Modern flying methods

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MODERN FLYING METHODS

On the SWISSAIR Line Zurich - Basle - London

(*Extract from "FLYING ADVENTURES" by Walter Mittelholzer, published by Blackie & Son, London*)

In no other means of communication and transport has there occurred so rapid a transformation of all standards and values in a short space of time, as in commercial aviation.

The introduction of reliable blind-flying instruments, and above all the system of wireless bearings (be it outside bearings from a ground station of direct bearing from one's own plane) have brought about a completely different method of flying in present-day commercial air-line operation.

With the former system, which we may call the "ground-to-air" method of direction finding, the position of the aircraft is determined by aerodrome ground stations, which take bearings on the small transmitters aboard the aircraft and then transmit the result back to the aircraft by wireless. The second or "air-to-ground" system of direction finding enables the pilot to take his own bearings by means of a wireless direction-finding apparatus, which is carried on board. For the use of this system the high-powered transmitters of the ground radio organization or broadcasting stations are available, rendering it possible for the pilot to take bearings over very long distances and as often as necessary, so that radio communication from aircraft to ground and vice versa can be dispensed with in most cases.

Whereas in cloudy weather we used to be forced by lack of visibility to fly beneath the clouds, often only a few feet above the ground surface, to-day the whole flight from beginning to end is carried out at a high-altitude safety-level. The pilot will select that flying altitude which affords him the most favourable conditions for a calm, and at the same time economical flight. In our northern latitudes, and especially during the winter months, the ice-formation limit is an important, in fact, a vital factor, in each choice of a blind-flying level. I will endeavour to give some idea of the practice adopted by a pilot on a modern passenger air service, and take Swiss Air Lines' regular service between Basle and London (distance 450 miles) as a practical example.

The machine employed on this line is a *Douglas D.C.2*, the same type as the "Flying Hotel" of the London-Melbourne air race. It is an all-metal plane, of cantilever low-wing type, with a span of eighty-five feet. Its twin 720 horse-power Wright or Bristol Pegasus engines enable it to attain a maximum speed of 200 miles per hour. Cruising speed at 60 per cent. of maximum power is 170 miles per hour. With a crew of three, fourteen passengers, and a load of 880 lb. of mail and cargo and 3,300 lb. of fuel, its range of action is 1,000 miles.

The instrument panel is equipped with the following control instruments for both engines: oil pressure gauge, oil thermometer showing oil temperature on entering and leaving engine, thermocouple, super-charger pressure gauge, revolution counter, and fuel pressure gauge. By means of a tabular diagram based on flying altitude, blower pressure and the number of revolutions, the pilot is able to determine the actual engine power at any given moment. According to this table the most favourable results on the Zurich-London route are obtainable at an altitude of 11,000 feet.

For navigation purposes the following equipment is installed:

- Two magnetic compasses, one of which is a bell-compass, fitted at eye-level, and which can be read off directly by the pilot.
- An air-speed indicator, the head of which is electrically heated to prevent ice-formation.
- An altimeter, with slow-motion graduation which shows every ten metres difference in altitude.
- A variometer, which indicated the rate of the plane's climb or fall in metres per second.
- The blind-flying equipment, which can also be coupled with the automatic pilot, an artificial horizon (Sperry system) and a directional gyro.

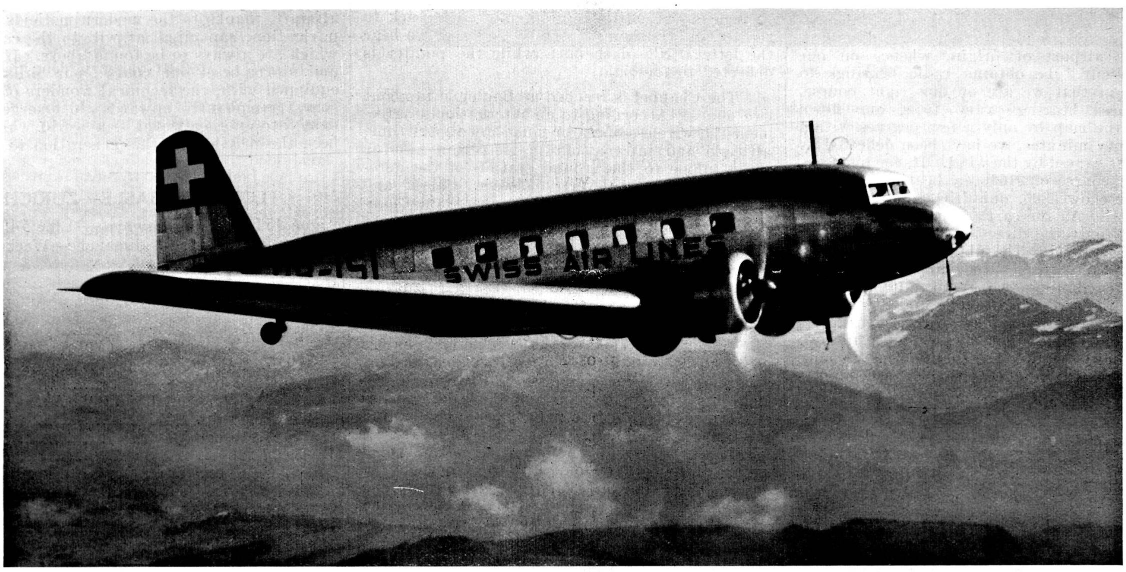
Before switching over to the automatic pilot, the pilot has to manipulate the plane until the control marks of the above-mentioned blind-flying instruments coincide with the desired route and the desired pitch angle. He then switches on the automatic controls by setting a transverse lever. The steering-gear is now rigid and can only be deflected by the pilot with a double effort. Any desired change of course, climb, loss in height or lateral inclination can be extremely closely adjusted by merely manipulating the corresponding knob, so that perfectly exact navigation is guaranteed. Especially when blind-flying in fog, a pilot can never maintain his course and altitude for any length of time with such accuracy, as that provided by the automatic pilot. Thus the factor of human deviation is eliminated, and the flight-captain has better opportunity for concentrating on his navigation problems.

The Douglas is equipped with the following wireless apparatus:

- A Telefunken wireless transmitter.
- Aircraft homing and direction-finding equipment.
- A blind landing outfit for visible and acoustic reception of a short-wave radio range beacon.

Shortly before commencing the flight, the appointed flight-captain checks up on general weather conditions over the continent, with the aid of the weather charts at the meterorological station. He also receives a printed slip from the meteorological expert, giving him the detailed weather reports received by wireless from all the stations along his route. Whereas the local weather reports all along the route used to be of prime importance (for the flight could not be risked if unfavourable cloud layers or bad visibility prevailed), to-day the pilot is mainly interested in conditions at his destination airport. Clouds at 150 feet and a visibility of only half a mile, which used to cancel that day's air service, are nowadays satisfactory conditions for performing the flight without undue difficulty.

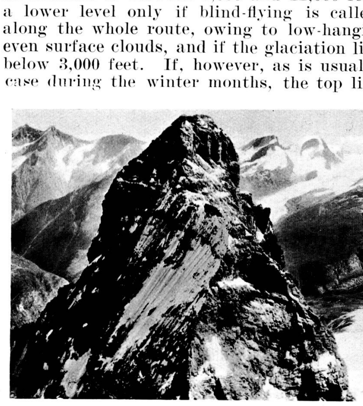
Besides the cloud level and visibility at Croydon airport, our flight-captain is especially interested in the pilot-balloon measurements. From these he obtains details of the wind direction and strength at various latitudes. As soon as this information is submitted, he can easily work out with sufficient accuracy before starting the duration of his flight, and above all, the drift on the various sectors of his route, which must be taken into account in setting his course. Thus by dead-reckoning, he will be able to fly to schedule almost to the minute, by merely regulating his flying speed. If he does not receive wind reports, as is usually the case when the weather is bad all along the route, it will be a simple matter for him to ascertain these details of wind speed and direction himself during the flight by wireless navigation, and increase or decrease his flying speed accordingly.



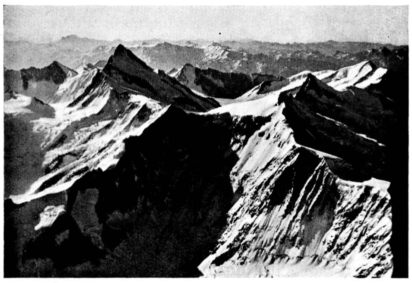
Douglas Air Liner in Flight.

This latter possibility is a feature of the latest high-speed planes, with their big range of speed, from a minimum of 100 miles per hour to a top cruising speed of almost 200 miles per hour. At such speeds wind currents, which — except in extreme cases — attain fifty miles per hour at the most, do not play such an important part, as with less modern planes with a top speed of 100 miles per hour. Thus navigation has also been rendered considerably more exact and simpler.

As a general rule the flight is carried out at an altitude of between 7,000 and 11,000 feet; at a lower level only if blind-flying is called for along the whole route, owing to low-hanging or even surface clouds, and if the glaciation limit is below 3,000 feet. If, however, as is usually the case during the winter months, the top limit of



Matterhorn.



Finsteraarhorn and Fiescherhörner.

the rain or snow clouds is not higher than 10,000 to 13,000 feet, the pilot will prefer to push up through the ice-formation strata, climbing at 1,000 feet per minute, in order to reach the calmer levels above. This ensures that his passengers have a tranquil flight. The crust of ice which thereby forms on propeller and wingedges usually chips off with the increasing height and sinking temperature. At all events the climb is definitely preferable to remaining in the glacial clouds below, and is tactically more justified, always assuming, of course, that the plane's climbing power suffices. With our twin-engined 1,400 horse-power Douglas I have time and again adopted this method, and with a fully loaded machine have never experienced difficulties. After ten minutes' flight, an altitude of 10,000 feet has been attained, which as a rule is the upper cloud limit. Beneath a clear blue sky, above an apparently infinite sea of clouds, the plane now continues on its flight in majestic calm and solitude.

Throughout the flight to London, the wireless operator, at the pilot's side, is in constant communication with ground stations. At first with Basle, our airport of origin, whence on our summons "qdr," he obtains radio bearings to make certain that we are on our right course. Should these bearings vary from our flown course on the map by only a few degrees within ten to twenty minutes, we have been deflected by lateral drift caused by the wind. If, for instance, on a flown course of 316°, the bearings received from Basle show 330°, our drift amounts to 14° to starboard. As the earth is not visible for the time being, only the direction flown from Basle can be ascertained. The plane's exact position on the map and flying speed can only be determined by combining two radio bearing transmitters — the airports at Basle and Strassburg. As soon as the wireless operator receives these details or determines them himself with his own direction-finding equipment, the pilot can at once gather the extent and direction of the plane's drift from his route map, by means of a wind triangle.

Grand Combin.

According to the general weather conditions, that is to say, the position of the isobars on the weather map, this drift may show considerable variations during a flight. The pilot will first of all compensate the ascertained drift in the opposite direction. In the above-mentioned case he would now fly a course of 302°. As soon as repeated radio bearings reveal that he is now on his direct route again, wind drift has been counteracted for the time being. But as in practice several variations of the diverting factors (wind, false direction information, deviation) occur during the flight, this method may have to be repeated continually.

Each ensuing radio bearing informs us whether we are on our right course or not. With the aid of the " automatic pilot " we are able to keep to a compass course to one degree of accuracy. This is all the easier as flying at high altitudes, above the clouds, the atmosphere is usually calm and free from wind gusts or " bumps." If the pilot has no ground visibility he will take one or more control bearings every twenty minutes, with the ground stations in his region, in order to keep posted as to his position and thus determine actual speed, and any eventual new wind variations.

Before the first half-sector of the route has been completed, that is to say, shortly before Rheims, the wireless operator tunes in his frame direction-finder on one of the big English broadcasting stations near London. If we are on our right course, the pointer of the frame-drive must be on the 0, that is, the plane's axis, in as much as no drift has to be compensated, in which case drift angle must be added or subtracted accordingly. The latest excellent Telefunken direction-finding equipment can be tuned in to half a degree of accuracy at a distance of over 200 miles. On switching on the home-finding equipment any deviation from our course can at once either be heard as an acoustic signal in the earphones, or can be seen on the course indicator. If we are on our course, a continuous dash is to be heard; if we hear the "A" sign (dot dash) or if the pointer of the course indicator is deflected to the left of the centre zero mark, we must turn the plane to the left until a continuous dash is again to be heard or until the pointer wanders back to the centre. If the contrary be the case, we hear the letter "N" (dash dot), while the pointer is deflected to the right.

The Channel is reached at Boulogne in about two hours. According to an international agreement the wireless operator must now report time, altitude and international registration number of his plane to the ground station of the aerodrome of St. Inglevert (between Calais and Boulogne) before setting off to traverse the Channel. Having crossed, in about twelve minutes, we put a message through to the corresponding English wireless station at Lympne. At the same time we get into touch with our destination, Croydon Airport, whence we receive the latest weather reports, with details of cloud altitudes, visibility, direction and strength of wind, as well as the height of the barometer. This last enables us to adjust our altimeter to Croydon's height above sea-level, for owing to the varying barometer readings in London and Basle, differences of as much as 700 feet may occur. On calling the international code signal " qdm," we receive within thirty seconds the exact course on which we are to fly to Croydon. In order to make the descent from *our high altitude as pleasant as possible* for the passengers, it should be carried out at a maximum fall of 400 *feet per minute*. If we had been flying at a height of 10,000 feet, this would mean starting with the descent about twenty-five minutes before reaching London. At an average cruising speed of 175 miles per hour this would correspond to a flying distance of about seventy-five miles. That is to say, we are obliged to start throttling the engines above the middle of the Channel, or if we are flying at 13,000 feet, as is often the case, in France before reaching Boulogne.

As we approach London, the directional bearing reports or our own bearings, as the case may be, become more and more accurate, until the plane is brought directly over the flying ground. If the pilot can still not see the ground, although he has now come down to 700 feet, he receives the signal " land " from the ground station. He now knows for certain that he is over the aerodrome, and will at once plane down until the ground is visible. The landing is then carried out in the ordinary manner with ground visibility.

A great improvement for landing in fog has recently been found in short-wave beams (beacon). A directed beam is installed on the aerodrome, radiating along the most favourable course to the air-port. The pilot is then able, by means of very sensitive indicators and acoustic apparatus, to follow this directed beam, and emerge from the fog in order to land within a few feet of the desired spot at the aerodrome. This process has the big advantage of being completely immune from the effects of thunderstorms, which otherwise often cause considerable electrical disturbance. Moreover, each landing can be carried out so rapidly and with such precision along a given line, that several planes can follow each other at short intervals. Zurich and Heston already possess such a short-wave radio range beacon, and soon all the leading airports in Europe will install this latest means of increasing flight and landing security.

I have endeavoured to describe the methods in use to-day, as employed by the crew of an air line, though I have only given some idea of the scheme without going into all the minute details of its execution.

To-day the flight-captain has such a diversity of auxiliary appliances at his disposal, that according to his capability and his experience, each flight accomplished may be said to involve the solution of a problem. The days of the irresponsible hardihood of the " joystick crusaders " are definitely a thing of the past for commercial aviation. Whereas we used to look upon reckless turns, vertical banking and acrobatic flying as the ultimate and highest achievement of a pilot, the steady, safe, and regular performance of our air services is to-day's watchword. While seafaring craft, bound to a single plane, have no possibility of avoiding storms, aircraft, thanks to the modern methods of aerial navigation, can climb at will to the calm levels which are always to be found above. If rain, fog and storm beset our course, our birds of steel, equipped with, the technical wonders of our age, soar triumphantly upwards, to emerge resplendent into another world — a world which it has been the privilege of this generation to discover.

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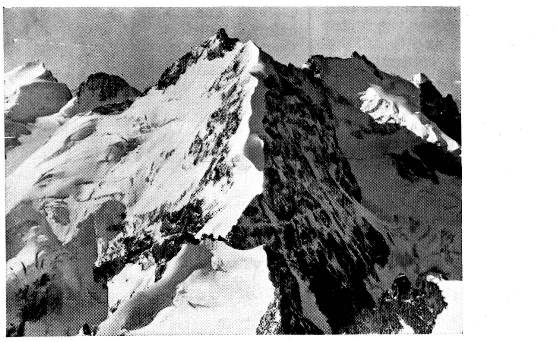

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