Among the Britannia operators making use of the new flight planning method are Cubana, who have four Britannia 318s in service

FLIGHT-PLANNING MADE EASY . . .

throttling and max. continuous power, this means that power will not affect the outcome of the flight and may be chosen to give the most convenient cruising height.

Cruising height is determined by stopping in the T.A.S. graph at the mean anticipated air temperature, and then running into the height graph on the right to read off, on the shaded or dotted scales as appropriate, cruising height. If the original entry into the headwind graph had terminated in the white area, height should be determined, generally speaking, as mid-way between the shaded and dotted heights (T.A.S. being reduced 5 kt for each thousand feet below dotted height, since wind is reducing by an average of 5 kt per thousand feet in the white area).

To determine flight time, subtract from T.A.S. the mean headwind component at mean cruising height, and divide this into track distance to give equivalent cruising time. Add 15 minutes to this to allow for climb and descent.

To ascertain arrival weight (i.e., weight 1,000ft over the destination, assuming that all reserves are intact except for *en route* fuel reserves) enter the second chart, as shown by the arrow, with T.A.S. and run through air temperature, flight time and arrival weight, finally reading off take-off weight.

This is the least take-off weight in which the flight can be made, allowing for a 5 per cent *en route* fuel reserve. If runway considerations permit a heavier take-off, either the flight can be made at a higher T.A.S., or more payload can be carried. In this case select a higher speed and go through the process again to find an appropriate take-off weight.

In many cases where "dog leg" tracks along airways make overall averaging of winds and temperatures unreliable, a sector-by-sector flight plan is required. (The word sector, in this context, means a segment of one particular flight, and does not imply that a landing is made.) In this case, the procedure described above should be run through for each sector, but instead of running down to the flight-time graph, turn off at the sector-time graph and into the sector-starting-weight graph to determine sector fuel.

For the first sector, starting from take-off, 1,500 lb should be added to sector fuel and ten minutes to sector time to allow for take-off and climb. For the last sector, 500 lb should be subtracted from sector fuel and five minutes from sector time to allow for the descent. These quantities do not vary much from one flight to another.

If you emerge from the chart with less than the "minimum sector fuel" (i.e., the minimum fuel required by operational requirements below which it is never permitted to go), then, of course, it is possible to use a higher speed. It is in this way that, by saving aircraft hours, complete extra flights can be squeezed in between checks, thus saving money.

The graphs at the bottom of the first chart, so far not referred to, are an in-flight guide to achieving the optimum flight that has been planned. In practice this amounts to deciding when to change from one to another of the cruising heights permitted by A.T.C. The example shown by the dotted line tells the captain that the best time to change, in one particular situation, is when the A.S.I. shows 230 knots.

Another use for this part of the chart is in planning the quickest possible flight regardless of fuel used, in accordance with the dictum that flying time costs more than fuel. Engine power is decided as before, and you enter with 250 kt I.A.S. (Britannia V_{no}, recently increased to 258), running up to the 2,000ft or 4,000ft lines depending upon the step-climbs required by A.T.C., or to the "basic" line if a drift-climb is permitted. Thence run across to approximate mean weight, then up to T.A.S. (shaded or dotted as appropriate), and also via air temperature and mean weight again to height.

The system makes it possible also to determine quickly, in cases where A.T.C. prohibit use of a particular height band, to go above or below this height. In other words, it is possible in a few seconds to see whether the aircraft is too heavy to attain the necessary height, and if so what amount of throttling is needed to fly below without exceeding V_{no}.

One possible limitation of the method is that it does not, in its present form, make allowance for three-engine cruising. However, range of the Britannia on three engines is claimed to be about the same as on four, and destination can still be made, though at a lower height, for the same I.A.S. In general, an engine failure would require a drift down of 7,000ft or 8,000ft.

The foregoing provides merely an outline of the method, which may well come to be used regularly by Britannia operators, in place of, or at least as an alternative to, the full "steam" manual method. It is indeed already used by C.P.A.L., Cubana and Hunting-Clan, and R.A.F. Transport Command are said to be most interested. Furthermore, the principle of the method may well be adapted to other turbine aircraft; and Bristol will have made an important contribution not only to the operation of their own product, but to the art of flight-planning in general in the turbine age. J. M. R.

FOUR NATIONS, THREE JETS

WITHOUT doubt one of the most significant events of recent times in the field of air transport was the equipment agreement in October 1958 between S.A.S. and Swissair. Although the terms of this agreement between the carriers of four sovereign nations have been recorded and commented on in *Flight* on a number of occasions, it is of particular interest to note the following abridged extract from Swissair's annual report for 1958:—

"During the course of the year under review it became ever more apparent that the three DC-8s we had ordered would not be adequate to put us in a sufficiently competitive position in the period beginning 1960.

"We made a long and thorough investigation to find the best possible solution for our company. Right from the start we were forced to take account of the characteristics of our route structure which consists of long, medium, and short segments, with traffic, in some cases, varying greatly. Considered from this standpoint, there was no doubt that a fleet made up of three types of turbo-powered aircraft—with varying range—would be the best solution, and that, in the interest of our gaining the best possible competitive position, they should all be pure jet. On the other hand, considerations of operational economy pointed equally clearly to the advantage of restricting ourselves to two types of aircraft.

"It so happened that our friends in S.A.S., whose network, like ours, consists of long, medium, and short segments, were faced with similar problems. As both companies have thus far followed practically the same policy in the purchase of new equipment, they both own highly similar fleets of propeller-powered aircraft. Both have also ordered Douglas DC-8s. Moreover both companies agree to a great extent on their basic concepts of air transport operations, and both work without government subsidies and without state intervention in the conduct of business.

"In view of our past cordial relationships, it was only natural for Swissair and S.A.S. to attempt to find a more economic solution to the problem of changing over to jet equipment than either carrier would have been able to find alone. The result of our studies and negotiations, as approved by the boards of both airlines, may be summarized as follows:—

"Swissair and S.A.S., by the beginning of 1961, will each introduce three types of jet aircraft, namely the Douglas DC-8 for routes with particularly long stages and substantial traffic, the Convair 880 for routes with medium-length stages, and the Caravelle for the more important routes in Europe and the Mediterranean area. All aircraft of these three types will be completely standardized for both companies. Maintenance will be divided: S.A.S. will handle overhauling and certain periodic maintenance checks for Swissair's DC-8s and Caravelles, and Swissair will take on the corresponding work for S.A.S. Convair 880s. Swissair has ordered five Convair 880s costing a total of 170 million francs for planes, spares, special operational equipment and a flight simulator. Of these, Swissair is leasing two to S.A.S. for a period of four years. On the other hand, S.A.S. has ordered four additional Caravelles which will likewise be leased to Swissair for four years.

"Each carrier, in principle, will only need to purchase parts of the types of aircraft for which it does the maintenance work. To a considerable extent crew training will be carried on jointly. In every way possible, both carriers will also assist each other in engineering and operational matters. Hand in hand with this technical co-operation, both companies will continue to work together on the commercial side as in the past."