Light aviation – past, present and future

A. C. Welch

1.0 INTRODUCTION

To attempt to predict the future of light and sporting aviation in Britain is not possible without a study of how it has arrived at where it is today. How, in the early days, it was the enterprise of the individual enthusiast which was the driving force in all aviation progress, to the present where ‘private’ flying, in all its many forms, has been massively outgrown by commercial airline operations.

The 1903 flights of the Wrights did not appear out of the blue. They were just one more exciting happening at a time of great engineering ventures. Trains were running regularly all over Britain, the internal combustion engine was reliable enough to power private motor cars and city buses. Gliders had been successfully flown, telephones were in regular use. There were passenger ships powered by 70,000hp engines crossing the Atlantic at speeds of 25kt. The world was wide open for anything new and in 1903 aviation quickly took pride of place.

Light aviation was the name given to ‘amateur’ flying in the 1920s, to distinguish it from military and commercial aviation. It is still the valuable entry into aviation generally, as it is a relatively inexpensive way to try out new ideas. But to fulfil its potential it has to remain attractive and affordable, particularly to the young. This paper endeavours to speculate how light aviation will fare during aviation’s second century in Britain – or at least for the next 20-30 years, in an increasingly complex world in which global accessibility is commonplace.

2.0 THE PIONEER YEARS 1903-1914

Although the first flight of the Wright biplane was little more than an exciting hop, its enormous importance was that it focussed worldwide attention on a configuration, control system and type of engine which, together, had shown powered flight to be possible. Feathers finally left the scene.

In Britain the next few years after 1903 became a ferment of enterprising trial and error. S.F. Cody worked on kites, balloons, dirigibles and aeroplanes, Dunne on gliders, A.V. Roe searched for an engine for his triplane; though he still believed that wing lift was created by pressure of the aerofoil on the air below. Farnborough on its Laffan’s Plain became a centre for experiments and the Daily Mail offered the first of its many money prizes for progress. In France both Bleriot and Antoinette monoplanes (Fig. 1) were in production by 1909, eagerly bought by people who wanted to become pilots. Within six years of the 1903 flight aeroplanes were carrying passengers, Bleriot had crossed the English Channel, Jose Weiss was flying gliders on the South Downs, a woman had flown solo and ominously, an aeroplane had flown above a battleship at sea. It was becoming a different world.

Competitive flying was now found to be practicable and enjoyable. There were no less than 38 entries for the first Rheims meeting in 1909, where 100km/h (62mph) was achieved. In 1910 Paulhan beat Graham White to win £10,000 in the London to Manchester race, Charles Rolls made a double crossing of the Channel without landing and the Brazilian Santos Dumont was flying his own designed aeroplanes in Paris. In 1911 there was a Round Britain race of 1,626km (1,010 miles) with 13 compulsory stops with prize money of £18,300 awaiting the 43 entrants (Fig. 2). 1911 was also important for the first seaplane trials to be held.

In this year the Royal Aero Club introduced pilot proficiency certificates without which passengers should not be carried and in 1912 the
RAC was given authority for the investigation of all air accidents by the Air Ministry. Before the year was out the first take off from a ‘carrier’ ship, the *Hibernia*, was successfully made by Commander T.O. Samson, the Royal Flying Corps was born, as was the Central Flying School. 1913 saw even faster progress. Adolphe Pegoud proved that aeroplanes could be looped and flown inverted, Flying Schools had taught 20,336 pilots and the first Schneider Trophy Race had been won for Britain by Howard Pixton flying a Sopwith Tabloid seaplane (Fig 3.)

Looking back it did not seem possible that all this could have taken place within a decade of the 1903 flight; that so quickly flying had come from a hop to a practical means of travel with an almost unlimited future. But such rapid pioneering progress had not come without a price; that of fatal accidents, an inherent part of any exploration learning curve. Some causes indicate the state of the art during this first decade.

1. Spiral dives, spinning and recovery were not yet understood so new pilots could not be taught and learnt the hard way, usually off a sudden turn. This was not helped by the often very small speed range between maximum and stall; on the 1909 Bleriot little more than 10km/h (6mph).

2. Aircraft structures and their maintenance were not sufficiently understood, particularly airframe deformation with changing speed. Engines were still far from reliable.

3. Pilots were reluctant to wear seat belts. With low flying speeds they preferred to be thrown out when crashing rather than be trapped in the fuselage.

4. It was easy to get lost. Maps designed for ground use were difficult to read in the air. Compasses were far from ‘dead beat’ and magnetic variation in England was a massive 16 degrees W.

5. There were no weather forecasting systems and, as yet, pilots had little understanding of the implications of three-dimensional weather.

On 4 August 1914 war was declared. It lasted five years and advanced the knowledge of aeronautics, air navigation and meteorology to an unprecedented extent (Fig 4).

### 3.0 THE OPEN DOOR 1918-1926

By the end of WW1 there were aeroplanes large and reliable enough for conversion to commercial use and, naturally, no shortage of fighter aircraft and skilled pilots. Factories, such as de Havilland, Rolls-Royce and Sopwith, were still geared up for production but there were almost no aeroplanes for people who just wanted to get into the air, including those too young to have been pilots during the war. It was not powerful aeroplanes that were wanted but cheap, easy to build flying machines. After such a dreadful war the mood was towards a life with simple pleasures. At the time people were more used to making things for themselves than they are today. Almost every village had its carpenter and suitable timber was widely available. There was as yet no waterproof glue but war surplus shops could provide nuts, bolts and other useful bits and pieces including airspeed indicators and altimeters. Across the country bike sheds became workshops for building things even, hopefully, something which might fly. Not surprisingly many aeronautical ventures remained unfinished.

It was fortunate that under-employed wartime manufacturers saw the public interest in little aeroplanes and moved into this possible market to help retain their skilled workmen. Before long motor cycle builders, like Douglas, noticed a new opening for their engines. It was the coming together of this need for work, aeronautical knowledge and workshop experience that contributed backbone to the widespread desire to get into a peaceful air after ‘the war to end all wars’.

A thousand miles away, in Germany, there was just as great a desire to fly, particularly among the young, but the Treaty of Versailles prohibited the building of aeroplanes. Instead they built aircraft without engines – gliders. These were not hang glider copies of their own 1890s pioneer Lilienthal, but simple wooden airframes, light in weight and configured to make the most use of their glide performance. Within two years of the armistice it was not only individuals who were building basic gliders but Darmstadt University saw them as the best available way to educate their aero engineering students. In the late summer of 1920 the Germans held a gliding camp on the Wasserkuppe in the Rhon mountains. Twenty four enthusiastic builders turned up, including one from Switzerland. On the final day a young engineer from Aachen University arrived with a low wing glider called the Schwarzteufel. He flew it for 2min 30sec over a distance of 1·6km (1 mile); the first gliding record.

The camps continued. In 1921 50 people arrived bringing with them...
45 gliders (Fig. 5), including the Vampyr of Arthur Martens from Darmstadt. He came again in 1922, this time remaining airborne for 1 hour 6 min. It did not take long for this new flying to spread across Europe. In Britain the ever-supportive Lord Northcliffe of the Daily Mail offered substantial money for a gliding meet in Britain. It took place at Itford, Sussex, in the cold October of 1922 and was attended by a remarkable collection of gliders including a flying bicycle and a beautiful de Havilland aircraft, the DH52, that warped its wings off, without harm to the pilot. The longest flight was by the French Peyret tandem-wing glider which soared above the Downs for 3 hours 21 min, a new world record. But fascinating as though extended flight was without an engine, it was a little aeroplane that most pilots really wanted. Since there seemed no reason why, in Britain, a small engine could not be added, it was decided that the 1923 meet should be for motor gliders and held at Lymne.

This brought promises of prize money from the Society of Motor Manufacturers and Traders and the British Cycle and Motorcycle Union, as well as from individuals. There were 27 entries with well known aeroplane manufacturers well represented and using available low powered motorcycle engines, Table 1. As encouragement the Air Ministry waived the need for Certificates of Airworthiness for the duration of the meet. At the end the English Electric Wren (Fig. 6) powered by a 398 ABC engine was acclaimed the best all-round performer with the DH53 Hummingbird, 750cc Douglas, as the best example of a practical private owner aeroplane. Within a fortnight a successful demonstration and race meeting was held at Hendon. For 1924 the big meeting would again be held at Lympne and be named the Light Aeroplane Competition.

Gliding continued developing in its own right with growing numbers of constructors, competitions and record attempts in most European countries as well as the USA and Australia. (By 1929 the distance record exceeded 300km and in 1934 the first 500km distance was achieved by four gliders on one day.) Gliding was moving ahead faster technically than light aeroplanes, a process greatly assisted by the increasing numbers of German universities using gliding to teach aerodynamics, design, construction, test flying and even factory management. Universities, including Aachen, Braunschweig, Darmstadt, Munchen and Stuttgart, formed Akafliegs (Academische Flieger Gruppen) in which students could take longer over their engineering degrees. They were given experimental ideas to work on, such as designing cantilever wings of 29m (95·1ft) span with aspect ratios of above 36, devising extended chord variable geometry wings and studying any performance benefits which might result from very lightweight structures. Stuttgart was the first to build and fly a wholly composite glider. As a result Germany, today, has an almost total grip on world glider manufacture. Akafliegs, mainly Darmstadt, also built aeroplanes from 1923 on, ostensibly to explore new ideas. The first was a motor glider, the D-8, followed in 1924 by the D-11 powered by a British Blackburne Tomtit two-cylinder, two-stroke of 20hp (Fig. 7). By 1929 they had produced a radical cantilever wing biplane, the D18, powered by an Armstrong Siddeley Genet engine of 65hp.

Light aviation comprised of aeroplanes and gliders now existed in its own right, having become clearly separate from commercial and military activities. It was the start of the Golden Years.

**Table 1**

<table>
<thead>
<tr>
<th>Aeroplanes using motorcycle engines, 1923</th>
</tr>
</thead>
<tbody>
<tr>
<td>English Electric Wren</td>
</tr>
<tr>
<td>Avro 560</td>
</tr>
<tr>
<td>DH53</td>
</tr>
<tr>
<td>Parnall Pixie</td>
</tr>
<tr>
<td>Vickers Viget</td>
</tr>
<tr>
<td>Anec 1</td>
</tr>
<tr>
<td>Handasyde Monoplane</td>
</tr>
</tbody>
</table>

Figure 5. The 1921 Blaue Maus glider of Otto Klemperer.

Figure 6. English Electric Wren. The 1923 best all round performer.

Figure 7. Blackburne Tomtit engine used in the Anec 1 and Avro 560.
4.0 THE GOLDEN YEARS 1927-1939

In Britain the light aircraft industry flourished with DH Moths (Fig. 8), Avro Avians, Blackburn Bluebirds, Westland Widgeons and the Southern Martlet all in production and powered by British engines. 3,000 Moths were produced and sold. In addition ultralights with engines of less than 50hp were flying, such as the Hendy Hobo, ABC Robin, Bristol Brownie, BAC Drone (Fig. 9) and Comper CLA-4 with the tailless Granger Archaeopterix to provide variety.

With such enterprise the world was open for exploration. In 1926 two Cirrus Moths had flown to India. In 1927-1929 five successful flights were made between England and Cape Town, and London – Australia had been flown in 15 days in an 80hp Avro Avian by Bert Hinkler. For the public enthusiast Alan Cobham began touring Britain. Already well known for his historic flight to Australia in a DH50 biplane, for which he was knighted, his Circus was soon established with no lack of customers. The young, especially, queued for five-shilling flights with many continuing into a lifetime of aviation. Cobham had the three-engined Airspeed Ferry specially built for his Circus and also encouraged the early autogyros.

Across Britain flying clubs multiplied and flourished. It was a time of minimum regulation with the Royal Aero Club still issuing Pilot Certificates, in advance of the A licence. Landing in fields was commonplace, to visit friends, for bad weather and for navigational reasons! The Moths and other slow biplanes were well suited to this sort of flying. There was also indirect benefit for the long distance flier across Africa from the growing commercial sector, for whom Shell set up fuel dumps for their trial routes.

As the thirties wore on it became apparent that a further war was increasingly likely. The RAF embarked on an expansion programme; much needed as the aeroplanes in use were almost entirely biplanes and little faster than the best from 1919. In February 1939 Alex Henshaw flew to the Cape and back in a little over four days. His Percival Mew Gull (Fig. 10) was some 30mph faster than the RAF’s latest fighter at the time; the Gloster Gauntlet, max speed 365km/h (227mph). Fortunately the Hurricane and Spitfire were beginning to come into service.

Aircrew recruiting was speeded up and to help with what would soon be a serious pilot shortage the Civil Air Guard was formed, offering subsidised training in flying clubs. This had no lack of applicants.

Light aeroplane flying and gliding ended their peaceful golden era in September 1939 (Fig. 11). In just 20 years a whole new national and professional industry had been successfully developed (Tables 2 and 3). Clubs, flying schools and private owners were plentiful with no shortage of people wanting to fly for the pleasure of being in the air. Light aviation was a great success story.

5.0 1945-1960

World War 2 affected civilian life in Britain far more than the earlier conflict and at its end aviation no longer held its former magic. Military flying remained to the fore due to the effect the war had had on the country as a whole and in the following cold war. Commercial aviation struggled into being with converted bombers and transports; its package holiday culture still far into the future.
A few manufacturers, including Auster and Miles, endeavoured to produce new aircraft, such as the J-1 Autocrat and the revived Messenger and the enterprising Sparrowjet, with two 330lb static thrust Pallas turbojets and a top speed of 230mph. The government set up a committee to find the best way forward, the 1947 Advisory Committee on Private Flying chaired by Whitney Straight and there was also the RAeS Informal Light Aircraft Committee led by Peter Masefield. Petrol tax was reduced for flying clubs and some subsidy for training was provided. The Kemsley Trust loaned money to secure airfields and buy equipment while the Royal Aeronautical Society in 1951 ran a design competition for a light aeroplane. But there were still many problems to be overcome by those who wanted to revive sporting flying. It was taking a long time to dismantle wartime Britain. Many airfields were still requisitioned and there was still strict petrol rationing for cars. Hundreds of Tiger Moths (Fig. 12) and other small aircraft suitable for club use were still in store and it took time before they were put up for sale at £50 each. There were other problems for manufacturers as the earlier almost universal use of wood for light aeroplanes had given way during the war to metal alloy construction. In any case suitable timber was less available. Some larger

Table 2

<table>
<thead>
<tr>
<th>Year</th>
<th>Type</th>
<th>Engine</th>
<th>Span (m)</th>
<th>$V_{max}$ (km/h)</th>
<th>$V_{min}$ (km/h)</th>
<th>Empty W (kg)</th>
<th>AUW (kg)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1909</td>
<td>Bleriot XI</td>
<td>Anzani 25</td>
<td>8.2</td>
<td>113.7</td>
<td>72.45</td>
<td>270.595</td>
<td>First Channel crossing.</td>
<td></td>
</tr>
<tr>
<td>1913</td>
<td>Sopwith Tabloid</td>
<td>Gnome 80</td>
<td>7.6</td>
<td>147.9</td>
<td>95.35</td>
<td>477.1060</td>
<td>Won first Schneider Trophy.</td>
<td></td>
</tr>
<tr>
<td>1913</td>
<td>Avro 504</td>
<td>Gnome 100</td>
<td>9.1</td>
<td>152.9</td>
<td>64.40</td>
<td>823.829</td>
<td>RAF, 10,000 built.</td>
<td></td>
</tr>
<tr>
<td>1927</td>
<td>DH Moth</td>
<td>Cirrus III</td>
<td>94.9</td>
<td>152.9</td>
<td>64.40</td>
<td>430.995</td>
<td>Tiger Moth forbear.</td>
<td></td>
</tr>
<tr>
<td>1927</td>
<td>Westland Widgeon</td>
<td>Cirrus III</td>
<td>10.9</td>
<td>160.100</td>
<td>68.42</td>
<td>383.852</td>
<td>Parasol monoplane.</td>
<td></td>
</tr>
<tr>
<td>1933</td>
<td>Miles Hawk</td>
<td>Cirrus IIIa 95</td>
<td>9.9</td>
<td>184.115</td>
<td>68.42</td>
<td>456.1,014</td>
<td>810.1,800</td>
<td>First of Hawk series.</td>
</tr>
<tr>
<td>1934</td>
<td>BK Swallow</td>
<td>Pobjoy 85</td>
<td>12.8</td>
<td>176.110</td>
<td>52.32</td>
<td>418.930</td>
<td>675.1,500</td>
<td>Klemm L-25 derivative.</td>
</tr>
<tr>
<td>1937</td>
<td>Chilton DW1</td>
<td>Carden Ford 32</td>
<td>7.2</td>
<td>179.135</td>
<td>56.55</td>
<td>315.700</td>
<td>Single seater. Four built. £315.</td>
<td></td>
</tr>
<tr>
<td>1937</td>
<td>DH Moth Minor</td>
<td>Gipsy Minor 90</td>
<td>11.367</td>
<td>188.118</td>
<td>70.43</td>
<td>436.970</td>
<td>652.1,450</td>
<td>103 built. Then WW2.</td>
</tr>
<tr>
<td>1946</td>
<td>Auster J-1</td>
<td>Cirrus Minor 90</td>
<td>10.8</td>
<td>135.123</td>
<td>77.48</td>
<td>443.985</td>
<td>720.1,600</td>
<td>Good glider tug.</td>
</tr>
<tr>
<td>1946</td>
<td>DHC Chipmunk</td>
<td>Gipsy Major 145</td>
<td>10.4</td>
<td>220.138</td>
<td>73.45</td>
<td>641.1,425</td>
<td>906.2,014</td>
<td>1,000 built in Canada.</td>
</tr>
<tr>
<td>1956</td>
<td>Cessna 150</td>
<td>Continental 100</td>
<td>9.8</td>
<td>196.123</td>
<td>77.48</td>
<td>443.985</td>
<td>720.1,600</td>
<td>USA to UK 1959 onwards.</td>
</tr>
<tr>
<td>1985</td>
<td>CFM Shadow</td>
<td>Rotax 582 64</td>
<td>10.33-8</td>
<td>88.54</td>
<td>48.30</td>
<td>190.418</td>
<td>410.890</td>
<td>England Australia solo.</td>
</tr>
</tbody>
</table>

NB The above data are as correct as historical or manufacturers sources allow. First figures metric then imperial.
manufacturers, understandably, now concentrated on the commercial aircraft market where they hoped for a more successful future.

Gliding fared better as few club sites were on military airfields and the lack of new gliders was quickly solved by Elliotts of Newbury, a pre-war furniture maker who wanted to keep its workforce intact while waiting for furniture restrictions to be lifted. The factory built 200 Olympia gliders (Fig. 13.), versions of the German Meise which had been designed for the cancelled 1939 Olympic Games and was well suited to club use and cross country soaring.

Within a few years parachuting had added itself to sporting aviation. Wartime chutes were available, reliable and cheap, as well as packers still around to maintain them. Parachuting also needed pilots and jump aircraft to operate. It all helped.

Despite its many problems light and sporting aviation had yet a chance to regain its pre-war successes, even if slowly. There were still no noticeable airspace regulations, air traffic control, radio requirements or complex air law to be learnt and remembered. It was the spread of these external demands that increasingly changed light aviation. Then, in 1959, the struggling British light aircraft industry received a blow from which it has never recovered, though its damage may not have been so apparent at the time; the government lifted import restrictions and opened the door for American club and training aircraft; inexpensive and ready to fly. The French hung on, holding a major design competition, which resulted in the Rallye (Fig. 14).

The next decade saw light aviation in Britain quietly coasting, increasing in cost and complication though not in numbers of people, particularly youngsters. It was not only airspace demands that grew but maintenance requirements, and landing fees. Many who learnt to fly were not interested in sporting aviation but did so in order to become airline pilots. Other countries faced similar problems, though least in the USA (Figs 15(a) and (b)). For the young, other recreational activities, such as scuba diving and water skiing were becoming available; less regulated, cheaper and easily available.

Flying clubs and schools were now firmly wedded to Cessna and Piper. British ex-war Tiger Moths, of which there were still many, were not ideal on runway airfields, had draughty open cockpits and tailwheels. New pilots learnt with tricycle landing gear so the art of three point faded. Flying schools were now finding that the majority of their customers were becoming middle aged, or older, simply because having got mortgages and children off their hands they could now afford the increasing cost. They wanted aeroplanes more like their comfortable cars with ignition keys and easy access.

Even gliding was affected by rising costs. High performance in any aircraft is expensive and was beginning to put top competition opportunities beyond the reach of many younger pilots, though the sport generally was still doing well due to its self-help culture. But the search for higher performance was unstoppable (Fig. 16). This could not be achieved unless the glider could retain the fair surface for which it had been designed. In moist conditions the wood swelled and in dry the glider took on the appearance of a starved horse. Varieties of sandwich construction...
were tried until success came in the late 1950s with the appearance of the first glass fibre glider, the Phoenix, designed by H. Nagele and R. Eppler at the Stuttgart Technical High School. Glass gliders also permitted water ballast to be carried in the wings to enhance high speed performance (Fig. 17); not possible in wooden aircraft.

By the early 1960s several German manufacturers were producing glass fibre gliders with L/Ds jumping from 35-40 to 50 plus. This rapid constructional change was not, however, without its problems. Although the new gliders were immensely strong they were found to lack stiffness which produced some spectacular flutter incidents. The cure lay in an even newer synthetic material; carbon fibre. Again it was the German universities which led the way. This dominance increased the hold Germany had over other manufacturers who did not have the expertise to change quickly enough to composite materials. Within a few years companies like Slingsby and Breguet had ceased making high performance gliders.

6.0 THE REVOLUTIONARY 1960s

Commercial air travel was growing ever more popular, speeded forward to its present worldwide coverage by the jet engine, and by manufacturers and designers needing to stay in business at a time of military downsizing. By the end of the 20th century commercial aircraft, airports and infrastructure were big business. But for it to operate efficiently restrictions on light aviation airspace increased.

No longer was it possible to fly over town and country without it mattering too much if the pilot became lost. Light aeroplane pilots were having to learn to be junior relatives of flight deck crews by compliance with CAS rules and changing height limits, by learning radio procedures and obeying controllers, even feeling something of a criminal if they got it wrong. Youngsters no longer hung around hoping that someone would take them up, and teaching became increasingly geared to the learning needs of commercial against fun aviation. Light aviation’s difficulties were not reduced by mounting objections to aircraft noise, regardless of what sort of aeroplane made it. Freedoms were slipping away.

Beagle, now a consortium of Auster and Miles, tried to stay in business by selling training aircraft to an ever-slimming and changing RAF as there was no chance of breaking into the dominance of Americanised flying club fleets. Later, Slingsby had a little success with the Firefly. But in Britain as well as across the world there were still pilots who wanted to fly ‘free as the birds’. They wanted to return to taking their own decisions, to being responsible for themselves. A revolution, unnoticed or ignored was about to break. Those who dreamed of flying with the same fervour as the pioneers could not afford, or disliked the complex way in which they saw their aviation going. Quite coincidentally, it was at this time that the NASA space programme was developing – far removed from simple flying. One of its products was a cross between a kite and a parachute designed by Francis Rogallo in order to lower space vehicles safely to earth. However, the ‘Rogallo’ was soon outdated largely because NASA endeavoured to use conventional controls, whereas the ‘new fliers’ had not forgotten about weightshift control as used by Lilienthal 70 years earlier, but the Rogallo had served its purpose as an inspiration for the simple flier. With modifications it soon grew into the flexwing hang glider (Fig. 18).

Within a year literally thousands of people across the world, including highly qualified aerodynamicists, were designing, building and flying these hang gliders. They obeyed no air traffic rules, not because the new fliers did not know them, but flying at such low levels, almost ground hopping, they were not in the way of other aviators except for a few startled glider pilots on seeing a brightly coloured ragwing appear on their hills.

With so much energy, so many innovative brains and so little cost it was not surprising that hang gliders improved so rapidly, not only aerodynamically but in performance using the new strong non-porous synthetic fabrics (nylon, mylar, later kevlar) that were becoming more readily available (Fig. 19). Much needed understanding of stability and control of these deformable aircraft was soon acquired, simply because of the large number of good brains concerned with finding solutions.

Within a few years, in March 1974, the Austrians announced a world championship, planning for some 50 entrants but with 200 turning up from as far as Australia and USA. Pilots launched by running off the hilltop above Kossen, a few managing to soar in slope lift. There was a great spirit of exploration, redolent of 1903, but there were also problems to come. As these cheap, portable, often homemade hang gliders grew in numbers and performance, they became regarded by conventional aviation as invasive and dangerous. Certainly in their early years there had been accidents, though little different in rate and reasons from those in the
formative years of aeroplane flying, gliding, parachuting or ballooning. Hang gliders had come to stay and were soon bringing into aviation new ideas, instrumentation and more importantly the young (Fig. 20).

Still free from the rules and restrictions affecting ‘regular’ aircraft and their pilots it was easy to experiment (Fig. 21). Then, as in the thirties with gliders, there were those who ‘wanted to put a little engine in it’. By now there were both Rogallo type flex wings with weightshift control and the more usual fixed wings, some tailless. A difficulty was where to hang the motor on these assorted shapes, particularly on aircraft where the pilot sat in a swing seat; pitch stability took a little time to sort out until it was appreciated that the thrust line had to be well below the wing. The breakthrough for the flexwings came with the Trike (Fig. 22), where the pilot, engine and landing wheels were in a single structure attached underneath the wing, to which the control frame was fixed.

7.0 THEN CAME MICROLIGHTS

The Trike attracted devotees not only of hang gliding but of ultralight aeroplanes so new ideas flowed freely. They became known collectively...
as microlights. Also, at the time effectively unregulated, they fulfilled the persistent desire for simple, low cost, flying and because of their freedoms soon developed into practical little aeroplanes (Figs 23 and 24). By the time CAA regulations caught up with them microlights were sufficiently established to retain considerable independence. This included a pilot licence suited to learning and flying from unlicenced airfields and responsibility for their own airworthiness standards under their national organisation, the British Microlight Aircraft Association.

Another organisation which was working towards cheaper flying was the longer established Popular Flying Association, grown from the earlier Ultra Light Aircraft Association. The PFA is primarily a homebuilt aircraft organisation, expanding fast with kit built constructions. Its great value lies in increasing the numbers and varieties of light aeroplanes flying in this country and in promoting engineering skills. Its pilots hold CAA PPLs.

8.0 THEN PARACHUTES CHANGED SHAPE

The many benefits of new synthetic materials had also not gone unnoticed by the parachuting fraternity. They had been using conventional round chutes designed originally only to save life and had the disadvantage of being directionally non-controllable, with inevitable downwind landings. Efforts had been made to overcome this real disadvantage, one by Pierre Lemoigne in France who built a many slotted canopy which moved through the air providing a degree of control; patented 1961. This was when Francis Rogallo was working on his delta kite, patented 1962, which provided ideas for the Paracommander steerable parachute in 1963 (Fig. 25). From all this came the ‘Square’ which was effectively a very primitive glider which could be turned into wind for landing controlled by distorting the outer ends of the ‘wing’ (Fig. 26). It added greatly to the sport with accuracy landing competitions and also international mass formation freefall records. The potential of the Square (Fig. 27) was exploited in Britain by Walter Neumark who realised that it could be towed up, not only to teach parachute landings more cheaply and safely than being dropped from an aeroplane, but that Parascending was an excellent way to teach the young about flying, including how to stay airborne in thermals. It also did not go unnoticed by hang glider pilots and others always on the lookout for simpler, cheaper flying. Here was an aircraft that could be carried in a car boot, but which would be even better if its performance could be improved. The innovative fliers got to work. Within a few years aspect ratios had increased from around two to eight or nine with \( L/D \) from two to four or five. These paragliders could be circled in the strong lift of thermal cores and before long soaring distances of 200km were being flown (Fig. 28). They were very attractive for the young – if landing in the mountains the pilot just wrapped up in his aircraft for a snug night! By the 1990s paragliders outnumbered hang gliders and were being made and flown across the world.
The appearance of paragliders in the sky was not lost on non-fliers. Those looking for a thrill sport devised kite-surfing, where a surfboard is pulled into the air by a paraglider, albeit only long enough for a quick loop. This new sport is already backed by a thriving little industry. If decrying such activities as not being aviation it perhaps should not be forgotten that in 1903 Cody crossed the Channel in a boat towed by a kite. Soon an explorer intends to be towed across the Antarctic ice by a paraglider. However, mainline paraglider pilots were soon on the track of their predecessors in wanting to add a little engine. In most the motor is in a cage on the pilot’s back (Fig. 29). Once again very small engines were needed but this was no problem with the present worldwide powering of chainsaws and garden tools. These simple Powered Paragliders (PPG) are used for spot landing competitions and local cross country flying with, for example, a week long tour from Lands End to John O’Groats providing an expensive fun holiday. Currently there are 45 factories making engines for PPGs, including some in Sweden, Ukraine, Poland and Italy. There is also a further market for motors for the Trike-bodied paragliders more popular in the States. It soon became apparent that these new off-beat developments did not just turn up out of the blue. Behind them were the ingenuity and brains of individuals who liked to do things for themselves. Nor did it stop. The flexibility of foot launching and landing also allowed even simpler powered flying, resulting in the FLPA (foot launched powered aircraft). The pilot takes off by running, retracts into a prone or supine pod at the tail end of which is a tiny engine, driving a propeller which folds itself when the engine is not running (Fig. 30). FLPAs are de-regulated in Britain, have a good safety record and are a fine opening for young pilots and engineers. They are looked after by a Code of Practice produced by the British Hang Gliding and Paragliding Association and the BMAA.

9.0 1980’s – 2002

The last 20 or so years of the 20th century saw the value of freedom to experiment with new, even untried synthetic materials. They had made hang gliding possible as well as the manpowered flights of Paul MacCready’s Gossamer Condor and Albatross. Almost all gliders are now made of composites with microlights and VLAs (Very Light Aircraft; non-aerobatic two-seaters of MTOW 750kg) converting increasingly to this material; as are quick build kits. (Table 5 shows world motorless distance records at the end of 2002) Not least this whole range of varied configuration light flying machines, including little autogyros, has spawned small industries supplying lightweight cockpit instrumentation and equipment (Fig. 31). At this end of the aviation market British enterprise is well represented, though in a small way. On the downside flying clubs and schools are still stocked with old technology aircraft, much of it American. Even if, miraculously, modern replacement British aircraft became available, re-equipment costs would be too high for the current amount of trade. So the situation is unlikely to change, particularly as new US aircraft, designed for the more profitable business flying market become available, including jet replacement engines. The last years have seen an increasing divergence between the ‘heavier’ end of GA; i.e. pilots who want, or need, to use their aeroplanes for flying to work or for serious long distance touring, and those pilots whose objective is primarily to enjoy flying to rallies, in competitions or visiting friends on farm strips and who prefer to stay as far from CAS complications as possible. It was such divergence which brought about the need for a simple Visual Flight Rules (VFR) pilot licence. The JAR FCL
important exception. However, lower level airspace is now seriously
5,000 ft with wave soaring and parachuting being a very small but
privileged, the rich and the selfish. Most light flying takes place below
against the public perception that private flying is a pastime of the priv-
blished, it can be cheaper and quicker to trailer it from Britain to Poland than wait to get the work done here –
in due course needs gel coat resurfacing, it can be cheaper and quicker
to inform the public about valuable learning skills, to taking responsibility, or
building a gliding club community do not attract interest. They go
against the public perception that private flying is a pastime of the priv-
ileged, the rich and the selfish. Most light flying takes place below
5,000 ft with wave soaring and parachuting being a very small but
important exception. However, lower level airspace is now seriously
restricted for use by commercial traffic, which is likely to increase with
new airports and extra runways. This requires that all pilots know
where they can or cannot fly which, for some is so complex or intimi-
dating that they never leave the circuit – which adds nothing to
competence.

A further problem for the future is that it is now so easy to travel to
parts of the world that offer better weather and flying. Perhaps half
those wanting to learn to fly choose America. Australia is perfect for
gliding championships and record attempts. Alpine countries and North
Africa attract paraglider pilots and there are British microlight, gliding
and hang gliding schools and centres established in Spain, Portugal and
France. While reducing much needed income for UK operators this is
totally understandable.

Such a disheartening downside will not be easy to change,
although the CAA is making efforts to simplify the pilot licence and
offload technical administration to National Associations which can do
the work responsibly and more cheaply. But there are not enough engi-
eers in the pipeline to cope with any manufacturing expansion, at least
in the short term. Good hardware that the buyer wants at the right price
and delivered on time is essential if Britain is to export to other coun-
tries, particularly those which pay lower wages. The home market is
not itself large enough to sustain production even in an efficient and
economically run business. At present there is small incentive for tech-
nical colleges or universities to encourage large intakes in an industry
which appears to offer little in the way of a solid future career for more
than a small number of students, nor is there a degree course specifi-
cally covering light aviation. Politicians say that Britain is financially
strong due to its service industries, but these do not produce goods or
skills that people want. For example, if a glider bought from Germany
in due course needs gel coat resurfacing, it can be cheaper and quicker
to trailer it from Britain to Poland than wait to get the work done here –
where there is capability but insufficient capacity.

### 10.0 TOWARDS THE FUTURE

Directions in which light aviation may go in the foreseeable future will
be primarily affected by the sort of flying that pilots want and the
aircraft that will suit their needs, all of which are affected by
established or changing political, bureaucratic and environmental
circumstances.

#### 10.1 Light aircraft flying

Ever since the days of the Moth, light aviation has contained an
element of professional flying. In the thirties there were air taxi firms
flying clients to business or race meetings in aeroplanes such as the
Leopard Moth or larger Short Scion. This element exists today with
pilots and aircraft equipped to use controlled airspace. The
future for this business flying is likely to remain strong, or even
increase, as improved equipment to deal with communications, colli-
sion avoidance and navigation becomes available. It is likely that the
aeroplanes used here will continue to be mostly American.

Flying by recreational pilots will probably remain much as at
present; touring, rallies, competitions, social and fun. In aircraft the
trend increasingly is towards higher cruise speeds without penalties in
either higher stall speeds or fuel consumption. Pilots want aircraft that
will take off and land in shorter distances and on less well prepared
surfaces, the standard for microlights being a 100 metre ‘deck’. In other
words, aeroplanes that give greater independence from ATC airfields
and are a pleasure to fly. If these aircraft have the additional bonus of being easily deriggable for garage hangarage or trailering so much the better.

Very Light Aircraft (VLA) and microlights built to the present requirements of maximum take off weight (MTOW) of 450kg, (990lb) two seats and minimum speed 65km/h come largely into this category of useful light aircraft. Some are also excellent trainers with the additional benefit of being able to operate with lower costs and fees. Microlights, particularly, attract young designers from across the world. There are currently 195 factories producing a range of aircraft from the cheap and cheerful, through STOL like the scale Fieseler Storch (Fig. 32) to the racer with \( V_{\text{max}} \) 250km/h (155mph) and \( V_{\text{min}} \) 58km/h (40mph) powered by a 100hp Rotax 912S. The latest British trike, the Pegasus Quik (Fig. 33), also with a 912S, cruises at 187km/h (85mph.) Microlights are also in use as tugs for both gliders and hang gliders and many use plastic three-bladed propellers with quick ground-adjustable pitch change – if needed for a shorter take off.

Microlights are manufactured mainly in the EU but also in India, the Czech Republic, Ukraine and Poland. In the USA ultralights come into a slightly heavier Sport Pilot Class with 22 manufacturers.

Although today’s light aircraft, like the Samba (Fig. 34) and Jabiru (Fig. 35), bear a superficial resemblance to the classic Miles Hawk or Auster they are not direct descendants. They evolved from the revolution which resulted in the hang glider, motorised hang glider and the microlight, and as they evolved so did the engines they needed. Rotax, for example, advanced from small two strokes to aircraft-approved four-strokes producing 100hp in about two decades. Lightweight diesels are not far behind as are small gas turbine and jet engines. The ready availability of reliable lightweight four-strokes has also provided a real stimulus for homebuilt aircraft designers as they allow for useful increased payloads.

The wide range of ‘new technology’ versatile light aircraft, intended primarily for the enjoyment of flying, is popular worldwide. In Britain the market is strong and has a good chance of making steady progress at home and abroad – provided that it can attract enough capital and is not overwhelmed by bureaucratic regulatory paperwork.

10.2 Gliding

The future for gliders may be somewhat different. Their present very high performance \( (L/D \sim 60) \) has been available now for more than a decade, and reached the stage where even a tiny performance improvement is uneconomically costly. As a result R&D has slowed – or in some cases changed direction towards more profitable craft intended to operate at the edge of space. Club and training glider manufacture continues, mostly in Germany and Poland, though with gliding worldwide in numerical decline there is no great incentive for constructors to lay out large sums of money on increased production. One Australian hang glider manufacturer, Moyes, has produced a light glider and microlight tug both transportable on a single trailer.

10.3 Motor gliders

There is growth in motor gliders because of the independence they provide. There are three varieties; self launching with good soaring performance and retractable engine; self sustainers which need a conventional launch but are able to fly back to base when thermals finish and nose-engined ‘touring’ motor gliders. These are usually two seaters with a reasonable soaring performance and are safe general purpose aircraft as they have plenty of wing area.

The self launching motor gliders, SLMGs, include the exotic, like the two seat ASH-25, \( L/D = 60 \) of 25-6m (84ft) span, which can carry 120kg of water ballast. The weight of its small fold away engine is barely noticeable. The ASH-25 and similar are very expensive, but there is a wider range of medium performance SLMGs, \( L/D = 35-50 \), which are considerably cheaper and provide good cross country soaring or power flying at acceptable cruise speeds (Fig. 36). Being gliders means that in many countries they come under easier regulations. Some lighter models are defined as microlights (Figs 37 and 38) which could help encourage young pilots to stay in gliding, if those at the older end of the sport actively encourage their integration. There are some 14 motor glider manufacturers in the world, mostly small, including one using an electric engine. Countries include USA, Italy, Russia, Slovenia and the Czech Republic. Typical petrol engines are listed in Table 6.
10.4 Hang gliding and paragliding

Hang gliding and the even more affordable and portable paragliding, have perhaps the greatest opportunity to expand and support a good sized manufacturing industry and training establishments. Paragliders, PPGs and FLPAs are also likely to advance in design and performance. This is flying in its most independent form. Buy a jet ticket, put your aircraft in the hold and then fly as far from conventional aviation as possible. Paragliders have flown over Everest and soared distances of 300km in SW Africa. They provide cheap and wonderful holiday flying high above the Alps for the young who have not yet lost their sense of adventure. There are globally 14 manufacturers of hang gliders, mostly in Europe and Australia, including one who makes inflatable ones for simple fun flying off hills. There are, however, 60 paraglider constructors making an average of ten models each at an average price of £2700, in countries like Korea, Slovenia, Ukraine as well as in the EU.

10.5 Outside influences

Light aviation grew and flourished through the enterprise and courage of individuals. Geoffrey de Havilland, for example, first designed and built an engine, then built an airframe around it and then taught himself to fly it. From such initiatives came little workshops with workers who, later, designed and built better flying machines, learning all the time. The big jets of today are a result.

We now live in a time of proliferating legislation. The EU, national governments, the HSE and countless committees which seem to work on the basis that only more legislation can provide safe ordered living. Obviously, there has to be a framework of rules but this must be balanced with allowing the individual to retain self-responsibility and to enable enterprise to thrive. Rules breed paperwork which easily gets out of hand and stifles the activities that it should be encouraging. Small firms find themselves overwhelmed with regulations about equipment safeguards, kitchen hygiene, disabled access, hours of work, minimum wage etc. all of which demands the completion of multi-page forms and the reading of pages of related notes. If there is too much of this then good brains are diverted from the real purpose of the business. Poorly drafted paperwork is a serious obstruction which government needs urgently to reduce. There is also a tax issue. One small club could not put up a much needed hangar as the annual council tax was going to be more than the value of the building.

Britain has another problem which affects many small businesses including light aviation. It is a public lack of interest or ignorance of the work and status of engineers. The oily rag perception is widespread, with the result that many intelligent and capable youngsters are discouraged by family and friends from taking up engineering as their career. It is also resulting in a growing disinterest in making things – even model aeroplane kits are becoming rare on shop shelves. Unless the young have
Gliding clubs are communities where there is something for everyone. Children of gliding parents learn to fly, aiming to solo on their 16th birthday, retiring pilots repair the winch or clubhouse and in winter pilots overhaul their own gliders. Last year ten world gliding championships were held, five being won by British pilots as young as 26. Information on these successes was sent to TV, radio and the national press, and was almost totally ignored. If light and sporting aviation has only a declining future much of its valuable activity for, currently, some 80-100,000 people will fade. Future seedcorn needs encouragement, not hindrance.

Change is always with us and recent years have seen huge changes in the perception of young people and what they want to do with their lives. It is very different from even 40 years ago. Unless income is the primary objective youngsters today do not want to spend their lives as a faceless cog in some multi national company, to which they have no feeling of loyalty. In the past a junior joining a company like Bristol, Hawker or de Havilland, and particularly its technical school, felt part of the family and former employees still speak with pride of ‘their’ company. If, today, youngsters join a small aviation factory they still feel an individual who can make a difference and see results; and they like it.

## 11.0 IN SUMMARY

Light aviation grew from the enterprise and courage of individuals to explore the air, as their forbears had explored new lands and wide oceans. Today, light aviation is publicly seen as an expensive, over-regulated and noisy pastime. But for those who do come into light aviation, in any of its varieties, there are opportunities to become future designers of aircraft, instruments or safety equipment, test pilots, record breakers and instructors. All have something to contribute to the future of this country.

If this is not recognised by government, the media or the public as important the risk is that flying school operators, constructors and pilots will decline in numbers, losing out to foreign competition. Decline has a habit of accelerating.

In the 19th century this country became famous for the achievements of people like Telford, Brunel and Newcomen and in the first half of the last for engineers like de Havilland, A.V. Roe and Sydney Camm. All of them saw what was needed and used their brains and energy to provide it. The second half of the last century saw enormous changes to the structure of major aviation companies due to the vast amounts of money swallowed up by big new passenger jets or military aircraft. and to the regulatory framework that went with it. Well known company names disappeared and buried near the bottom of the pile was light aviation. This country cannot survive for ever by just servicing other people’s washing.

### ACKNOWLEDGEMENTS

Grateful thanks to Dr Darrol Stinton, F.G. Irving and Guy Gratton for checking the text, to Joe Schofield of Skywings and David Brenner of Microlight Flying, Bill Brooks, Charles Brown and the RAeS Library for photographs, to Liz Douglas for printing my slides and to many others for hunting down obscure items of information.

---

**Table 6**

Some typical petrol engines

<table>
<thead>
<tr>
<th>Type</th>
<th>Dry weight (kg)</th>
<th>BHP</th>
<th>kg/hp</th>
<th>cyl</th>
<th>Used in</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gipsy Major</td>
<td>138</td>
<td>130</td>
<td>1.06</td>
<td>4</td>
<td>Tiger Moth</td>
</tr>
<tr>
<td>Gipsy Six</td>
<td>227</td>
<td>200</td>
<td>1.13</td>
<td>6</td>
<td>Proctor</td>
</tr>
<tr>
<td>Lycoming 0.235</td>
<td>129</td>
<td>108</td>
<td>1.2</td>
<td>4</td>
<td>Cessna 150</td>
</tr>
<tr>
<td>Continental 10.360</td>
<td>149</td>
<td>210</td>
<td>0.6</td>
<td>4</td>
<td>Piper Archer</td>
</tr>
<tr>
<td>Rotax 912S</td>
<td>65</td>
<td>100</td>
<td>0.65</td>
<td>4</td>
<td>Europa</td>
</tr>
<tr>
<td>Jabiru 6000</td>
<td>105</td>
<td>200</td>
<td>0.52</td>
<td>8</td>
<td>Scale replica</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Spitfire</td>
</tr>
</tbody>
</table>

**Two stroke** (powered paragliders, some SLMGs and SSMGs)

<table>
<thead>
<tr>
<th>Type</th>
<th>Dry weight (kg)</th>
<th>BHP</th>
<th>kg/hp</th>
<th>cyl</th>
<th>Used in</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tina 200</td>
<td>15</td>
<td>18</td>
<td>0.8</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Mini 2</td>
<td>16</td>
<td>26</td>
<td>0.8</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Cors-Air</td>
<td>14.3</td>
<td>21</td>
<td>0.6</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>