

'SPORTING goods'

*Pilot-constructed airplanes now are an accepted
part of the aviation scene
and flyers are taking a closer look at
general aviation's 'sporting goods' department*

The all-wood Pietenpol Air Camper first appeared in 1930. This is now enjoying a revival. However, with lighter modern flat-four engines replacing the original Model A Ford, a much longer nose is needed to maintain the proper balance.

EDITOR'S NOTE: When an authoritative article is sought on either antique planes or homebuilts, few are better qualified to write about general aviation's "Sporting Goods" than Peter M. Bowers of Seattle, Wash. Pete Bowers is well known to readers of *The PILOT* as the author of our "Yesterday's Wings" series. He is an aeronautical engineer and is now completing his 21st year with The Boeing Company. He joined Boeing in 1947 after six years with the U.S. Air Corps-Air Force. He is a graduate of the Boeing School of Aeronautics.

■ ■ Homebuilt airplanes, designated "amateur-built" by FAA and assigned a specific airworthiness category of their own, are growing up fast. More and more of them are leaving the little outlying no-radio airports and moving into the general aviation centers. The very fact that they are able to do this is evidence of their maturity.

It was not always so—although there have been homebuilts since the days of the Wright Brothers, they did not have legal status until 1947. Many of these were substandard "back-yard" products turned out by people with little structural or aeronautical knowledge. Some, however, were sufficiently professional to develop into production designs. When Federal licensing requirements went into effect in 1927, the pure amateur design became illegal. The license requirements were set up for commercial designs produced by companies that could afford the extensive stress analysis and the structural and flight testing required for an approved type certificate. No provision was made for the little guy who just wanted to fly around the back pasture in an airplane he designed and built himself.

This official suppression of homebuilts was gradual. The new regulations were Federal and, therefore, not binding on the states which had their own regulations. This left open a market for designs and materials for amateur builders for awhile, supported a small industry of plans and parts sellers, and filled sizable sections of several aviation and mechanical magazines with plans and news. However, this activity was slowly killed off as the state regulations were brought in line with the Federal, but a few bootleg operations carried on in out-of-the-way locations. Oregon was the last notable holdout, but the freedom of its skies ended with World War II.

It is due to the perseverance of one of the Oregon pioneers, George Bogardus of Troutdale, that homebuilts achieved legal status after the war. Flying a prewar homebuilt on a 90-day straight experimental license, the only kind he could get for it, George made a round trip to Washington, D.C., to prove the dependability of sensibly designed



homebuilts and petition FAA for recognition of them. The petition brought results, and the present "Amateur-Built" subcategory of the "Experimental" category became effective in 1947.

The new legality did not suddenly fill the skies with homebuilt airplanes. Even though Bogardus had formed a national organization, the American Airman's Association (AAA, not to be confused with today's Antique Airplane Association), the timing was unfortunate. Those who wanted to fly cheaply and for fun could buy a war-surplus trainer or liaison plane. Many builders, who should have risen to the occasion, started building midget (85 h.p.) racers for this new class that appeared at the 1947 National Air Races. (These ships are licensed as racers, not homebuilts.)

Today's homebuilt movement did not get rolling until the early 1950's. As an example of exactly the right action at exactly the right time, a new organization called the Experimental Aircraft Association (EAA) was formed in 1953 to crystallize and coordinate the renewed national interest. With this support, EAA was able to carry out the organizational and liaison work started by AAA, which had died of malnutrition in the lean postwar years. EAA membership has now passed 40,000 and its members have put an estimated 3,000 amateur-built airplanes into the air.

EAA and the homebuilt movement have grown together. With some 250 local chapters, the organization performs two main functions. It serves as an information and talent pool and also as an encouragement society. In the old days, the few successful homebuilts got written up in the magazines while the failures were deliberately ignored. Because of this, other builders repeated the same mistakes. EAA is extremely candid and objective, and unsuccessful experiments are carefully analyzed and the findings published for the benefit of all. At the chapter level there is great exchange of information and the would-be builder who is hesitant to start because of his lack of knowledge has the example of others before him and the backing of more experienced builders to give him confidence.

Although accepted by the general aviation pilot, most of the homebuilts are somewhat of a puzzle to him. He cannot quite see the role of an anachronism like a fixed-gear, open cockpit biplane at a time when the Piper Cherokee has to pull up its wheels to remain competitive. It's a matter of orientation. The average general aviation pilot is conditioned to the airplane as a training tool and as transportation. The homebuilder makes no excuse for his bird's limited utility. He has produced an article of sporting goods, pure and simple. Viewed in comparison with such items as small boats and sports cars, the lack of comfort, speed and range makes sense.

Perhaps the best way to distinguish between "sporting goods" and "transportation" is by the pilot's use of the airplane. Transportation is a means to an end. The operation of a sport plane



Smith DSA-1 "Miniplane" is most popular of the homebuilt biplanes. Original 65 h.p. produced marginal performance so majority have moved into the 85-125 h.p. range. With adequate power, such a midget can do recreational and even good air show aerobatics.



Wittman "Bonzo" was near-duplicate of 1947 Goodyear Racer "Buster," itself rebuilt from a prewar racer. With 85 h.p. engines over-revved to 3600 r.p.m. these 14-to-16-foot span midgets can do over 200 m.p.h. on the straightaways, but land over 80.

Nesmeth "Cougar," patterned after Steve Wittman's "Tailwind," combines with it to be the most popular of the homebuilt two-seaters. Power from 85 to 125 h.p. gives this 21-foot span wood and tube side-by-side design a cruising speed up to 160 m.p.h. Photos by the Author





Pitts biplane was first used by air show aerobatic pilots in late 1940's, now is popular with the homebuilders. Most use 85-125 h.p.; some show types carry 180. This 125 h.p. version was 1966 champion in new racing class for open cockpit sport biplanes.



The Corben "Baby Ace" of the early 1930's was modernized for homebuilders by EAA's president Paul Poberezny in 1954. Fuselage and tail are welded steel tube, 25-foot wings are of wood. Most of these are flown with 65 h.p. engines, use some "Cub" parts.

All-metal Long "Midget Mustang" was designed in 1947 to be a production article for sport or racing. Plans now on the market for homebuilders. This modified version has 18½ foot span and retractable gear; cruises 160 m.p.h. on 108 h.p. Starting is by hand.



is the end in itself, whether it be used for aerobatics, racing, or merely to carry its builder inefficiently but proudly around the pattern on wings he created himself.

The majority of homebuilts, approximately 80%, are single seaters for several good reasons. There is less airplane to build, less material to buy, less power required for snappy performance, and a simplified storage problem (some pilots team up and get three small ships in a standard T-hanger for a handsome saving in hangar costs). There is some resistance to single seaters on the part of the wives, but in general, those who have what it takes to build an airplane will not be unhappy flying alone. However, the "second generation" of postwar homebuilts is showing an increased emphasis on two seaters. Actually there is little "Lone Eagle" operations involved. Most owners of single seaters can find others to fly formation cross-country with or do a little friendly dog-fighting.

The major differences between the bootleg prewar homebuilt and the legal postwar model are nearly 100% use of aircraft quality materials and structures and reliable air-cooled aircraft power plants that provide decent power loadings. The major fault of the prewar designs was too much weight and not enough power. While available in the 1930's, the little flat-fours were too costly for most homebuilders, who used a variety of worn-out small radial engines and converted motorcycle and automobile engines, most notably the 40 h.p. Model A Ford. A few special designs today use the Volkswagen engine, but nothing has come, so far, from attempts to make a practical adaptation of the air-cooled Corvair engine. Almost all engines, instruments, and wheels used on homebuilts are bought as used items rather than new.

Power plants for the postwar single seaters started in the 65-85 h.p. range. When the pilots rediscovered a fact learned long ago by the homebuilders of the 1920's, that airplanes and power plants could not be scaled down equally, some of the smaller biplanes with spans of 15-20 feet moved up to the 90-125 h.p. range. About the only ones still using 65 h.p. engines are the relatively long span (24-28 foot) monoplanes.

In appearance most of the homebuilts are boxy and old-fashioned to such a degree that they are sometimes called "latter-day antiques" by more progressive designers and pilots. There is a reason for this, too. Simple lines generally reflect structural and aerodynamic simplicity. A relative few are thoroughly modern, with compound curves all over and such performance boosters as retractable gear and constant-speed propellers. Relatively few boast electrical systems and such luxuries as starters. Hand-starting is as much a part of open cockpit flying as helmet and goggles. Besides, the weight of starter, battery, generator and supporting gadgetry, nearly 100 pounds, imposes a considerable performance and payload penalty on an airplane that may gross between 700 and 900 pounds.

The absence of electrical systems generally precludes the use of radio, although many are now adopting battery sets like the "Standby 1" or the older "Airboy" for tower communications. Although normally licensed for VFR day flight only, some of the homebuilts go full electric with gyros and omni and are approved for night and IFR operations.

Construction methods and materials follow standard industry practices—but by about 25 years. Steel tube fuselages with fabric cover and wood-and-fabric wings, almost a memory in today's factories, are the most common homebuilt structures. All-wood designs are popular since many inexperienced builders have confidence in their woodworking capability but either distrust their metal working and welding or do not have the necessary tooling. Some homebuilts are all metal but Fiberglas is in use so far only for cowlings, wheel pants, and compound-curve fairings.

Only about 20% of the homebuilts flying are designed by their builders. Many of these are not really original, being largely copied from long-established commercial designs or from other successful homebuilts. It is unfortunate that the postwar midget racers got started before the homebuilts. The racers influenced some of the early homebuilt designs which, with equivalent size and weight but lower power, had very poor low speed flight characteristics. Very few of the homebuilders are inventors or even good innovators, and with good reason. When they are going to spend between 1,000 and 2,500 man-hours, and approximately the same number of dollars, on a recreational airplane, they want assurance that it will perform reasonably well. This encourages the most conservative methods and configurations and earns the "latter-day antique" appellation. The other 80% of the builders buy plans for proven designs that are available at prices from \$15 to \$150.

Most of the airplanes built from purchased or published plans are faithful to the original in basic structure and aerodynamics. Some builders make minor changes to satisfy their own desire for individuality, because they think they are making actual improvements, or merely to save time and money by using parts that they already have. This results in many variations in cockpit and cowling details, wing tip and tail shape, landing gear construction and, of course, engine power. There is nothing in the regulations that says the builder has to follow the plans.

To the great dismay of the designers, a few builders adulterate the design to the point where it is nearly unrecognizable—usually with detrimental effect. The designer has usually considered most of the possible variations himself and rejected them for good reasons. Some of the changes are inadvertent—the builder made a mistake somewhere along the line, but was able to carry on from that point. The most common crime committed by the builder against the designer is his tendency to increase



Although a "Latter-Day Antique" in appearance and construction, all-wood Bowers "Fly Baby" won EAA Design Contest for easy-to-build, easy-to-fly beginner's homebuilt. Does well on 65–85 h.p.; larger engines introduce structural and weight penalties.



Volmer VJ-22 "Sportsman" features a wooden hull and 100 h.p. engine installation that can use wing and tail surfaces from Aeronca "Chief/Champion," Taylorcraft, or Piper "Cub." FAA permits use of factory-built parts on homebuilts within reasonable limits.

All-metal Andreasson BA-7, built while designer was employed by Convair, is now a production article; built by Malmo in Sweden and Bolkow in Germany. Some of the Bolkow "Juniors" have been imported into the United States and fitted with 100 h.p. Continental engines.



the gauges of structural materials. An extra 50 to 100 pounds can appear this way as if by magic, and on an airplane that is usually structurally overdesigned in the first place.

Obsolescence is an unknown term among the homebuilders. Age does little to diminish the popularity of a design. Some, such as the Corben *Baby Ace* can trace their origins to the late 1920's. The all-wood Pietenpol *Air Camper* of 1930 is suddenly a hot item among the builders. The rationalization here is that you have to go back a long way to find the simplicity and low cost sought by the relatively unskilled builder/pilot. The additional miles per hour found in more modern designs of equal power are generally achieved by structural, aerodynamic, and cost compromises that the fly-for-fun pilot is unwilling to make. This lack of concern with m.p.h. on the upper end of the performance curve is a further distinction between sporting goods and transportation.

The performance of the homebuilds, especially the smaller ones, hands the general aviation pilot his greatest surprise. If the homebuilds have one flight characteristic in common, it's quickness. Because of the smaller dimensions and weight, their inertias are much lower. With short spans, especially for the biplanes, the rate of roll is terrific. With the same power as larger and heavier production types, the homebuilds show rapid acceleration on take-off. The pilot of a Cessna 140 who flies a single-seat 85 h.p. *Fly Baby* is apt to find himself 10 feet in the air at about the time he'd expect to get the tail up on the 140. With a climb propeller, an 85 h.p. *Fly Baby* is off the ground in 250 feet and climbing 1,100 feet per minute.

The extremely short length of some homebuilds contributes to a certain amount of ground-looping tendency. Tricycle landing gear, a weight and drag handicap on the smaller designs, is usually reserved for two seaters. Practically all homebuilds are "rudder" airplanes, and that surface can be seen working constantly during the landing approach and rollout.

The smaller size of the homebuilds results in lower Reynolds' numbers and greater aerodynamic interference fac-

tors, which produce the equivalent of higher wing loading. These result in surprisingly high sink rates. A power-off approach in a small biplane is a shallow dive at the end of the runway. "Float" is not one of their characteristics. To get *Cub* performance, one has to have *Cub* wing loading and *Cub* size.

These characteristics do not mean that the average homebuilds are vicious or even tricky by "winged automobile" standards. They handle differently in inverse proportion to their size and power loadings. The two principal errors committed by general aviation pilots when checking out are overcontrolling and underestimating the rate of sink. The control problem usually results from the fact that they apply the control forces they are used to in heavier airplanes. This is overcome by a cautious approach and a little practice.

The legal aspect of homebuilds is not as sticky as one would expect from the formidable word *EXPERIMENTAL* painted on the sides. Flight restrictions are practically nil after an initial proving-out period of 50 hours within 25 miles of the home base (75 hours if using a noncertificated engine). They are licensed for recreational and educational use only and cannot be used for hire but can be used for personal transportation connected with a business. They are not to be flown directly over cities, large gatherings, etc. The experimental status complicates the insurance problem, but more and more of the life policies are now permitting flight in homebuilds. EAA and FAA are working together right now to remove the onus of *EXPERIMENTAL* by creating a new "Special Airworthiness" category that will give qualified homebuilds what amounts to an approved type certificate.

Those that build their own planes can get them approved for flight and can do their own maintenance without having a mechanic's license. FAA engineering inspectors keep an eye on the construction and lift the initial flight restrictions after the test period. After that, annual relicensing is done by the FAA safety office. Homebuilds can be sold, but the buyer has to have a mechanic's signoff on maintenance and inspection when applying to the FAA for renewal of the

airworthiness certificate.

It used to be that a builder could cut down and rearrange the major components of a *Cub* and have a homebuilt airplane, but no more. To qualify as a "homebuilt" today, 51% of the airplane has to be made by the builder, although the regulations do not say whether this is by weight, area, or man-hours. Neither can a designer put out extensive kits of prefabricated parts, with formed and predrilled skins, etc. All the builder does here is assemble an aeronautical Erector set, not build an airplane.

Within reasonable limits, factory built components can be used. These are mostly engine mounts, gas tanks, control system components, and in some cases, landing gear. The Volmer VJ-22 amphibian was designed for and is allowed to use Aeronca *Chief/Champion* wings and tail. Some extensively rebuilt antiques, notably non-ATC'd civil designs or old military types that could never qualify for standard licenses, are licensed amateur-built to give them greater operational freedom than they would have under straight experimental certification.

Plans for several dozen successful designs for home building are on the market. Few advertise in the general aviation magazines but ads for practically all can be found in EAA's own monthly magazine, *Sport Aviation*. This 60-page slick-paper journal is edited by EAA's president, Paul Poberezny, and covers all aspects of the homebuilt movement. It is not available to the general public, being one of the benefits of the \$10 annual membership. Even if one has only a slight interest in homebuilds as such, membership is worth the price for EAA also covers antiques, history, soaring, and the other hobby aspects of aviation that involve "sporting goods." EAA headquarters is at P.O. Box 229, Hales Corners, Wis. 53130 (a suburb of Milwaukee).

If you want to see the cream of the homebuilt crop, head for Rockford (Ill.) Municipal Airport when EAA holds its annual convention from July 28 through Aug. 3. This will be attended by a combined total of 500 homebuilds and antiques and about 3000 general aviation models that drop in to see the show. □