by MICHAEL F. JERRAM

Like the Cub in America, the name Tiger Moth has become synonymous with small plane to the English, and you might therefore suppose that the airplane was the product of meticulous planning or inspired genius. The disappointing truth is that it was a child of serendipity, born out of the very best traditions of table-napkin design and eyeball engineering. It was cobbled together piecemeal—an engine from here, an airframe from there, a little trial, a little error, and more than a hint of luck.

By 1931, de Havilland was building the last of the upright-engine Moths the DH6OM Metal Moth—and a military variant was submitted to the British Air Ministry as a potential trainer for the Royal Air Force. Civilian Moths were well-proven and popular the world over, but the ministry was not at all happy with the location of the center-section fuel tanks directly over the front cockpit. This made rapid exit almost impossible—and therefore dangerous—for a pilot in full-service flying kit and parachute.

But they did like the ship generally, and Geoffrey de Havilland, mindful of the prestige value of an RAF order, had his chief designer, Arthur Hagg, set to work modifying the Moth in a tiny shed at Stag Lane Aerodrome (a muddy, little field near London, long since disappeared under concrete, where the great de Havilland enterprise had its humble beginnings).

Hagg took as his basis a Metal Moth airframe mated to one of the new 120-hp Gipsy III inverted, inline engines from a Puss Moth cabin tourer. The obvious solution to the cockpit-access problem was to shift the center section forward, which he did—by 18 inches at first and then by another four—until the cabane struts were completely clear of the cockpit.

The center of gravity was now behind the center of pressure, so Hagg swept the wings by shortening each wooden rear spar, bringing the tips of the upper wing 11 inches aft and the lower, nine. This is why a Tiger Moth's wing ribs, unlike those of a Great Lakes or a Pitts, do not align with the airflow.

The result was the DH6OT, which took its name, Tiger Moth, from an earlier de Havilland design, the little DH71 racer. Eight were built using Hagg's mock-up in lieu of plans, and flight trials soon revealed that the sweptback wings had brought the ailerons perilously close to the ground. No problem. They clipped a few inches off the bottoms of the interplane struts and off went the planes to the Aircraft and Armament Experimental Establishment at

A Tiger's Tale England's greatest trainer endures as a classic collector's piece



A cherished collector's piece now, the de Havilland Tiger Moth introduced a generation of British pilots to flying. It is as revered as the American Cub and Stearman. Photos by the author.

Martlesham Heath in Suffolk for evaluation.

An order for a production prototype followed swiftly enough for de Havilland to have it flying within the month, though none of those associated with the project—de Havilland himself, or Hagg, or test pilot Capt. Hubert Broad knew then that they had created an enduring classic. Thirty-five of the new model DH82s, called Tiger Moth Mark Is were ordered for the RAF, and in all 134 were built, including 20 manufactured in Norway and Sweden.

Most aircraft went to the military whose demands were so great that the many British flying clubs that wanted the airplanes were unable to have them.

In the fall of 1934 the DH82A was introduced, with the improved 130-hp Gipsy Major I engine and plywood turtleback replacing the stringers and fabric of the previous model. It was this air-



plane, the Tiger Moth Mark II, that was to achieve the greatest fame of the series. When the production lines closed in August 1945, 9,231 had been built of which 8,677 were DH82As or 'Cs (the Canadian version)—in England, Norway, Sweden, Portugal, Australia, New Zealand and Canada. Maybe 500 still exist, a healthy survival rate for what were essentially expendable airplanes.

Tiger Moths are distinctly military airplanes, with cramped tandem cockpits and few of the niceties of their tourertype contemporaries. They do have baggage compartments, though, and climbing aboard is made easier by deep, hinged-door panels and the absence of the bracing wires and exhaust pipes that were a painful trap for the unwary on earlier Moths (though those long exhausts did a fine job of heating the cockpits). The doors may be unlatched in the air for more elbow room, but at the expense of raw blasts of wind that, in any case, seem to penetrate a Tiger's cockpit everywhere.

Even by the standards of their day, Tigers are extraordinarily cold and drafty airplanes; a good flying jacket is desirable even in summer (in England, at least), and goggles are essential in the rear position though you may barely manage without them up front. You need a chunky cushion, too, if you are short-limbed, for those cockpits were intended for seat-pack parachutes, and you really cannot see much at all over the panel when sitting up front.

Communication between occupants was never a Moth strongpoint. It relied upon the Gosport tube, a curious contraption of hoses connected to the helmet earpieces (not unlike but much less efficient than a doctor's stethoscope) through which instructors somehow managed to hammer home the rudiments of airmanship to their ear-straining students. Gosports are a little better than a couple of cans and a piece of string, but only just, and you could always tell a Tiger man by the minstrelblacking of his face from the rubber mouthpiece.

Most Tigers have electric intercoms now, but, if not, you might be better off passing notes to and fro, taking care not to knock off the mag switches that are outside on the cockpit coaming. ("Up" is hot, "down" is off.)

Flight controls and instruments are duplicated. The rear cockpit, from where the airplane is flown solo, has an additional lever on the right side to lock the Handley-Page slats when taxiing over rough ground or doing aerobatics. A spring-loaded "cheese-cutter" trim lever is mounted in a quadrant on the leftcockpit wall and connected to a J-3-style variable-incidence tailplane. There are no brakes, just a tailskid to slow you up by tearing out great chunks of the grass from which you must operate.

Bring your own chocks. The skid is rudder-linked, restricting full and free pedal movement while the airplane is stationary. Once on the move, it is a reasonably effective means of calmweather steering. However, Tigers are notoriously contankerous in wind and need someone to grab hold of the wingtips, which—wouldn't you know—have no hand-holds. With no tailwheel, manhandling is also a pain, for a Tiger must be caught by its tail, hoisted shoulderhigh and trundled, wheelbarrow-style.

The Canadians fitted Bendix brakes and castoring tailwheels to their Tigers and in deference to the climate, added sliding canopies and cockpit heaters.

Trickier to fly than their contemporary trainers (the Hawker Tomtit and Avro Tutor), intolerant of sloppy handling, and having a knack of magnifying every little shortcoming in a pilot's technique (though never to the point of being dangerous), the Tiger Moth was an excellent and, despite all, forgiving airplane. It was popular with instructors and the bane of students' lives.

It was said that if you could fly a Tiger you could fly anything, and those who were taught in them truly learned to fly. In the early war years these men would like as not go straight from Tigers to Spitfires or Hurricanes. In these singleseat fighters, they could have no dual instruction—just an hour or two reading the pilot's notes, some words of wisdom from those who had gone before (often just a few days before, which made them experts)—and off they went, sink or swim. Quite a few sank, and those that swam might have thanked the Tiger's little idiosyncracies.

Not that a Tiger Moth's performance is exactly fighterlike. It will climb 800 fpm at 60-65 mph, cruise around 80-85 mph and, throttle to the wall, will give you maybe 105 mph downhill. At around 60 mph indicated, the wing slats, which deploy at a predetermined angle of attack, begin to slide out, holding off the stall to 45 mph. By careful airspeed control, you can putter along watching the slats pop out and back like the paws of a cautious cat toying with a mouse.

Although a Tiger spins fast and with enthusiasm, it recovers impeccably. The tigerish reputation is largely undeserved, dating from the time when, following the Allies retreat from Dunkirk in WW-II, the RAF experimentally fitted them with underwing bomb racks to attack invading German troops on the beaches. Test pilots found that the hitherto conventional spinning characteristics of some of the airplanes were seriously impaired; one Tiger took 13 turns to recover, so a couple of antispin strakes were tacked on, just ahead of the tailplane.

Modification #112, the latest addition was called, and you'll find that most ex-RAF Tigers (which is most) still do have them. After the war, the Dutch civil aviation authorities—a conservative bunch at the best of times—insisted that any Moth certificated in Holland

A TIGER'S TALE continued

should have a large triangular-fin extension added, a modification as ungainly as it was unnecessary.

Aerobatics? A Tiger Moth will loop as nice as you please and do immaculate hammerheads. Where it falls down (excuse the pun) is in its lack of inverted capability. The fuel is gravity-fed from the 19-gallon, center-section tank, and the Gipsy engine just will not run for long inverted (maybe that should be right-side up?). The flat-bottomed airfoil is against inverted flight, too. Someone once installed a set of slip-on symmetrical landing edges on a Tiger, but they were not especially effective and were soon removed.

Alan (later, Sir Alan) Cobham's flying circus airplanes had separate fuel tanks in their front cockpits, pressurized by wind-driven pumps to enable the craft to be flown inverted for as long as there was gas in the auxiliary tanks, and it worked well enough. One of his pilots celebrated the 25th anniversary of Bleriot's English Channel crossing by flying a Tiger across inverted.

The Super Tigers flown after WW II by the Tiger Club (the American branch of which was started in Waco, Tex., by



Climb at 60, cruise at 80, stick the nose down with full power and you might get 105 mph. Aerobatics? Great. Just don't remain inverted too long—the Tiger has no inverted fuel system. If you want one, start looking, because there are only about 500 left of over 9,000 built between 1934 and 1945. Frank Price



Like the British sports car of the era, the Tiger Moth is drafty, cramped, sparse of creature comfort and intolerant of sloppy handling, but it rewards the skilled hand with an enjoyable flying experience.

Frank Price) were similarly modified for sustained inverted flight. Their tanks were relocated in the front cockpits, uprated Gipsy Major 1C engines with inverted systems were added along with beefed-up wings and increased elevator area.

Even so, these planes suffered a failing inherited from the earliest Moths poor aileron control, thanks to Hagg's differential gearing that slowed the movement of the downgoing aileron to eliminate adverse yaw. It was also supposed to roll the airplane level if it was stalled in a turn, but in so doing it produced a mushy control response that was further aggravated by the lack of ailerons on the top wing.

"One machine adaptable for every branch of training-flying, fighting, bombing, photography or wireless," ran de Havilland's publicity puffs for the Tiger Moth, and training was, of course, its primary role. Hundreds of thousands of British and Commonwealth pilots gained their wings on them at Reserve Flying Training Schools, under wartime Empire Training Schemes and with RAF Volunteer Reserve and University Air Squadrons right into the mid-1950s. The Tiger was indeed most adaptable, and de Havilland might well have added float- or ski-plane, artillery spotter, light bomber, ground attack, communications or maritime-patrol airplane-or even target drone-to publicity releases.

The bombers carried eight 25-pounders (aimed by using the center-section bracing wires as sights) on racks



beneath the wings or fuselage. Another scheme involved fitting trays under the rear-instrument panels for stowing grenades that the pilots were supposed to drop down chutes set into the floor. The top brass thought this a grand idea, but the pilots, pondering the dire results of live grenades jamming in the chute, thought otherwise, and the scheme was abandoned.

Five Tiger Moth coastal patrol units were set up in 1939 at bases in Scotland, Northern Ireland and the northwest coast of England. The airplanes flew in pairs on "scarecrow" duties, recording shipping and watching for Uboats. Their pilots were tormented by freezing seaspray from which wing and tail surfaces of the plane were protected by coatings of gooey, yellow lanolin paste. If an enemy submarine was sighted, pilots were supposed to fire off flares to summon naval units for the kill, and, incredibly, one U-boat was sunk as a result of these patrols.

Ditchings were not uncommon, and the airplanes carried a brace of homing pigeons (honestly!) in wicker baskets on the front seat so a downed pilot could send a note of his position back to base. The birds were nothing short of a liability and an actual occupational hazard because wood shavings (provided for their comfort), loose feathers, and a profusion of droppings were all blown back into the pilots' faces, causing sore throats and even more sorely frayed tempers.

Most bizarre of all was a device called

a "paraslasher." Pure Rube Goldberg in conception, it was a farmer's handscythe attached to an eight-foot pole projecting through the airplane's floor so that it lay flat along the fuselage but could be swung down vertically when required.

The Tigers, it was thought, would fly among invading paratroops, cutting canopies and shroudlines and further harassing those who made it safely to the ground. It is easy with hindsight to mock, but at the time a Nazi invasion of England looked imminent, and ploughshares had rapidly to be turned into swords, however makeshift. The prospect of being split asunder by 18 inches of cold steel, traveling at 90 mph was scarcely relishing, and it just might have worked.

Some Tigers even flew without pilots. The DH82B Queen Bee, which appeared in 1934, was a gunnery-training target drone—what we would now call an RPV. It claimed to be the world's first truly operational pilotless airplane. The Queen Bee had a wooden fuselage for buoyancy and economy (instead of the Moth's welded-steel tubes), increased fuel tankage and a strengthened airframe for catapult launching from a ship's deck.

The guidance system was based upon the two-axis Mark 1A autopilot, incorporating gyroscopically controlled compressed air valves operating pistons linked to elevators and rudder via a radio receiver and relay in the rear cockpit. The front position had conventional stick and pedals and a telephonedial selector for initial fine-trimming of the automatic controls by a test pilot who could override the radio signals by means of trip levers on the control column.

Most Queen Bees were operated on floats and controlled either by direct transmission from a ship's radio room or by a "portable" console. (It stood six-feet high and weighed 1,500 pounds.) Nine commands were available by pushbutton or dial: climb, dive, straight-andlevel, right turn, left turn and so on, and the autopilot was preset at standard rates for each maneuver (a turn was rate one, climb was 400 fpm, standard operating height was 9,000 ft msl).

Radio control was in its early infancy at the time, and many an operator had the experience of being buzzed by his Bee or watching it disappear over the horizon, oblivious to all commands. The Queen Bee had a novel automatic landing device, triggered by a bob-weight at the end of its 30-foot trailing aerial. When the radio operator selected "glide," the throttle was retarded, and the drone would glide down until the aerial struck the water's surface, thus automatically transmitting "throttle fully closed, switches off, stick back." The drone would settle onto the water to await recovery

With the uncluttered approaches of

open sea, the system was more or less foolproof. Trouble began when they converted a couple of airplanes to land gear and flew them from shore bases, forgetting about the automatic landing aerial. As the Bees approached the field, over trees or hangars, the aerials touched, the throttles closed, the sticks went back

Tiger Moths soldiered on in RAF service until 1954 when they were replaced by Chipmunks, and then began a new era of Tigers, Tigers everywhere. They were sold off as surplus at give-away prices. One purchased by a friend of mine cost him about \$45, and he still has it. Hangars at Croydon Airport were stacked to the very roof with Tigers, and one-by-one they reemerged, flawlessly rebuilt for sale to clubs, private owners, and even foreign airline training schools. Versatile in peace as in war, the old Tiger served as trainer, glider-tug and cropduster, playing as great a part in the perfection of aerial agriculture in Europe and Australasia as did the Stearman in America.

The Tiger Club used them to revive the touring airshow and to resurrect the nearly forgotten art of wing-walking. For those who preferred to remain inside, there appeared the curious Thruxton Jackaroo, a four-place cabin conversion, intended to provide low-cost touring capability. Jackaroos (an Australian word meaning "newcomer") were certainly not pretty airplanes like Wacos or Staggerwings, but they were cheap. Nicest of all was Shelia Scott's, which had white leather upholstery. Hardly a good idea, since you had to plunk your muddy boots onto the seats to get into the things.

The Tiger Moth is a collector's piece now. Most have been lavishly and lovingly restored, often in the wartime camouflage that they all once had. One has an improbable red-and-white checkerboard scheme that turned out to be the same design as was applied to an RAF aerobatic team's Tiger in 1932 (the Red Arrows or Thunderbirds of their day). A friend of mine has one finished in the colors it had carried when it served at an Empire Flying Training School, and he bases it at the same field from which it flew during the war.

Were Tiger Moths the world's greatest trainers? Those who had learned in them and from them would have it so. As with first loves, so with first airplanes. To the Englishman, his Tiger; the American, his Stearman; the German, his Stieglitz or Jungmann. And there is probably a hero of the Soviet Union, somewhere up there in his Foxbat, who still keeps a yellowing snapshot of a Polikarpov Po-2 tucked away amongst his rubles.

Perhaps in 20 or 30 years when we're all reminiscing about those fine old Cherokees, 150s, Yankees, or whatever, there will still be someone around to say, "Ah, but you should have flown a Tiger Moth." And so you should.