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AIRCRAFT CIRCULARS

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

No. 65

THE DE HAVILLAND 61 "CANBERRA" (BRITISH)

A 6-8 Passenger Airplane

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THE DE HAVILLAND 61 "CANBERRA" (BRITISH)

A 6-8 Passenger Airplane.*

A new commercial airplane has been designed and constructed by the De Havilland Aircraft Company for an Australian firm. The airplane has passed most of its flying tests so that a more detailed description of it has become possible. A few more tests still remain to be carried out, but already it has been definitely established that the DH-61 has a quite remarkable performance for the paying load it carries. For instance, the paying load is no less than 1900 lb. (with a Bristol "Jupiter VI" engine) and with this the airplane has a top speed of 126 M.P.H., and will cruise well throttled at 105-110 M.P.H., at which speed it has a still-air range of about 475 miles.

In designing the DH-61, Colonial requirements were kept in mind, and although the airplane has been produced specially to the order of a fruit preserving company, the 61 should, by very minor alterations, be a suitable type for quite a number of regular air lines where as yet the traffic is not large enough to justify the purchase of a more powerful three-engined type. Its load-carrying capacity is such as to make it an economical airplane to operate, especially bearing in mind the high performance. For instance, with fuel for nearly 500 miles at a cruising

*From "Flight," December 29, 1927.

speed of well over 100 M.P.H., the paying load is 4-1/4 lb./HP. For shorter ranges this load is, of course, correspondingly greater, and vice versa. As the Bristol "Jupiter" has a reputation for low cost of upkeep, the 61 should be an airplane with many applications. The fitting of floats would probably be a comparatively simple matter, so that in districts where the seaplane type is to be preferred the 61 again would seem to meet the case. As a seaplane the paying load might be slightly smaller, although the difference would probably not be sufficiently great to be really serious.

General Design

There is little in the general design of the DH-61 to indicate that its flying qualities are at all out of the ordinary. The airplane is just a straightforward tractor biplane of typical De Havilland lines, and in a group of airplanes it might easily pass more or less unnoticed.

The "Canberra," as this first "61" has been christened, is an airplane of a total loaded weight of well over 6000 lb., so it must be realized that the biplane arrangement is very much more compact, especially as the wings are designed to fold back. To design a large monoplane with folding wings is a serious problem, and the consequence is that one sees nearly all monoplanes with one-piece wings, requiring a large hangar space and presenting very serious problems in transport. The advantages of the monoplane over the biplane would have to be very considerable to make

it worth while adopting the type, and as they are by no means so, it is not a difficult matter to make out a very good case for the biplane. One may be quite certain that the De Havilland Aircraft Company is fully alive to this fact, and that the biplane arrangement was not chosen merely because most of the firm's airplanes have been of that type.

As to the features of the design which have resulted in such a good performance for the load carried, it is not very easy to point to any one thing and say that that is the main reason. The fuselage is of the type which has come to be somewhat derisively known as "slab-sided," and it is of relatively large cross-sectional area. Thus, superficially, there seems to be little reason to expect a very low body drag. On the other hand, the nose of the fuselage has been very carefully designed, and as the pilot's cockpit is well aft of the wings, the whole front portion of the fuselage is entirely free from excrescences (with the exception of an oil cooler and an air intake for the ventilation of the cabin). The "Jupiter" engine, in spite of a not inconsiderable diameter, looks quite small on this fuselage, and in spite of the relative absence of cowling, it seems likely that the air flow over this region is fairly free.

The biplane wing arrangement has also been designed with a view to good aerodynamic efficiency. The wing span is 52 ft., the wing chord 6 ft. 3 in., and the gap 7 ft. The gap/span ratio is thus 7 : 52 = 0.135. The "span loading" (i.e., $span^2/W$) is

2704/6200 = 0.436. At the cruising speed of 110 M.P.H. L/D_i (ratio of lift over induced drag) is 54. This is the monoplane value, and with the biplane arrangement used, i.e., a gap/span of 0.135, this value is increased to 68.8, so that the induced drag at the cruising speed is only 90 lb., corresponding to a horsepower of 26.4 only. Even allowing for propeller inefficiency, the power required to overcome induced drag at cruising speed is under 40 HP. A monoplane, to give the same value of induced drag at the same speed, would have to have a wing span of about 66 ft., and as it would probably not be fitted with folding wings, would be rather a cumbersome affair for its weight. The thin wing section of the 61, plus its bracing wires and struts, probably has no greater profile drag than that of a thick section such as would be used in a monoplane wing.

Structural Design

Intended for use in Australia, the DH-61 has been designed as a very simple and robust airplane, mainly of wood construction, and such few metal fittings as are unavoidable have been kept as plain and straightforward as possible. The fuselage is of the normal De Havilland type, with four longerons and a skin or planking of plywood. This again, is covered with fabric, and all joints and edges in the plywood are similarly protected. The fuselage is built in two sections, bolted together, the joint being covered with a glued-on fabric strip. The roof of the

cabin forms another unit, bolted and screwed to the top longerons, which can be removed for repairs or when a thorough inspection of the fuselage structure is required.

The installation of the "Jupiter VI" engine is of very simple type, the engine plate being of duralumin, supported on steel tube members. The whole unit is detachable from the fuselage by undoing four bolts at the corners, the structure remaining being a complete and rigid unit without loose parts. The gasoline supply is of the simple gravity, feed type, the center section of the top wing forming the gasoline tank with a capacity of 80 gallons. This center section is situated slightly higher than the two halves of the top wing, so that when the wings are folded the trailing edges of the top wing can pass under the center section tank, thus avoiding any complication in the design of the corners of the top wing (Figure 4).

The oil tank is made in one with the top cowling, making one unit instead of two, and one mounting common to both. The oil cooler is mounted direct on the top of the tank. The oil temperature gauge is inserted in the sump alongside the outlet to the engine, so that the correct temperature should be recorded. A cock is provided which must be turned off when the airplane is standing, and to avoid the danger of starting without turning this cock on, a magneto earthing switch is arranged to cut out the magneto when the oil is turned off.

The wings are mainly of wood construction, but have metal drag struts. All drag wires are connected direct to the ends of

the struts, so that cross-grain shrinkage does not affect their adjustment for tautness. The ribs are made a floating fit on the spars, metal tracks and leading edges being employed. Provided the wings are rigged according to instructions, there is no need for jury struts when folding the wings.

The landing gear of the DH-61 is of somewhat unusual type, in that there is no axle. This type of landing gear has become very popular in America, as it has been found that it gives less tendency for the airplane to "nose over" when alighting on rough ground, in tall grass, or corn. Instead of the usual type, however, quite a different arrangement has been evolved, the general scheme of which will be clear from Figure 6. The usual vee on each side, i.e., the telescopic compression "leg" and the "radius rod," are rigidly fixed together at their lower ends, the lower tube of the telescopic "leg" carrying the wheel being overhung as a cantilever from the point where it emerges from the upper tube to the wheel. The structure on each side is completed by a transverse diagonal strut running to the longeron on the opposite side. With this arrangement, the angle of the diagonal struts is very good, while a wide wheel track is provided, and the bend in the axle tube is not so sharp. Springing is by rubber blocks in compression, and the blocks are lightly loaded so as to prevent them being over-compressed, with consequent hardening. All working points are provided with "Tecalemit" grease gun nipples, with the exception of the telescopic tubes, which are lubricated by

oil fed through oil cups at the top of the "legs."

The cabin of the DH-61 is of generous proportions, the width being no less than 4 ft., so that two passengers sit side by side very comfortably indeed, while if desired, it is possible to carry three side by side, although the accommodation is then slightly cramped. The sofa seats are arranged across the cabin against the front and rear walls, and two bucket "seats" are placed in the middle of the cabin, between the two others. There is a space between them, so that passengers can get to the front sofa seat easily.

The pilot's cockpit, an extraordinarily roomy one, by the way, is placed well aft of the wings and cabin, and extends upward into a sort of "conning tower." It might have been thought that the view, with such a wide fuselage in front, would have been rather poor. As a matter of fact, it is very much better than one would expect, and only in dropping the tail to land is it obstructed to any serious extent. However, even then, by looking diagonally, instead of straightforward, the pilot can easily see the ground ahead. He will already have made sure, in gliding in to land, that the ground straight ahead is clear. The advantage of having the pilot aft is that the trim remains unchanged, so that it is never necessary to carry useless ballast to trim the airplane. Cynics might say that also this is is a very safe place for the pilot in a crash, so that he would probably live to relate what went wrong! A small window between cabin

and cockpit permits of communication between pilot and passengers.

The luggage space provided is on an unusually generous plan, one compartment being situated ahead of the cabin (Figure 5), large enough to hold a couple of cabin trunks, while a smaller compartment is under the pilot's cockpit. In the cabin there are spaces for light hand luggage in the forward wall, and two smaller recesses in the aft wall.

Altogether, the De Havilland 61 is one of the most comfortable of modern airplanes, and it deserves to become very widely used in localities where a medium power airplane suffices for the amount of traffic obtainable.

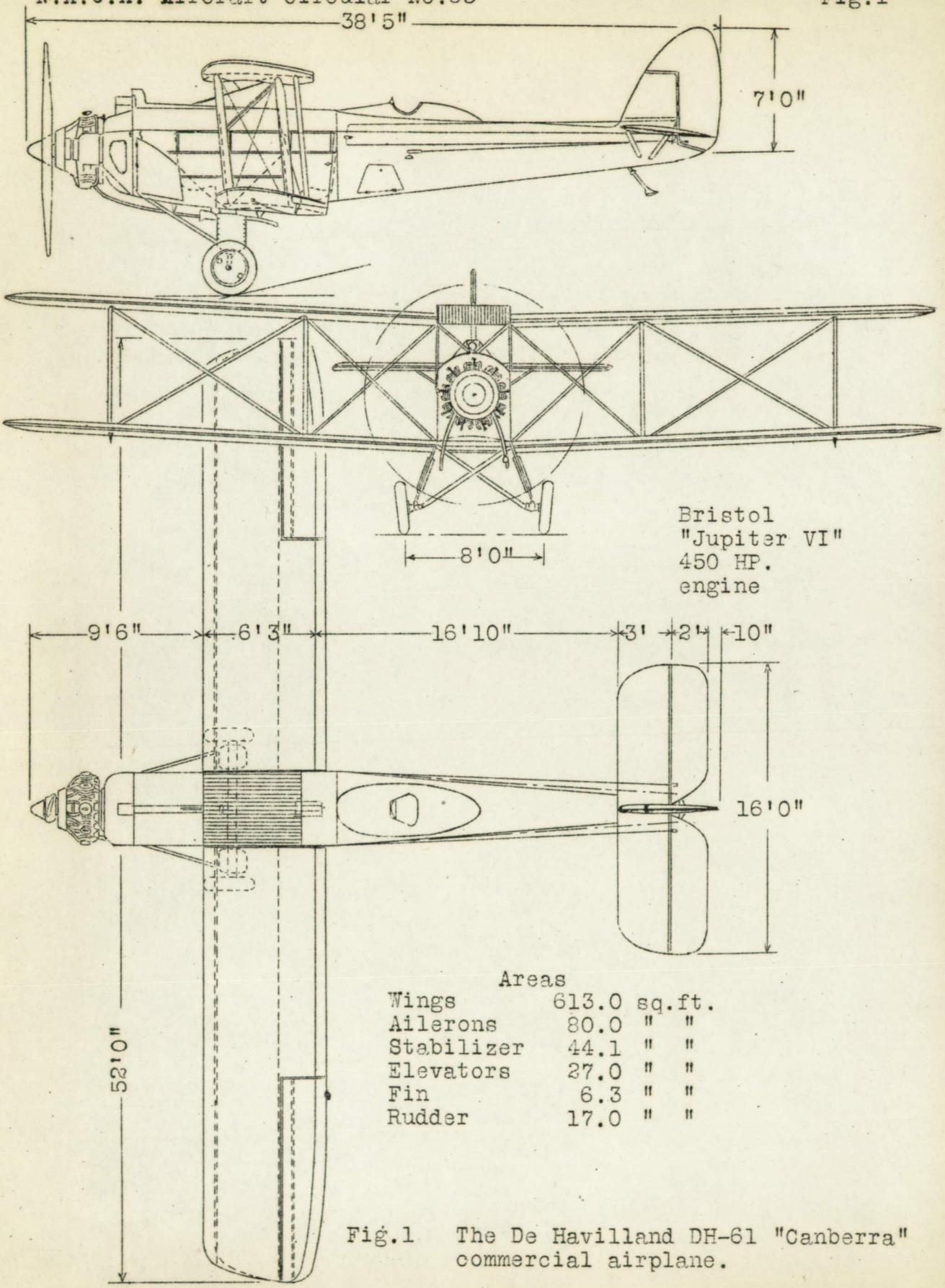
The main characteristics of the airplane are:

Total loaded weight	6200 lb. (2280 kg)
Paying load	1900 " (864 ")
Gasoline	80 gal. ($4\frac{1}{2}$ hours cruising)
Wing area	613 sq.ft. (57 m^2)
Wing loading	10.1 lb./sq.ft. (49.5 kg/m^2)
Power "	13.8 lb. (6.27 kg) per HP.
"Wing power"	0.734 HP./sq.ft. (7.9 HP/m^2)
Span loading (biplane)	0.436
Top speed	126 mi./hr. (203 km/h)
Cruising speed	105-110 mi./hr. (170-177 km/h)
Stalling speed, about	47 mi./hr. (76 km/h)
Rate of climb	650 ft./min. (3.3 m/sec)
Ceiling	15,000 ft. (4570 m)

Everling Quantities (Metric Units)

"High-speed figure"	19
"Distance figure" (top speed)	4.8
"Altitude figure" (ceiling)	8.9

While the "distance figure" is of about average value, the "high-speed figure" and "altitude figure" are both unusually high, especially the former, which is far above the average.



Areas

Wings	613.0	sq.ft.
Ailerons	80.0	" "
Stabilizer	44.1	" "
Elevators	27.0	" "
Fin	6.3	" "
Rudder	17.0	" "

Fig.1 The De Havilland DH-61 "Canberra" commercial airplane.

Figs.2 & 3

Views of the DeHavilland 61"Canberra" commercial airplane

"Flight" Photographs

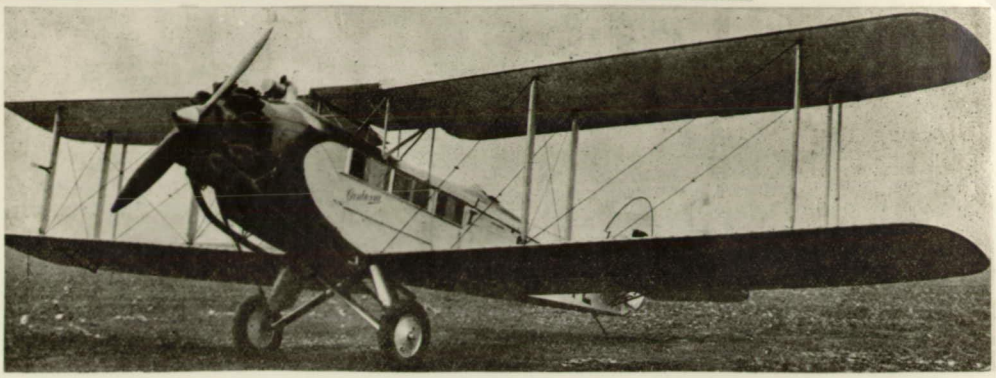


Fig.4

Three-quarter front view of the DH-61 with wings folded. The top center section, containing the gasoline tank, is on a higher level than the wings, so that the corners of the top wing can pass under it when folded.

"Flight" Photograph

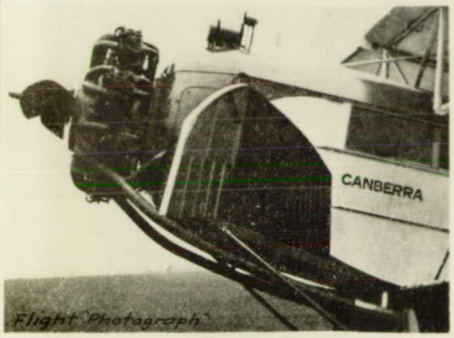


Fig.5 Installation of the Bristol "Jupiter" engine in the DeHavilland 61. The large exhaust pipes taken under the fuselage reduce the engine noise to comfortable proportions. The hot air muff for heating the air in the cabin can be seen on the pipe on the port side. Note the large front luggage compartment, which will accommodate a cabin trunk or two.

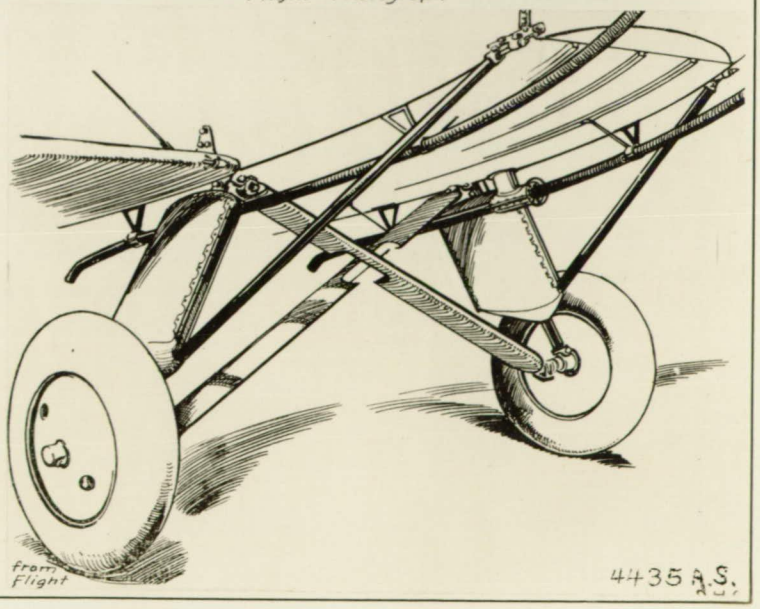


Fig.6 The landing gear of the DH-61 airplane. The wheel track is very wide, and a large travel of the wheels is obtained.