strip taxis to the next and unloads passengers and luggage Luggage for departure is loaded and the helicopter then taxis to the third strip to take on passengers It is then in a position to take off on the first strip again Helicopters can be parked side by side on the two strips not actually used for take-off and landing Luggage lifts run down the light well to the offices directly below Fuel pipes with covered connections on the flight deck also run down the well to storage tanks in the basement, the fuel being pumped up when required

The remaining area of the triangular plan is given over to car parking and warehousing, with a wharf on the river side of the site Both internal and external ramps run from the ground floor to the flight deck and are for the use of cars, warehouse trucks and any flight deck traffic The car parking and warehousing part of the building are connected with the heliport only inasmuch as they provide a revenue to a building that requires so much waste space around it and warehousing is the traditional industry of this stretch of the river

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Experiences of a technician in learning to fly a helicopter

In Vol 10 No 2 we announced details of the first Alan Marsh Award which was made to Mr M A P Willmer, D C Ae, A R C S, B Sc, and took the form of a short course of helicopter flying at Air Service Training Ltd, Hamble We asked him to record his impressions of the experience for the benefit of all members

* * *

This report on my experiences at Air Service Training Ltd in the Autumn of 1956 is divided into three sections The main section deals with the dual tuition and passenger flying, it is supported by a subsidiary section on the Ground School and some comments on my position as a non-pilot on a pilots' course My stay at Hamble lasted nearly three weeks The flying time consisted of five hours under tuition and roughly two and a half hours as a passenger

On my arrival, the contents of my course were discussed and my flying instructor and I decided that as I was a complete novice to flying it would be in my own interest to have some helicopter air experience as a passenger before attempting to handle the controls I was, therefore, taken up with other members of the course who were just starting with me, whilst they gained actual experience of feeling the effects of the controls, and in this way I obtained about 1½ hours of flying I felt that this time was extremely helpful for it afforded me not only the opportunity to become acquainted with the sensation of being in a helicopter, but also with the kind of mistakes I should make later

Thus, I went forth to my first flight at the controls with some idea of the errors that I was about to commit and many resolutions on how I should prevent their occurrence The memories of this first flight, which lasted 35 minutes, are unforgettable The instructor put the aircraft in steady level flight at 45 kts and then gave me control of the cyclic stick At first I held the stick in the same position, the forces were slight since the stick was trimmed for the airspeed at which we were flying For a short time the aircraft pursued its course and I relaxed a little However, it was not long before a disturbance occurred Resolutions forgotten, I chased after it until, from our steady 45 kts level flight, we were descending in the vortex ring state The instructor put the helicopter back again into level flight and I had another attempt, this time with a little more success

The main difficulties were judging the attitude of the helicopter and appreciating the time lag in the air speed indicator The former was the harder to overcome as there was so little that could be used as a datum The front of the helicopter, a Hiller 12C, was made of perspex with one horizontal bar near the midway position and it was almost impossible at first to notice changes in attitude However, on this first flight I managed to achieve forward flight by watching and having patience with the A S I I also tried some level turns and made some attempts at hovering In both cases I was given the cyclic stick to control but, whilst the turns were tolerably successful, my hovering was hopeless As the helicopter began to swing about I followed behind with sharp stick movements

On the second flight I improved slightly as I began to become accustomed to the controls After these two flights, my flying programme was divided into two parts Firstly to achieve a respectable hover with all controls and secondly, to see what a helicopter could do and to attempt a few of the manoeuvres myself

Recalling my first flights as a passenger, I think that, on reflection, although they did not stop me from making what may be called the initial fundamental mistake of flying—allowing the aircraft to fly you—they did help me to improve more quickly than I should otherwise have done

In my attempts to hover, it was soon impressed on me how vital it was to appreciate quickly changes of attitude immediately they occurred At first I was much too slow, but as time progressed my ability to spot changes increased and with it my confidence to correct such changes before the helicopter became out of control

As I began to improve with the cyclic stick so I was given more controls to command, thus increasing the number of points to be watched With all the controls, small adjustments were continuously being made and now the r p m of both engine and rotor had to be watched as well as the attitude I was surely given a taste of the terrific concentration needed to hover for any length of time

In the second part of my flying programme I tried transitions from hovering to forward flight and climb , from descending under power to the hover , circuits , autorotative descents and recovery to powered flight , sideways and backward flight , turning on a spot , taking off into the hover , landing from the hover and hovering outside the ground cushion I was also shown various ways of landing the helicopter after engine failure at low heights , tail rotor blade and tail rotor cable failures This range of experience left me in no doubt as to the skill required by a successful helicopter pilot In order that this range should be as broad as possible I was taken up as a passenger with other students being shown these manoeuvres on several occasions Of these manoeuvres, many are made more difficult when performed in winds of over 15 kts Perhaps the most interesting, from this point of view, is the turning on a spot Here the pilot has not only to stop the helicopter drifting downstream but is also faced with the weathercock stability of the aircraft The latter is the major menace and the manoeuvre under these conditions is noted for its large cyclic stick movements and the skill required by the pilot in manipulating the pitch of the tail rotor

In the first fortnight of the course, the students received several lectures in the ground school on the basic principles of helicopter flight Explanations of how a helicopter flies and is controlled were given in practical terms Mathematics was noticeable only by its absence The lectures were designed to give a pilot new to helicopters, some idea of what was happening and why The ground covered ranged from elementary theories of how the rotor generated lift and on the stability of the aircraft, to the mechanics of the transmission system I found the instruction very interesting and especially enjoyed the discussions which occurred during the course and which the instructor encouraged as much as possible In the course of these discussions we were told a fair amount about the maintenance problems and some of the amusing and informative events and incidents that had occurred since the school had opened its helicopter section

The above paragraphs tell of what happened during the official school hours However, both my fellow students on the helicopter course were residing at the school with me and invariably points which had aroused interest during the day were discussed over dinner in the evening They were both members of the R A F and were taking a conversion course from fixed wing aircraft One had come off ' Hunters " and the other off " Lincolns " Although very often fatigued by a hard day's flying, I am glad to report that as the days passed their joy and satisfaction in flying their new and our accustomed type of aircraft increased During our informal discussions, I was able to compare their problems with my own and at first they were very similar However, as to be expected, they progressed much more quickly than myself, due mainly to their store of air experience

To sum up my own experiences, I include the programme which forms the basis of the 20 hrs flying given in the full course It is divided into two parts —

PART A TO FIRST SOLO

1 Familiarisation with helicopter type
2 Preparation
3 Air Experience
4 Effects of controls (translational flight)
5 Power and speed changes
6 Autorotation (*a*) Entry and development of autorotation (*b*) Control of speed and r p m (*c*) Recovery to powered flight
7 Hovering
8 Take-off and landing
9 Transitions (*a*) Transition from hover to forward flight and climb (*b*) Transition from approach to hover (*c*) Overpitching
10 Circuits
11 Demonstration of Engine-off landing
12 First Solo

PART B PAST SOLO

13 Sideways and Backward Flight (*a*) Sideways Flight (*b*) Backward Flight (*c*) Combination of sideways and backward flight
14 Turns on the spot
15 Taxying
16 Engine-off landings (*a*) Autorotation to 50 ft flare re-engagement and overshoot (*b*) Engine-off landings at low forward speeds
17 Vortex ring state
18 Forced landings
19 Low flying

Of these items I was allowed to try many and I experienced the rest, except for flying solo As a result I have now a much better appreciation of the pilot's viewpoint as well as a physical understanding of what has been, until now, merely mathematical formulae It is well known that pilots often talk in a language of their own when discussing or describing helicopter problems and qualities The only true way in which one can really understand them is by starting at the beginning and associating words with the actions and feelings being described This short introduction to helicopter flying has gone some way in helping me to achieve this and I shall always be grateful for having been given the opportunity to be able to do it

In conclusion, I should like to thank all those at Air Service Training Ltd for the way in which they made my stay so enjoyable and profitable, especially my flying instructor, Mr Hazlehurst I should also like to express my sincerest thanks to the Awards Committee of the Alan Marsh Memorial Trust for having made my taste of "forbidden fruit" possible Apart from now being able to appreciate the difficulties involved in piloting a helicopter, I have also experienced the joy and satisfaction of having done a little myself

M A P W

A note from the Chairman of the Trustees

For a considerable number of years I have had a close professional association with technicians, and my experience had been that the more they fly the more realistic is their approach to design problems related to the operating characteristics of aircraft

The Alan Marsh Award exists generally to further education in the rotary wing branch of aeronautical science and it was decided that, initially, one most useful way in which this objective might be achieved would be to provide some flying instruction facilities for selected engineering students who would otherwise have no opportunity of studying the problems from a practical viewpoint

I hope that after reading Mr Willmer's account of the benefit he derived from his pilot familiarisation course with Air Service Training, you will feel not only that the policy of the Council to provide this form of practical education has been justified, but also that he was a worthy choice for the first Award

Your personal help, however, continues to be needed Firstly by nominating a young man of outstanding technical ability in the rotary-wing field for the 1957 Award

Secondly, and particularly if you have not already done so, by making a contribution, no matter how small, to the Trust Fund

The present capital sum invested is £1,500, and my aim this year is to increase this amount so as to ensure an adequate annual income for our objectives

R A C BRIE

AERODYNAMIC ASPECTS OF HELICOPTER DESIGN

Written contribution received from Mr D W Allen, of Bristol, to Dr Roberts' paper which appeared in Vol 10, No 1, July, 1956

In discussing deceleration tests to determine the mean profile drag coefficient Dr Roberts omitted his induced power contribution from equation (23), which should read

$$-\,I\,\dot{\Omega} = \tfrac{1}{8}\,\delta\rho\sigma\pi\,\Omega^2 R^5 + \frac{1\,175\,T^{3/2}}{\Omega}\sqrt{\frac{1}{2\pi R^2\rho}}$$

Combining the equation for thrust in the form

$$T = \tfrac{1}{2}\,\rho\,abc\,\Omega^2R^3\left(\frac{\theta}{3} - \frac{v_1}{2\Omega R}\right)$$

with the induced velocity expression, the resulting quadratic gives $T = K\Omega^2$, where K has a constant value for a given collective pitch (and density)

Now δ according to equations (27) and (28) increases with $\left(\frac{C_T}{\sigma}\right)^2$,

which varies with $\left(\frac{T}{\Omega^2}\right)^2$ or K^2 Therefore the expression $\delta = \delta_o + \delta_2\left(\frac{C_T}{\sigma}\right)^2$,

is constant for a given collective pitch, Reynold's Number effects being neglected

Equation (23) can now be written in the form $-I\dot{\Omega} = (A\delta + B)\Omega^2$,

$$i\,e,\ \delta = \frac{I\dfrac{d(\frac{1}{\Omega})}{dt} - B}{A}$$

Thus the value of δ obtained here is less than that obtained by neglecting induced power by an amount B/A or $\dfrac{18\,8}{\sigma R^3}\left(\dfrac{K}{2\pi R^2\rho}\right)^{3/2}$

In deriving equation (26), Dr Roberts has considered only the blade rotational power It would be more correct to include the power absorbed by the H force The overall increase in δ due to compressibility is then given by

$$\Delta\,\delta = \frac{\int_0^{2\pi}\int_0^1 M^3\,F\,dx\,d\psi}{\frac{\pi}{2}(1 + 3\mu^2)\,\frac{V_T{}^3}{a^3}}$$

Dr Roberts' Reply

The analysis given in the Paper was written out for the case of zero thrust For other cases the equations in the Report give a value of the effective δ (including induced effects) which may then be turned back into a power requirement If the true value of δ is required then the extra term must be included

Using the notation of Mr Allen —

$$-I\dot{\Omega} = (A\delta + B)\,\Omega^2 = A\,\delta_{eff}\,\Omega^2$$

where δ_{eff} is the effective drag coefficient including induced effects

$$\text{Now since } \delta = \frac{I}{A}\frac{d}{dt}\left(\frac{1}{\Omega}\right) - \frac{B}{A}$$

$$\text{and } \delta_{eff} = \frac{I}{A}\frac{d}{dt}\left(\frac{1}{\Omega}\right)$$

the power required at a given collective pitch setting is

$$P = (A\delta + B)\,\Omega^3$$

$$= (A\,\delta_{eff})\,\Omega^3$$

by substitution for δ Thus both methods give the same answer for the power required at a given collective pitch setting

With regard to Mr Allen's last comment, if one ignores radial flow effects then his expression for the overall increase in drag coefficient is correct However, an evaluation of the two expressions for the increase shows that using the torque increase only as in the lecture, gives a more conservative value for $\Delta\delta$ [in the ratio of approximately $(1 + 2\mu^2)$] and hence is less likely to under-estimate the value of $\Delta\delta$ This is one of the reasons we have used the expression in (26), particularly as the answers are already very low compared to the other method mentioned

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MEMBERSHIP SUBSCRIPTIONS

Members are reminded that subscriptions become due on March 31st

Members who wish to be considered for regrading should apply to the office immediately