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# PROFESSOR G. T. R. HILL, *Fellow*

## 1895 - 1955

WITH THE DEATH of Professor G. T. R. Hill, M.C., M.Sc., M.I.Mech.E., F.R.Ae.S., on 26th December 1955 the world of Aviation has lost one of the most lovable pioneers who ever breathed enthusiasm into flying.

Geoffrey Terence Rowland Hill was best known for his Pterodactyl tailless aircraft but his inventiveness did not stop with the Pterodactyls or even begin with them. His first recorded achievement in Aeronautics was to win a flying competition with a model aircraft which he had designed and built. He was then in his early teens and it was not long afterwards that he and his brother, who later became Air Chief Marshal Sir Roderic Hill, designed, built and flew a full scale glider. As a glider it was probably not a resounding success but as an enterprise by two boys in their teens in the year 1913, it was truly remarkable.

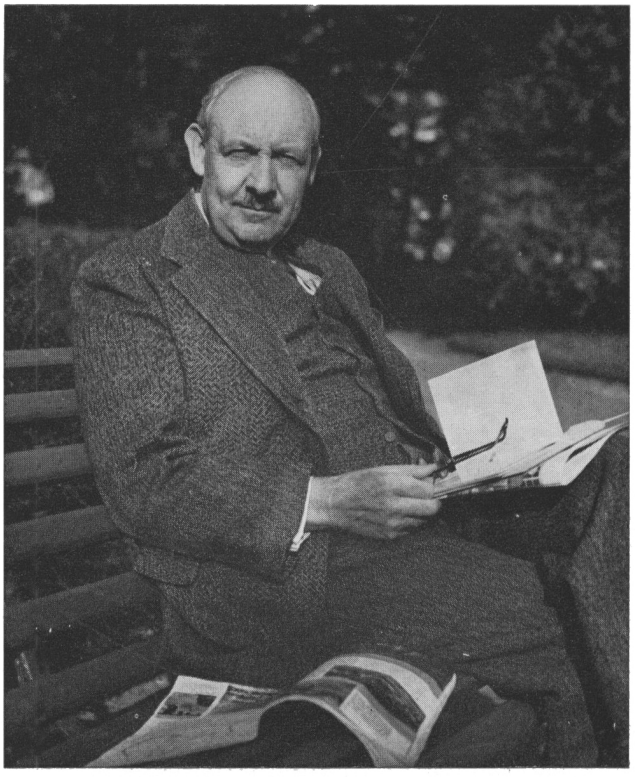
The difficulties which the two boys had to overcome were not only technical but also financial and, not surprisingly, parental. The technical problems were overcome by straight thinking and simple experiment. For example, the wing spars were stressed—or should we say proof loaded—by laying them across two chairs placed at roughly the semi-span of each wing and then the two brothers and, I think, two of their friends sitting astride the centre section and doing a little bouncing just to make sure.

The financial problems were solved largely by selling paintings by Roderic. Whenever funds were low Roderic had to stop work on the glider and paint some more pictures.

That they ever overcame the parental difficulties can only be attributed to the extraordinary persuasiveness which they both possessed throughout their lives.

Geoffrey was the first to fly the glider from a gentle slope on the South Downs near Eastbourne. Like all aircraft it took longer to prepare for flight than anyone expected and it was nearly dark when Geoffrey found himself airborne for the first time in his life in a glider which also had never flown before. A rather frightening phugoid motion soon developed in the midst of which Geoffrey suddenly heard the swish of grass under him and found that he had made a nearly perfect landing. Over the next 40 years Geoffrey looked back on that moment as the proudest in his life.

While all this was happening at weekends Geoffrey Hill was an undergraduate at University College, London, where he took his degree in 1914. He then



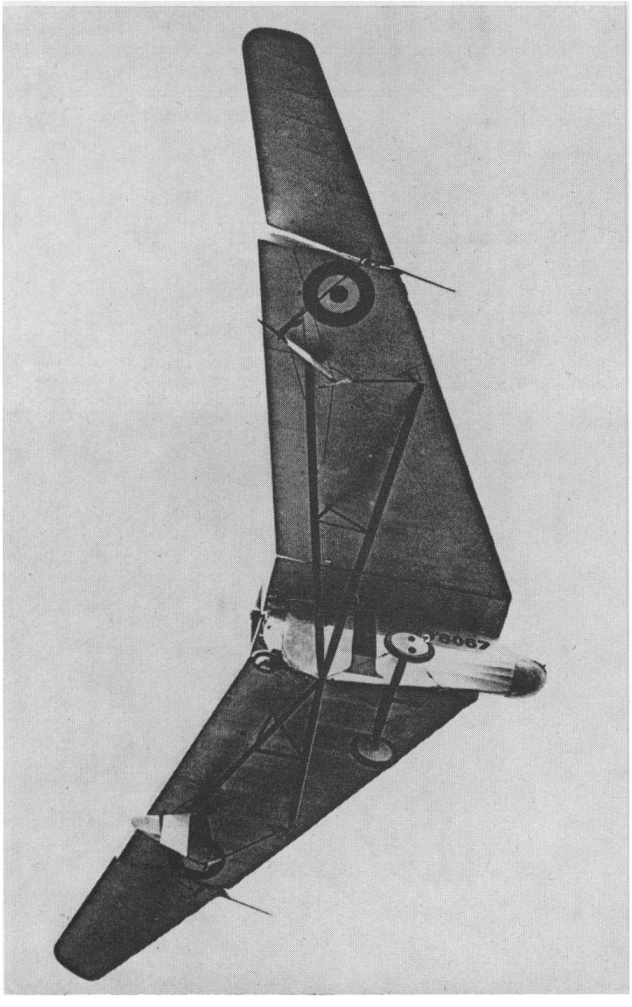
G. T. R. Hill.

entered the Royal Aircraft Factory as a graduate apprentice and remained there until 1916, when he obtained a commission in the Royal Flying Corps. It is ironical to reflect that he had previously been rejected as medically unfit for the Hampshire Air Parks Volunteers, a local unit formed by members of the Factory staff. He served in France with No. 29 Squadron until he nearly lost his life as the result of experimenting with an aircraft which had insufficient elevator power.

He was invalided home with the rank of captain and with the award of the M.C.

He then joined the Ministry headquarters as deputy to Mr. (later Professor Sir Leonard) Bairstow in control of aircraft research and experiment.

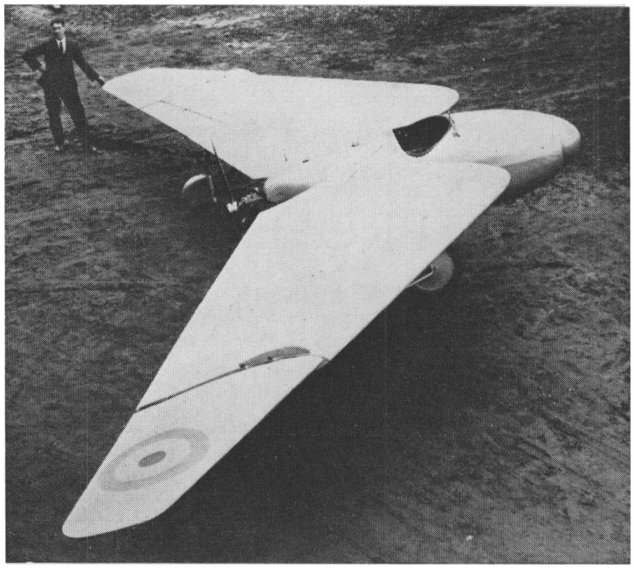
By 1918 he was in the air again, this time as Test Pilot in charge of the Aerodynamics Flight at Farnborough. Later he became Chief Test Pilot to Handley Page Limited where he shared in the early development



The original Hill Pterodactyl (32 h.p. Bristol Cherub engine) 1925.

of the Handley Page slat, undertaking both wind tunnel work and then full scale flight experiment on the DH.9 with a long undercarriage.

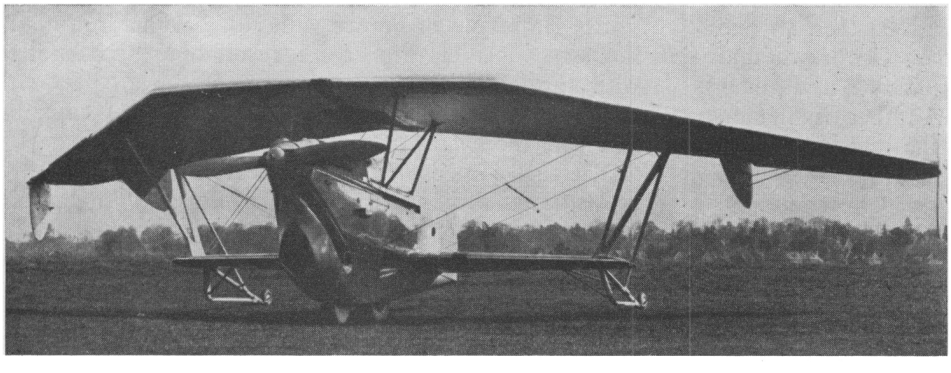
Throughout this time he had been profoundly concerned by the phenomenon of stalling and he set himself the task of designing a truly safe aeroplane. He made a close study of sea birds and came to the conclusion that they did not use their tails for longitudinal control in normal flight but relied on wing warping and changes of wing camber. This observation



The Westland-Hill Pterodactyl Mk. IA (75 h.p. Armstrong Siddeley Genet engine) 1926.

set him thinking along the lines which led him to his well known tailless pterodactyl configuration. He must also have been influenced by Dunne's work. Here his early experience with the glider came to his aid and, to test his new ideas, he again designed, built and flew a glider. This was in 1924 and the following year he fitted it with a Cherub engine—the Hill Pterodactyl Mk. 1, which now has its place in the Science Museum at South Kensington. During the time he developed this aircraft, Hill was the holder of an 1851 Exhibition Scholarship which involved experimental flying at the Royal Aircraft Establishment.

In 1926 Hill joined the staff of the Westland Aircraft Works and designed several further types of Pterodactyls, of which three were built. Among other novel features may be recorded the first use of wing sweepback variation during flight, use of spoiler air brakes, probably the first use of a bicycle type tandem-wheel undercarriage with wing tip skids and certainly the first use of wing tip slats on a swept-back wing. The Mk. IV was the first tailless aircraft ever to be spun, rolled and looped. The series culminated in the Mk. V in 1932, which was a two-seater sesquiplane fighter, powered by a Rolls-Royce Goshawk engine and capable of about 200 m.p.h. As it was built to an Air Ministry Specifica-



The Pterodactyl Mk. V two-seat fighter (600 h.p. Rolls-Royce Goshawk engine) 1932.

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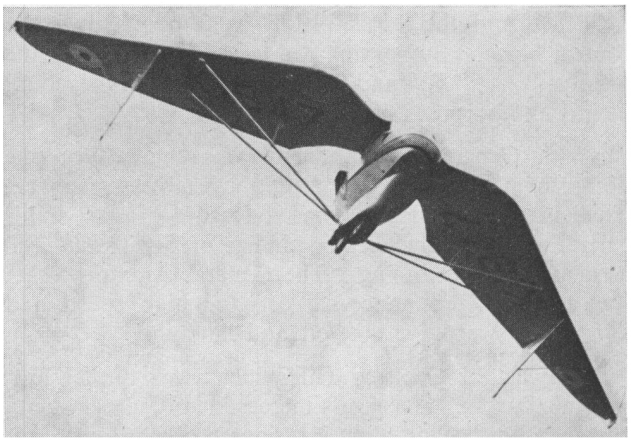
tion, the contract included among other things, the development of a power-operated gun turret. When the Pterodactyl was finally rejected in favour of a more conventional design Hill felt that the aircraft had been judged on the operation effectiveness of the gun turret and other extraneous things and that his ideas had never been assessed on their true worth. This was a great disappointment to him.

In 1934 Captain G. T. R. Hill was appointed to the Kennedy Chair of Mechanical Engineering at University College, London. It may well be that his most valuable work was done there because he was an inspiring lecturer, always able to instil enthusiasm into his students by his delightful style and happy wit and because he would go to enormous lengths to rig up all manner of practical demonstrations. He never tried to teach too much in any one lecture but made sure that what he did teach would be understood and remembered. There may be better ways of getting students through examinations, but Professor Hill was far more concerned that his students should leave him with the fundamental principles straight in their minds and with an enthusiasm for their work.

In the early part of the 1939-45 War Hill was in charge of the Air Defence Research Department of the R.A.E. at Exeter. Here he was concerned with a dangerous series of experiments on the vulnerability of aircraft to collision with barrage balloon cables, with cable-suspended mines, and with the early work on radio proximity fused bombs.

Subsequently, in 1942, he became Scientific Liaison Officer between the British and Canadian Governments and during this period he inspired the National Research Council in Canada with the idea of building an all-wing aircraft. This resulted in an experimental glider which was flown successfully by Squadron Leader Kronfeld and others, and which provided some useful data for future designs.

It would be a mistake to think that all Geoffrey

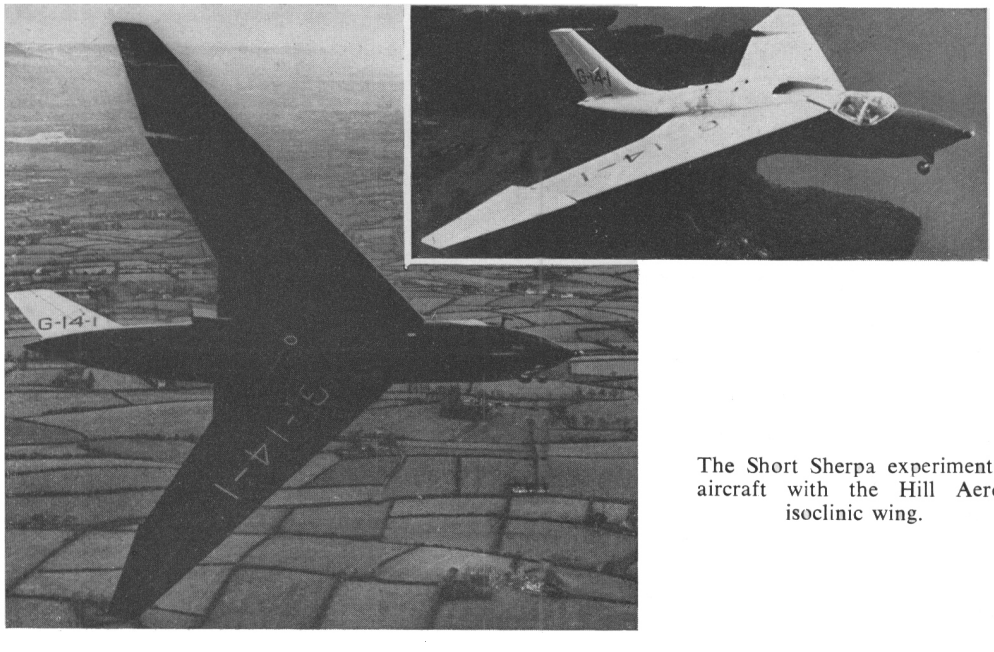


The Pterodactyl Mk. IV three-seater (120 h.p. D.H. Gipsy engine), 1930.

Hill's inventive powers were focused on the realisation of a successful tailless aircraft. After the war he was engaged as a consultant to Short Brothers at Rochester and to General Aircraft at Feltham. It is true that he pursued his old line with Shorts, a line which resulted in the "Sherpa," but he also worked on a gust alleviator which he called the " Smooth Ride Flap " and a form of aerodynamic balance for control surfaces which he called " Hill's Holes."

The Smooth Ride Flap was based on the principle that it was unnecessary to eliminate the effects of gusts provided that the effect could be reduced below the threshold value. He defined the threshold value as that at which all normal passengers would retain their breakfasts.

" Hill's Holes " consisted of an ingenious arrangement of three pistons in separate cylinders. The " $b_0$ " piston was fed with dynamic pressure from the leading edge of the aerofoil, the " $b_1$ " piston from approximately the points of maximum change of pressure with




The Short Sherpa experimental aircraft with the Hill Aero-isoclinic wing.

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incidence and the " $b_2$ " piston from points near the control hinge. By varying the leaks (holes) across the pistons, " $b_0$," " $b_1$ " and " $b_2$ " could be adjusted, to all intents and purposes, independently.

With General Aircraft, Hill was engaged on the design of a high speed aircraft of variable sweepback. This, in a lesser degree, was a feature of one of his early Pterodactyls where the change of sweep was used as a means of trimming. The General Aircraft design was to have pronounced sweep for high speed and almost no sweep for take-off and landing.

The last of Geoffrey Hill's ideas was the " Aero-isoclinic " wing. As speeds increased and aeroelasticity began to be recognised as a serious problem in aircraft design, he saw a new merit in his old Pterodactyl configuration with the all-moving tip controllers. By substituting these controllers for the conventional elevators and ailerons he saw a way of overcoming the effects on control power and stability which arise from proximity to the control reversal speed. The problem then arose to find a design criterion for the wing stiffness in torsion. Hill, when faced with this problem, took it away for a week and returned with the idea that the torsion box should be placed well aft in the wing so as to get a rearward location of the flexural axis and that the stiffness in torsion and bending should be so adjusted in relation to each other that flexure of the wing would not introduce any of the undesirable loss of incidence at the wing tips which is a feature of normal swept-back wings.

This conception was tried out on the Sherpa, which is a small experimental aircraft built as a scale model of a high altitude bomber. It performs very satisfactorily and has succeeded in demonstrating the soundness of Hill's ideas.

It was a great disappointment to Hill that, in spite of the Sherpa, the conception of the aero-isoclinic wing was never adopted for an operational aircraft. Again he felt that his ideas were not being assessed on their true merits, but were rejected because there was no demonstrable improvement in performance over conventional designs.

He never allowed these disappointments to embitter him but he did allow himself, as a result, to take an impish pleasure in scoring off officialdom. One day, for example, he came into the Mess at Short Brothers beaming all over his face. When asked the reason he said " Today we have got a building licence for one of the buildings we have put up on the farm."

The farm, near Londonderry, was his home and with his wife and two sons he found great pleasure in running it and indulging his skill as an engineer. He designed and fabricated lightweight roof trusses for his buildings and even constructed his own silo in pre-stressed concrete. It was there that he died during Christmas week after being in poor health for about three years.—D. KEITH-LUCAS, *Fellow*.