DEPARTMENT OF INDUSTRY AND COMMERCE
METEOROLOGICAL SERVICE

TECHNICAL NOTE No. 11

# THE UTILISATION OF AIRCRAFT WEATHER REPORTS AT THE METEOROLOGICAL OFFICE, SHANNON AIRPORT

BY
P. K. ROHAN, M.A.

DUBLIN
1952

# The Utilisation of Aircraft Weather Reports at the Meteorological Office, Shannon Airport

By
P. K. Rohan, M.A.

## 1. INTRODUCTION

This note deals, in short outline, with the uses to which aircraft weather reports are put at the Meteorological Office, Shannon Airport. The methods by which the reports are obtained and disseminated, and the form in which they are received, are outlined in Appendix I.

The main applications of the data at the Airport may be summarised as follows:-

(A) immediate use in improving service to aircraft already in the air or taking off within a short period

- (i) as an aid to the maintenance of meteorological flight watch, including the issue of Warnings (See Paragraph 2)
- (ii) in the improvement of flight forecasts which are in the process of preparation (See Paragraph 3)
- (iii) as an aid in pre-flight briefing (See Paragraph 4)

(B) subsequent use in making a more accurate analysis of the current general meteorological situation, thus improving later forecasts

- (i) in Upper Air Analysis (See Paragraph 5)
- (ii) in Surface Analysis (See Paragraph 6)
- (iii) in the Preparation of Vertical Cross-Sections of the actual weather situation across the North Atlantic (See Paragraph 7)

(C) long-term use in improving the general standard of forecasting

- (i) in post-flight review of flight forecasts for which Shannon Airport was the responsible issuing Meteorological Office (See Paragraph 8)
- (ii) in statistical studies (See Paragraph 9)

## 2. USE OF AIRCRAFT WEATHER REPORTS IN METEOROLOGICAL FLIGHT WATCH

The Meteorological Office, Shannon Airport, is responsible for providing Flight Meteorological Watch to all outbound and inbound transoceanic flights, other than a small number of through flights which are not scheduled to receive new briefing and documentation at the Airport. Flight meteorological watch is also provided, by special arrangement, to certain flights not landing at Shannon.

For each such flight receiving individual watch, a "Flight Progress Chart" is maintained, which shows not only the scheduled route and time - table of the aircraft, as given in its Flight Plan, but also its hour-by-hour progress and encountered weather as revealed by its position and weather reports. Specimens of the two forms used for this purpose are attached (Diagrams A and B). Form 7417 (Diagram A) is that normally used and is capable of accommodating two flights flying on the same flight forecast. Form 7414 is used for flights operating via the Azores or Iceland, or otherwise deviating considerably from an East-West track.

The method of completing and using the "Flight Progress Chart" is as follows -

(a) Particulars available at the time of departure are entered in black ink in the appropriate spaces at the head and foot of the Form as indicated on the sample attached.

(b) Details of various key points along the flight plan track as specified in the flight plan message are entered in red in the body of the chart and particulars of alternates are also entered in the appropriate space, as soon as the departure and flight plan message is received. The expected times of arrival at various key points are entered immediately above the points to which they refer and well clear of the track (so as to leave room for the actual position reports).

(c) As each position and weather report comes to hand it is immediately scrutinised by a special officer allocated to that duty, the "Forecaster's Assistant". If that officer notes that the report contains observations of icing, turbulence, thunderstorms, hail, sharp change of wind direction or strength, a plain language comment on weather condition or a marked deviation from expected flight-plan position he immediately brings the report to the attention of the forecaster, so that the forecaster can examine without delay the necessity of issuing forecast amendments to aircraft in flight or of warning aircraft of reported hazardous conditions. This procedure insures that the forecaster is immediately made aware of the occurrence of important weather developments along the air routes without being required to interrupt chart analysis, forecasting or briefing to scrutinise each report immediately it is received.

(d) Having notified the forecaster when appropriate of special features of the report, the assistant plots the report on the appropriate flight progress chart, if Shannon is responsible for Flight Meteorological Watch over part of the flight. If Shannon has no responsibility for Flight Meteorological Watch for the flight, the report is still retained for reference by the forecaster and for further use in other connections.

(e) The scheme for plotting actual aircraft weather reports on the chart is described in Appendix II.

The meteorological officers responsible for surface and upper-air forecasting and meteorological flight watch over the North Atlantic keep the current Flight Progress Charts under continuous scrutiny, and check the forecasts which have been issued to flights against the aircraft weather reports, taking also into account such other reports of upper-air conditions as may be available. When the reports indicate either actual conditions, or indications of new developments, not anticipated when the original forecast was issued, amendments are issued as appropriate to aircraft in flight in respect of winds or other elements.

It should be noted that upper air temperature and wind reports from surface stations are normally received only twice per day. Accordingly, in a high proportion of those situations in which a new development has not been correctly forecast, the first indication of a forecast error is obtained from reports from aircraft in flight. The information on upper air conditions obtained from surface stations may be up to twelve hours in retard of that obtained from aircraft in flight, a time lag which negatives much of its value for direct and efficient use in providing Flight Meteorological Watch.

## 3. DIRECT USE OF AIRCRAFT WEATHER REPORTS IN THE PREPARATION OF FLIGHT FORECASTS

Recent aircraft weather reports along the route or through the weather systems involved are among the most valuable tools available for

the preparation of forecast charts and flight forecasts. When a forecaster prepares a prognostic chart on the basis of the latest and earlier analysed charts, as well as the other reports included in the bulletins exchanged internationally (e.g. UATS & RAWIN), he invariably checks that his forecast is not at variance with an analysis of the recent aircraft reports. These reports are frequently less than an hour old, while the latest analysed chart may (in the case of Upper Air Charts) be up to 18 hours old.

In the preparation of route forecasts, the aircraft weather reports are the only factual evidence at hand of icing, turbulence, cloud and weather conditions at upper levels along the routes for which the forecast is being prepared, and in preparing these forecasts the forecaster makes continuous reference to recent aircraft weather reports.

## 4. USE OF AIRCRAFT WEATHER REPORTS IN PRE-FLIGHT BRIEFING

Aircraft weather reports are a valuable asset at pre-flight briefing. No matter how well a forecaster explains the basis for the various elements of the forecasts, most crews like to be assured that the latest reports received from other crews on the relevant route support the picture presented by the forecaster. In fact quite a number of crews give the impression that they consider a discussion of recent aircraft reports the most important item of their pre-flight briefing.

A word should be said here regarding dubious reports from aircraft. As explained in the next paragraph, no aircraft weather report is rejected without most careful and anxious consideration, in which all available data are given due weight. A rejected weather report is not suppressed at subsequent pre-flight briefings. Indeed special attention is drawn to the fact that it is not in agreement with the forecaster's considered opinion, and the evidence against its validity is exhaustively discussed, so the pilot may be fully informed as to the degree of likelihood, however small, that it should prove in fact to be essentially correct. This procedure strengthens confidence, and draws the attention of crews to the importance which attaches to every aircraft report and to the need for the best possible accuracy in them.

## 5. USE OF AIRCRAFT WEATHER REPORTS IN UPPER AIR ANALYSIS

In analysing upper air charts the analyst takes full account of reports from aircraft in flight. The method of plotting these reports is described in Appendix III. When he has difficulty in getting his analysis to suit an individual aircraft report, he first checks the key to the aircraft identification in order to find the direction in which the aircraft is flying. In this way he can frequently accept a discrepancy between a report and his analysis by concluding that a wind report from the aircraft refers, not to the actual position, but to a mean along the track in an interval within the last hour. Other elements reported which may be difficult to explain may be due to instrumental errors e.g. D. factors may be shown to be consistently low from a particular flight in a region where numerous other reports are available. If he cannot explain a discrepancy by any of those considerations, he checks the report against all other evidence available including reports from other aircraft in the region at the time and from aircraft reporting from the same situation later. In this connection he checks current flight progress charts and other aircraft reports to establish whether the evidence of a new development is bourne out by later as well as by simultaneous reports. Only when he is satisfied that there is no evidence to support an unexpected report does he reject it in his analysis. In spite of a reasonably well placed network of upper air stations in the North Atlantic, a very considerable number of systems show changes in their intensity and movement without early signs of these developments being reflected directly in the UAT reports. Therefore to capture a timely indication of these changes the analyst has to rely on aircraft reports and his own technical skill and knowledge. An extensive collection of reports on the North Atlantic is accordingly essential for accurate analysis.

## 6. USE OF AIRCRAFT WEATHER REPORTS IN SURFACE ANALYSIS

Aircraft reports are used quite extensively in surface analysis. The surface analyst is very much interested in the activity of fronts, cloud distribution in air masses, temperature lapse with height and convective cloud development as well as icing and turbulent conditions in clouds and airmasses with which he is concerned, and, less directly, in the general wind flow aloft. In all these details aircraft reports give him factual information which is of considerable importance to him in evaluating the synoptic situation. Thus a report of extensive cloud and/or precipitation on the cold side of a quasi stationary front may give the first indication of a new wave development on a front, and may, in the case of areas with scattered surface reports, be many hours ahead of a surface report confirming the development of the wave. The advantages conferred by aircraft reports are considerable in general forecasting as well as in the preparation of 24 hour terminal forecasts at airports in maritime areas. Aircraft reports serve in this connection to compensate at Shannon to a considerable extent for the lack of a close network of upper air and surface stations over the North Atlantic Ocean.

## 7. USE OF AIRCRAFT WEATHER REPORTS IN VERTICAL CROSS-SECTION ANALYSIS

The methods used at Shannon Airport in the preparation of Vertical Cross-sections of actual weather situations are described in Appendix IV. A specimen cross-section is reproduced as Diagram C.

In the analysis of these actual cross sections much of the information regarding the activity of weather systems and fronts such as cloud, icing, turbulence and precipitation is obtained directly from in-flight reports. The finished product is used in a three dimensional analysis in the area in which Shannon is most interested. The cross section is found very useful by forecasters in their capacity as analysts, forecasters and briefing officers, and in the preparation of post flight reviews.

## 8. USE OF AIRCRAFT WEATHER REPORTS IN POST-FLIGHT REVIEW OF FLIGHT FORECASTS

The Duty Analyst at Shannon carries out a post flight review of all outbound North Atlantic flights for which the office issued a forecast. All other flights for which Shannon was responsible M.M.O., the scheduled operation of which was interrupted or seriously affected by weather conditions, are also reviewed.

The Analyst enters in a "Post Flight Review Log" notes on how each Atlantic flight forecast went. These entries are based on surface and upper air charts, aircraft reports, upper air soundings from ships and shore stations and the corresponding cross section of actual Atlantic weather. The main purpose of the post flight review is to enable the forecasters concerned to trace the source of errors and thus improve the standard of forecasting. Recurrent causes of error are stressed in these reviews. The reviews are regarded as important contributions to the efficient working of the office.

In the preparation of the reviews considerable weight is given to actual aircraft reports and comments made by aircraft commanders at de-briefing. In particular reports from the particular flight under review and comments by its commander are, of course, regarded as being among the most important factors to be considered in a post flight review.

## 9. USE OF AIRCRAFT WEATHER REPORTS IN STATISTICAL STUDIES

Aircraft weather reports are essential to statistical studies of the distribution with area and height of such elements as aircraft icing and turbulence. Particular attention has been given at Shannon to statistical analysis of forecast and actual wind components.

## 10. CONCLUSION

This note, although it represents only a brief and inadequate study

of the subject, illustrates the wide variety of uses to which aircraft weather reports are an invaluable contribution. It will be seen that the quality of the service provided, and of the weather analysis maintained at a meteorological office responsible for an oceanic area depends in very large measure on frequent, prompt and accurate reports from aircraft.

## APPENDIX I

## Origin, Distribution and Form of Aircraft Weather Reports Handled at Meteorological Office, Shannon Airport

### 1. Receipt of Aircraft Weather Reports

Aircraft Weather Reports are received either direct from the aircraft in flight, at the post-flight debriefing, or from other meteorological offices as individual reports or collective bulletins on fixed telecommunication circuits.

The latter group comprises -

(a) periodic collective messages in respect of the Shannon/Prestwick Oceanic FIR from Prestwick, which is a designated collecting centre in respect of reports not received directly at Shannon;

(b) periodic collective messages in respect of the Icelandic Oceanic FIR from Iceland;

(c) reports from other parts of the North Atlantic and Western Europe, received on the West European TPR circuits and on the North America-Europe RTT MET transmissions.

### 2. Debriefing of Flight Crews

Considerable importance is attached to post-flight debriefing as a source of supplementary information encountered during flight, even though the time-lag involved may decrease the value of the data compared with that transmitted in flight.

In order that debriefing may be effective, orderly and not unduly prolonged, the responsible officer prepares before hand, in the light of the aircraft's in-flight reports and of the general meteorological situation, the points on which further information is desired, either on matters of particular current weather interest (e.g. icing conditions, activity of fronts, etc.), or on difficulties arising out of in-flight reports of the aircraft concerned which appeared to be deficient or garbled or difficult to accept.

Opportunity is taken at debriefing to illustrate the value of in-flight aircraft observations and the use made of them, so that flight personnel may be encouraged to make observations with extra care and thoroughness.

When the debriefing reveals significant new weather information not already included in the aircrafts in-flight reports, this information is promulgated to other bases as described in the following paragraph.

### 3. Dissemination of Aircraft Weather Reports

All in-flight and post-flight weather reports received either directly from aircraft, or through Prestwick under 1(a) above, are retransmitted in periodic collective bulletins -

(a) through Dublin to Dunstable, for circulation in Europe

(b) through Azores to New York, for circulation in U.S.A., Canada and elsewhere.

### 4. Form of Aircraft Weather Reports

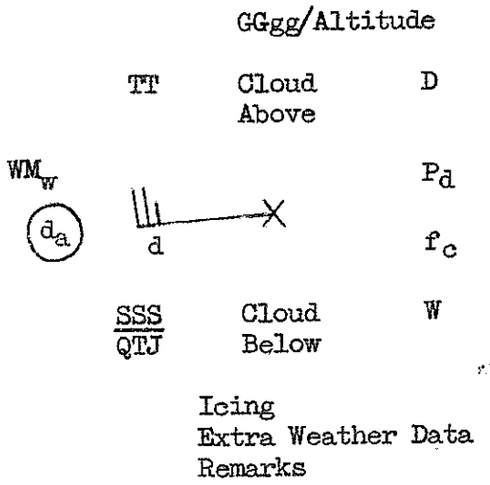
The majority of weather reports received at Shannon at present (1952) are in POMAR Code, although within the Shannon/Prestwick Oceanic FIR most aircraft transmit their weather reports in Q-code or plain language.

Reports in POMAR Code are generally complete. Reports in Q-code or plain language usually contain (in addition to position, altitude and time) the "flight conditions", air temperature, D-factor and wind. A fair proportion of plain language reports include observations of cloud and actual weather.

## APPENDIX II

## Plotting of Aircraft Weather Reports on Flight Progress Charts at the Meteorological Office, Shannon Airport

1. Plotting of aircraft weather reports on Flight Progress Charts is carried out in general conformity with the model shown below:-




2. The various elements in the aircraft position and weather report are plotted as follows:

Time (GGgg) as received.

Altitude as pressure altitude ($H_s$ $H_s$ $H_s$ $H_s$ 0). If this is not available, indicated (HHHOO) is substituted.

Flight Conditions (Fc) and method of determining position (Pd) in abbreviated plain language.

Present Weather ($WM_W$) and Past Weather (W) by means of the conventional signs.

Cloud Details above or below the station position, as appropriate, in the form:

The cloud type symbol, and underneath - the cloud top, h h h, (if available) separated by a stroke from t t t.

The cloud amount, separated by a stroke from the cloud base, $h_b$ $h_b$ $h_b$ , if given.

Cloud type in the form ⌒ (Stratiform) ⌓ (cumuliform) or ⌂ (extensive vertical developments) as appropriate.

Cloud amount as S (scattered), B (close together with small breaks) or O (no appreciable breaks), as appropriate.

Wind, in the conventional way, each full feather representing 10 knots. The second figure of the wind direction is entered on the side of the wind arrow opposite to the feathers. Wind feathers are plotted in groups of five, with a space between successive groups. With high wind velocities, when the frequency and detail of reports leads to overcrowding in plotting, the actual wind speed in knots may be written along the end of the arrow in place of feathers.

Accuracy of Wind Determination ($d_a$) as a ringed figure at the end of the wind arrow.

The D-factor ($H_d$ $H_d$ $H_d$ $H_d$), as received, with the appropriate sign + or -

Temperature as for surface observations.

Ground Speed (SSS) and Air Speed (QTJ) if reported. These elements are plotted as indicated on the station model, being separated by a short horizontal line.

Extra weather data, icing and supplementary remarks of meteorological interest, in plain language or in Q-code, as received.

## APPENDIX III

### Plotting of Aircraft Weather Reports on Upper Air Charts at the Meteorological Office, Shannon Airport

1. Charts for the 700, 500 and 300 mb. levels, covering an area from Central Europe to the Pacific, are prepared twice daily (at 0300 and 1500 G.M.T.) at Shannon. In addition to observations from Upper Air Stations, reports from aircraft, whether received separately or in collective messages, are plotted on the charts. Each aircraft from which a report or series of reports is available is allocated a number in sequence. The position of the aircraft is indicated on the chart by a station circle and the aircraft identification number is plotted in the circle. For reports from unidentified aircraft received in collective messages, "X" replaces the number in the station circle. A key to aircraft identification numbers, giving call sign and flying height is entered in the top right hand corner of the chart.

2. The normal time and height limits for the plotting of reports in upper level charts are as follows:-

A time limit of ± 3 hours from the time of the chart.
A height range of 8000 to 12000 feet for the 700 mb. level chart and a height range of 15000 to 21000 feet for the 500 mb. chart. Aircraft reports appropriate to the 300 mb. chart are not at present being received.

In the absence of adequate data the time and height limits given above are occasionally extended at the discretion of the upper air forecaster to include other data.

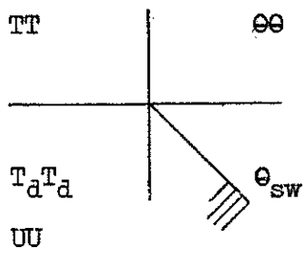
3. Temperature, wind and height in feet of pressure surface (calculated from aircraft report by applying the observed D. factor to the standard height for the level) are plotted for each aircraft report. Where a report on the chart refers to a height and/or a time different from that of the chart, the height and time are entered close to the plotted report in the form GG/hh.

## APPENDIX IV

### Preparation of Vertical Cross-sections of Actual Weather Situations at the Meteorological Office, Shannon Airport

1. Actual weather cross sections for the route Shannon to Stephenville on the G.C. track are prepared twice daily (at 0300 and 1500 G.M.T.) at Shannon. The cross sections extend from the surface to 35,000 ft. and each cross section is drawn using the same symbols as are used in flight forecasts, with Ireland shown on the right hand side of the section and Newfoundland on the left. Upper air soundings for Valentia, ocean weather ships on the route, and Newfoundland are plotted on the cross section. Surface reports for the time of the cross section and situated on the route are plotted below the cross section and aircraft reports suitable to the cross section are plotted at the appropriate position and altitude using the same model as for flight forecasts.

2. On the cross section, Temperatures are plotted in accordance with the following model -




Where

TT = Temperature ($^{o}$C)

$T_dT_d$ = dew point ($^{o}$C)

UU = relative humidity

θθ = Potential temperature ($^{o}$F)

sw = Wet bulb pseudo potential temperature ($^{o}$F)

Inversions are shown as thick vertical lines in the inversion layer.

DIAGRAM A

FORM 7417 [2]

DEPARTMENT OF INDUSTRY AND COMMERCE – METEOROLOGICAL SERVICE

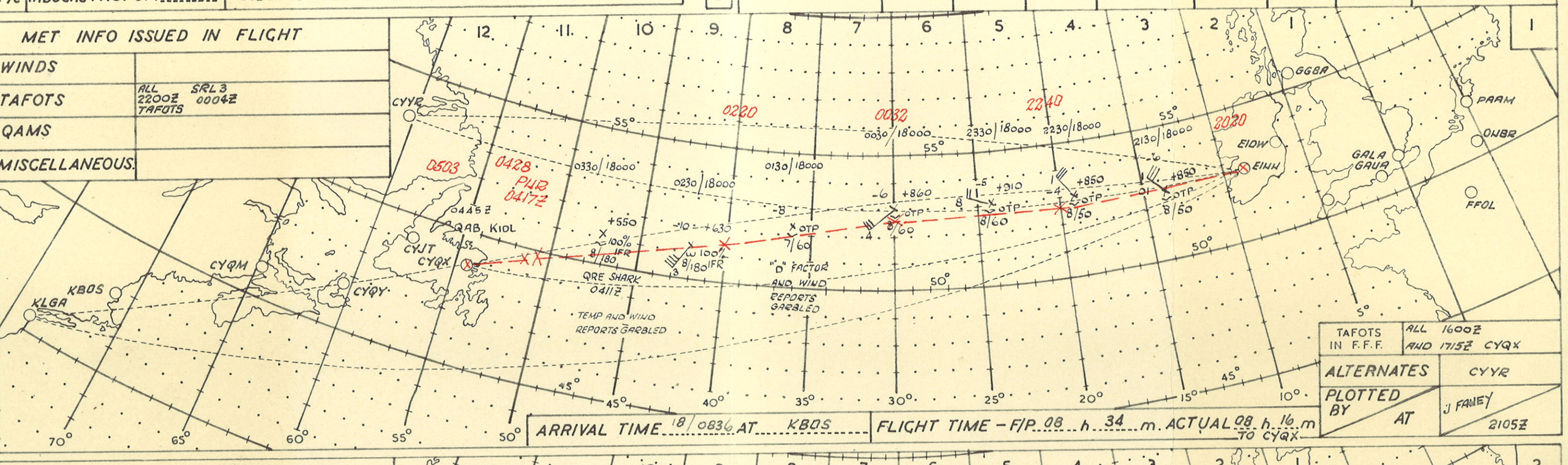
DATE 17th July 1952.

| F/c | Inbound: ROFOT: ..... | Outbound: Time of F/c charts: 0300Z F.F.F. No. 1262 |
|---|---|---|

| | Route | Track | Flight Altitude | ETA 30°W | Flight Plan Airspeed | Company | A/c No | Trip No | Call Sign |
|---|---|---|---|---|---|---|---|---|---|
| 1 | EINN – CYQX | 5D P/P | 18000 | 0032 | 242 | TWA | N24C | 943/17 | WHL OP |
| 2 | | | | | | | | | |

| MET INFO ISSUED IN FLIGHT | |
|---|---|
| WINDS | |
| TAFOTS | ALL 2200Z SRL 3 0004Z TAFOTS |
| QAMS | |
| MISCELLANEOUS | |

1



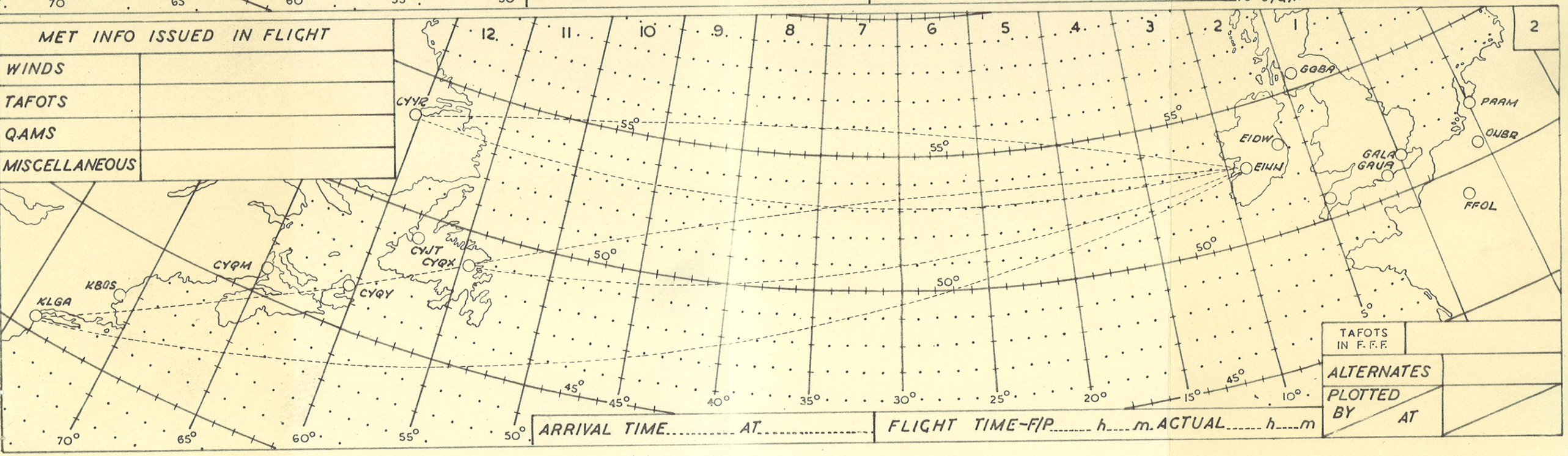

| TAFOTS IN F.F.F. | ALL 1600Z AND 1715Z CYQX |
|---|---|
| ALTERNATES | CYYR |
| PLOTTED BY / AT | J FAHEY / 2105Z |

ARRIVAL TIME 18/0836 AT KBOS

FLIGHT TIME – F/P 08 h 34 m. ACTUAL 08 h 16 m TO CYQX

| MET INFO ISSUED IN FLIGHT | |
|---|---|
| WINDS | |
| TAFOTS | |
| QAMS | |
| MISCELLANEOUS | |

2




| TAFOTS IN F.F.F. | |
|---|---|
| ALTERNATES | |
| PLOTTED BY / AT | |

ARRIVAL TIME ..... AT .....

FLIGHT TIME – F/P ..... h ..... m. ACTUAL ..... h ..... m

DIAGRAM B.

TWA 17C

Date 29th Aug 1952 Route EINN to CYQX Track ..... Altitude 8000 - QX 18000 → 35°W ETA 30°W 0339 FP Airspeed ..... Call Sign WHLBD Trip No. ..... Arrival time 30/0834 at CYVR 963/29

| MET. INFO. ISSUED IN FLIGHT | | |
|---|---|---|
| | WINDS | |
| | TAFOTS | Amend 2200Z QX JT 2200Z QY |
| | QAMS | |
| | MISCELL-ANEOUS | |

P/P TRACK VIA 60N 35W.

0429 0339 0304

PJR 0613Z

0531/18000 0431/18000 0331/18000 0231/18000 0131/18000 0031/18000

0520

-15 -24 -20 -770 -15 -530 -13 -100 -10 +320

OTP 8/140 OTP 6/100 OTP 8/180 IN + OUT CLOUDS 8/100 OTP 8/100

QRE 45° CYQX 0840Z

0631/18000 -24 -420

ALTERNATE:- CYQY

OTP 55° 5/-

QRE CYVR 0805Z

ESTIMATE LOW CENTRE 61N 34W

SNOW SHOWERS

2331

0836

| F/C | |
|---|---|
| | TAFOTS IN F.F.F. |
| | ROFOT. |
| | TIME OF F/C CHARTS |
| | F.F.F. No. 1570/52 |
| | Plotted by: J. Staunton |

DEPARTMENT OF INDUSTRY AND COMMERCE – METEOROLOGICAL SERVICE

Form 7414 (2)

DEPARTMENT OF INDUSTRY AND COMMERCE — METEOROLOGICAL SERVICE

# ACTUAL WEATHER CROSS-SECTION AT 0300 GMT ON 19TH JULY 1952

Route Shannon to Stephenville via Cunder - Track Great Circle

Prepared at the Meteorological Office Shannon Airport · By R. Carvalho

ZONE: 12 · 11 · 10 · 9 · 8 · 7 · 6

**SYMBOLS**

- Rain
- Freezing Rain
- Ice Pellets
- Snow and Rain Mixed
- Snow
- Hail
- Light Icing
- Moderate Icing
- Severe Icing
- Fog
- Sand or Duststorm
- Storm of Drifting Snow
- Moderate Turbulence
- Severe Turbulence
- Squall
- Thunderstorm

35000 FT · 30000 FT · 25000 FT · 20000 FT · 15000 FT · 10000 FT · 5000 FT · MSL

FRONTAL ZONE

ZONE OF CONVECTIVE INSTABILITY

WARM INVERSE

T = −20°C · T = −10°C · T = 0°C · T = +10°C

θSW = 64°F

SURFACE REPORTS AND REMARKS

815 · 807 · 803 · 4YC

Wear Set. at all levels.

DEPARTMENT OF INDUSTRY AND COMMERCE — METEOROLOGICAL SERVICE

Diagram C

# ACTUAL WEATHER CROSS-SECTION AT 0300 GMT ON 19TH JULY 1952

Route Shannon to Stephenville via Gander - Track Great Circle

Prepared at the Meteorological Office Shannon Airport By R. Carvalho

11 10 9 8 7 6 5 4 3

10000 METRES
9000 METRES
8000 METRES
7000 METRES
6000 METRES
5000 METRES
4000 METRES
3000 METRES
2000 METRES
1000 METRES
MSL

FRONTAL ZONE

ZONE OF CONVECTIVE INSTABILITY

ZONE OF CONVECTIVE INSTABILITY

WARM INVERSION

COLD ZONE OF CONV. INSTAB.

CONV. INSTAB.

T = −20°C

T = −10°C

T = 0°C

T = +10°C

θSW = 64°F

θSW = 64°F

θSW = 62°F

θSW = 56°F

Near Sat. at all levels.