio of 1.8. This gives you a pitch of 30.6". Cement both halves together and let it dry. If you must carve a block, use one of the following dimensions: 17x1 $\frac{1}{8}$ x1 $\frac{15}{16}$ ". Draw the diagonals on the wide face, mark off the hub, and cut the block into a blank by trimming away the balsa to the lines. Then start carving your blank. Always carve the concave sides first and completely finish them with sandpaper varying from #2 to #10-0. Then carve the convex side. The blades, just after carving but not yet sanded, should be $\frac{5}{16}$ " thick at the hub, tapered to $\frac{1}{16}$ " at the tip. Sand the blade with rough sandpaper and then with finer and finer grades until the hub is $\frac{3}{64}$ " thick and the tip is paper thin. When sanding, support the blade only with your fingers. To support it on something else will undoubtedly warp it out of shape and may even cause you to break the blade. Make a template of the blade shape and cut your prop outline to fit it. Then finish the edges again with rather fine sandpaper, finally ending up with #10-0.

Make a shaft of .016" diameter wire, insert it into the hub and cement it into place. Put on two flat washers; one should

be cemented to the back of the hub and the other should be free. The semi-carved prop is finished in exactly the same way, saving you all the heavy carving. If you wish, and are expert enough, you may make a microfilm prop. (See AIR TRAILS, December, 1936.) If you do, use a 17" diameter and 1.8 p.-d. ratio in the microfilm prop also. Wooden propellers of this diameter should weigh about .018, microfilm props about .008 oz.

ASSEMBLY AND FLYING

Clip the wing on to the stick so that the can is just about halfway between the leading and trailing edge. Bind the clips with a bit of silk thread in order to prevent the clips from sliding around on the motor stick. Hook on the propeller and slip a 20" loop of brown $\frac{7}{64}$ " rubber on the shaft and the rear hook. Wind the rubber about 200 turns and release the model. If the ship stalls, move the wing backward; if it dives, move it forward. Wind up the rubber more fully, about 1,000 turns, and release. If there is a slight tendency to stall, wash out the left tip of the tail. Another anti-stall device is to put a negative incidence in the prop. Both these dodges are not good if the stall is a real one, when the only remedy is to move the wing back.

Fully wound to about 2,500 turns, the model should fly, under good conditions and with a reasonable amount of luck, 27 to 28 minutes. The original model, with 2,000 turns, flew 22 minutes, of which 350 turns were not used. Flights of 14 minutes have been turned in by the model beneath a 35-foot ceiling. This should encourage those builders who do not have the advantages of a high ceiling.

SPECIFICATIONS

| | |
|---------------------|---------------|
| Wing area..... | 149.1 sq. in. |
| Tail area..... | 40.8 " " |
| Rudder area..... | 11.1 " " |
| Wing incidence..... | 1.5° |
| Tail incidence..... | -1.5° |
| Prop incidence..... | 0° |
| Prop pitch..... | 30.6 in. |

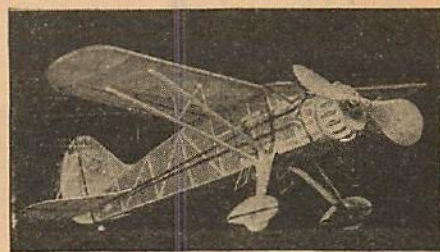
WEIGHTS

| | |
|-------------------------|-----------|
| Wing spars, center..... | .0085 oz. |
| Wing spars, tip..... | .0080 " |
| Wing ribs..... | .002 " |
| Microfilm (wing)..... | .002 " |
| Wing clips..... | .0025 " |
| Tail and rudder..... | .0035 " |
| Boom..... | .0035 " |
| Motor stick..... | .0175 " |
| Prop..... | .018 " |
| Total..... | .0655 oz. |

MATERIALS

$\frac{1}{16}$ " sheet, 4- and 5-lb. stock
 $\frac{1}{32}$ " sheet, $\frac{1}{64}$ " sheet
 Microfilm solution. Cement
 Wire, .010, .014, and .016" diameters
 Dural thrust bearing.

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| T | E | R | N | S | A | I | C | O | N |
| S | M | E | A | R | G | N | A | R | L |
| E | N | N | O | B | L | E | T | E | A |
| R | A | A | B | A | T | C | D | R | O |
| L | U | G | A | N | S | O | N | M | A |
| A | S | S | I | T | M | E | N | R | E |
| S | E | C | E | D | E | T | O | U | R |
| A | L | T | E | R | E | N | T | E | R |

Answers for December

MOFFETT

(Continued from page 44)

Now wind the motor tighter—from 400 to 900 turns. If you're afraid of losing the model in a current, fit the nose plug loosely so it will drop out after the motor is unwound. This will handicap the glide and the model will settle to the ground. With only 400 turns, Gray's ship flies 45 seconds under power and after the propeller stops glides for 1 minute.

SUMMARY OF DESIGN

Gray has been kind enough to send us some of his ideas on model design. Here are his comments:

"To be a place winner in a contest, your model must combine the following

points—stability, consistency, power, and gliding and soaring abilities. I say consistency as applying to one's self more than the plane. You've got to know your plane. If your model is stable, it will give consistent flights providing you're up to scratch.

"The free-wheeler is a necessity. The next step from free-wheeling is a folding propeller. The free-wheeler described in this article has been used by me from the start. It is simple and clean.

"Wing is of clean design. I prefer parallel wings in the respect that there is less area at the fuselage to be affected by air disturbances. It is easy to build, as all the ribs have the same profile. In a taper wing, 90 to 100 per cent of the chaps draw out the tip and root ribs, possibly one or two of the others, and then they contend that their tapered

wing is more efficient than your accurately constructed parallel wing.

"Fuselages in the future designs can be improved a great deal. This model was built in a hurry for the 1936 contest. I intended to use a round fuselage with a spinner on the propeller. Even better would be a fuselage with an elliptical cross section. The undercarriage on this model is simplicity itself, light in weight, and stands the gaff with little resistance to hinder the model."

After you've built and flown Gray's model you'll realize fully the soundness of Gray's ideas. Personally, we're very glad he won the trophy. And if we can't persuade it to return to the United States during 1937, we hope that Gray will continue to be its custodian during its sojourn in New Zealand.

RACING SPEED

(Continued from page 48)

wings before the top covers are put on. They were purposely included to aid in getting the wings lined up on the fuselage.

Now mount the wings on the fuselage frame with $1/2$ " dihedral angle.

AUTOMATIC MECHANISM

Study the parts and their purposes as shown in the various drawings. They may seem complicated at first, but careful examination will reveal that they are not difficult to construct. The "rear hook" mounting, illustrated in drawing 3, is the heart of the whole thing. Instead of having a rigid hook, a crank-like wire part, moving in an aluminum tube bearing, rises as the rubber is wound and pulls the control bar back about $1/4$ ". The control bar connects with the aileron crank, giving constant control, at X on drawing 1. Then at Y the doubled reverse bend in the control bar locks the flap control wire, if it is held up while winding, and when the motor runs down, the bend slips past the flap wire Z and releases it, letting the flaps down.

On toward the front, the landing-gear release latch is shown, in four different views provided to make that part clear. The latch is bent like a door-lock latch on the end of a crank. At the top of the tube, a plain crank is bent at an angle to derive the force from the rear-hook coupling, which is bent with a long eyelet to slide on the latch crank. A small spring holds the latch in engaging position when the motor is wound so the landing gear can be retracted, and yet the long eyelet is adjusted so it forces the latch off when the motor runs down.

The landing gear struts are in tripod shape as on the large plane. The struts C extend to the center of the fuselage and have bends made as illustrated,

which make an equalizer. The "equalizer" holds the two landing-gear halves in corresponding positions at all times and also allows for the cross center movement of the extensions. That is why the long loop is made. The landing-gear wires had to be soldered together in spite of the effort to evade this model-builder's hate. A spring of suitable strength holds the landing gear in the down position, eliminating the use of down lock and gaining a darn good shock absorber.

All in all, the three operations depend on the control bar being drawn back as the motor is wound and then moving forward again as the motor unwinds. The latches should be arranged so they release just as the motor completes unwinding.

COMPLETING THE MODEL

Split the top wing cover with an undercutting slice along the line of the aileron control. Force the control wire down on the ribs to make depressions and then cement the cover back together. It is best to leave the aileron off until the control is in. The aileron should be neutral with the motor unwound. Assemble the control parts and test them thoroughly before proceeding with the remainder.

Cover the top of the fuselage between formers 3 and 4 and make the cockpit covers of $1/32$ " sheet with celluloid openings. Make the windshield of two celluloid patterns and set it aside to attach when the model has been doped.

The tail surfaces are three-ply wood sanded to a streamline shape. The outside ply sheets are parallel $1/64$ " sheets over cross-grained $1/32$ " sheet. The two opposing plies tend to prevent warping, if dried properly. Cement the tail surfaces on.

Add bamboo stringers along the fuselage. The stations for these are not shown on the drawings for clearness and because you would prefer to use your

own number. Eleven tapered stringers were used above and below the side longerons on the original model.

Cover the model with yellow tissue. After the tissue has been dampened and dried to draw out wrinkles, dope the wings red and the fuselage and tail yellow, using the numerals and scheme shown on the model and in the Gallery photo on page 31. Now attach the windshield.

FLYING THE MODEL

The speed propeller designed especially for this model gives the best results. Leave the blades thick at the spinner and taper the thickness to the tips. Maintain the helical pitch, by all means. The first motor of four loops of $1/8$ " flat brown lubricated rubber should be installed before covering. After that a small hole must be cut in the rear of the fuselage to reach the "S" hook.

While testing the model, bind the landing gear and flaps in up position with rubber bands. Try to test in tall grass until you are confident of good adjustment, then use the controls you have sweated so much over and get a real thrill from seeing the things happen "up there."

MATERIALS

1 $1\frac{5}{8} \times 2\frac{1}{2} \times 2\frac{3}{4}$ " medium nose block
1 $1 \times 1\frac{1}{8} \times 6$ " propeller block
1 pr. $3/4$ " wheels or blocks
4 $1/16$ sq. x 18 " strips
1 $1/16 \times 1/8 \times 18$ " strips
7 $1/64 \times 2 \times 18$ " sheet
1 $1/32 \times 2 \times 18$ " "
1 $1/16 \times 2 \times 18$ " "
1 3×4 " .005 sheet aluminum
1 1×4 " " celluloid
12" #14 music wire
24" #12 " "
12" #10 " "
 $1/2$ oz. yellow dope
 $1/2$ oz. red dope
 $1/2$ sheet yellow tissue
8 ft. $1/8$ " flat brown rubber.

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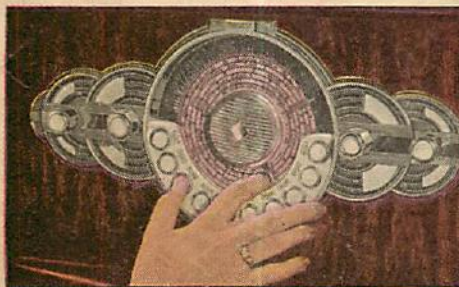
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