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N.Z. Meteorological Office Circular Note No.15.

FOGS AT WAIPAPAKAURI AIRFIELD.

P/O J.F. de Lisle - July,1943.

Because of the great number of fogs which occurred at Waipapakauri during the early autumn of 1943, an investigation of previous weather records has been made to see whether such conditions are general, or if not, the reason for such an increase in fog days. Records from February 1939, were available, but it was not until January 1942 that there was a full time observer and records were in any way complete, consequently, more weight will have to be given to observations made since that time. Also, since records are available for so few years, any conclusions drawn should be regarded only as tentative, to be modified or amended when more data is available.

For purposes of classification, fogs have been divided into two classes:

(a) Radiation
(b) Those due to other causes.

The frequency of all fogs at Waipapakauri Airfield is as follows:-

1939: (exclusive of January): 13 radiation
6 other

1940: 2 radiation
5 other

1941: 0 radiation
2 other

1942: 19 radiation
6 other

1943: (Jan. to April inclusive): 32 radiation
1 other.

In what follows, radiation fogs only will be considered and the distribution of this type throughout the various months of the year is shown in Table I.

TABLE I.

	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1939	-	3	5	3	2	-	-	-	-	-	-	-
1940	-	2	-	-	-	-	-	-	-	-	-	-
1941	-	-	-	-	-	-	-	-	-	-	-	-
1942	-	3	6	2	3	1	-	1	-	2	1	-
1943	4	5	20	3								

The greater number of fogs recorded in1942 and 1943 may, to some slight extent, be explained by the increased accuracy of the observations, but the value of 20 for March 1943 is abnormal and depends, as will be seen later, on special local conditions existing during that month.

Throughout the summer of 1942-43 there were peat fires burning just south of Waipapakauri, and March being such a dry month there were also scrub and grass fires all round the borders of the airfield. The extremely hygroscopic products of combustion would form suitable nuclei for the condensation of water vapour. Combined with this, the anticyclonic situations predominating in March were very favourable for fog formation.

Aircraft temperature soundings were made on 10 occasions on the same day radiation fogs had occurred and in 8 cases these show well-marked inversions. These subsidence inversions, characteristic of aging anticyclonic conditions, were in a number of cases visible because of the very thick smoke haze limited by them and stretching miles down wind. This also gave an idea of the amount of atmospheric pollution which existed at that time.

Table II shows the heights and details of the inversion.

TABLE II.

DATE	HEIGHT	TEMP.	DATE	HEIGHT	TEMP.
Feb.13,1943	5000 ft.	8.5°C	March 17	5000 ft.	8.8°C.
	6000	11.0		6000	9.8
	7000	11.0			
Feb.15	4000	10.5	March 27	6000	6.3
	5000	12.0		7000	7.5
	6000	12.0			
Feb.26	8000	1.3	March 29	5000	10.0
	9000	2.0		6000	10.5
	10000	2.3			
March 15	3000	10.5	April 19	5000	10.0
	4000	11.0		6000	7.5
	5000	11.5		7000	7.5

As in the majority of observed cases the vertical extent of the fog was not great, the smoke particles and products of combustion would probably be limited to a fairly shallow layer by a low inversion during the evening and the fog when formed would actually be a mixture of smoke particles and water droplets. When the fog cleared the smoke particles would be carried upwards by convection currents to the upper inversion.

From a study of the synoptic situations existing at the time of fog formation, it was evident that the fog would form not only when an anticyclone was centred over the area, but also when one was advancing eastward across the Tasman Sea with light to moderate southwesterly winds at Waipapakauri.

This can also be shown by an analysis of the wind direction and force for 5-6p.m. on the night preceding fog formation.

In Table III the number of times the wind blew from each direction is shown for the 44 cases for which records were available:

TABLE III.

Dirn.	3+mph.	<3mph	Calm
N	1	2	
NE	4	1	
E	-	1	2
SE	-	-	
S	5	1	
SW	19	5	
W	1	1	
NW	-	1	

Thus, in the majority of cases for winds greater than 3mph, the direction was SW, i.e., the anticyclone was advancing on to the area.

Anemometer records from May 1942 were examined to find the wind forces preceding the radiation fogs which had occurred since then. The

results are shown in Table IV:

TABLE IV.

Wind Beaufort No.	Time G.M.T.				
	5 - 6	8 - 9	11 - 12	14 - 15	17 - 18
0-1	14	39	45	45	45
1-2	7	6	-	-	-
2-3	8	-	-	-	-
3-4	14	-	-	-	-
4-5	2	-	-	-	-

From this Table it seems that even if the wind were as great as 18 mph at 6p.m. a fog could form as long as the wind had dropped to 5 mph by 9p.m., a wind greater than 5 mph at 9p.m. being enough to prevent fog formation.

The amount of temperature fall for each hour after sunset for clear nights for November 1942 to March 1943 was found. These values for each hour were averaged and a cooling curve constructed. As it is only recently that 6p.m. and midnight observations have been carried out, there are not enough wet bulb readings to attempt to construct a fog prediction diagram on the pattern of Petterssen or Taylor.

When cooling to the dewpoint has occurred, a further reduction in temperature is necessary to produce condensation and fog, therefore, an inspection of thermograph records will permit a rough estimate of the time of formation of radiation fog. Thus, on the 44 fog days recorded, at the time of the minimum temperature, the fog should have formed and have been thickening.. .Table V shows the frequency of minimum temperature at various times for the 44 occasions considered:

TABLE V.

Time N.Z.M.T.	22	23	00	1	2	3	4	5	6	7
Frequency	1	1	-	1	4	3	11½	15	6½	1

From this Table it is seen that most fogs form somewhere about 4 or 5 a.m., the number forming before midnight being only 2; thus, there seems to be little chance of fog affecting night flying.

The Airfield is about 6 feet above sea level with a gentle slope up towards its western edge where this a small hillock. This slope would have a negligible effect on the drainage of cold air so that the reduction of surface temperature over the airfield must be by radiation only. To the south, however, is low-lying swampy land, also the Awanui River. Frequently, a ground fog will form in this area when there is no fog at all over the airfield. This has been found troublesome at times in early morning flying when an aircraft has had to use the N-S runway and take-off directly to the south into fog. When there has been fog over the whole area, it always clears from the airfield first and then persists for a time to the south.

Clearance of radiation fogs has, in general, occurred by 9a.m, at the latest, though there were isolated cases in March 1943, when there was no clearance till 9.30a.m., resulting in delayed patrol take-offs.

A comparison of conditions at Onerahi, Whenuapai and Tauranga with those occurring on fog days at Waipapakauri was made to see whether the fog conditions were local only. Records were available for Tauranga and Onerahi for all fog days at Waipapakauri, but in the case of Whenuapai only 0800 N.Z.M.T. observations for 1942 and 1943 have been made.

This comparison gave the following results:

Onerahi Airfield:	1 Fog 1 River fog 6 Ground fogs 4 Adjacent fogs
Whenuapai Airfield:	8 fogs
Tauranga Airfield:	1 Fog 1 Ground fog

It appears that fogs at Waipapakauri are not in general accompanied by fogs at these other airfields. If, therefore, Waipapakauri should be unserviceable because of fog, in most cases Onerahi, Whenuapai and Tauranga would be workable.

From all the above data, the following tentative conclusions can be drawn:

1. The number of fogs occurring during early 1943 was greater than usual and was due to the long period of anticyclonic weather and to the presence of a large number of impurities in the air in the form of smoke particles and products of combustion.

2. On the day preceding fog formation the wind in 24 cases out of 30 was either SW or S for winds greater than 3 m.p.h.

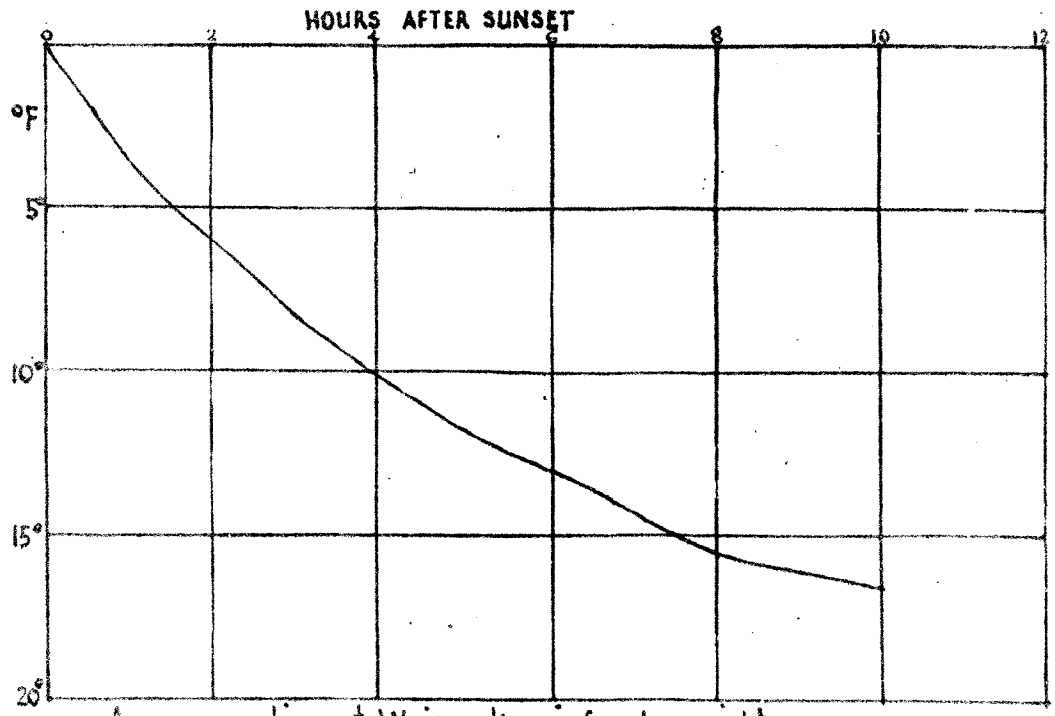
3. A wind greater than 5 m.p.h. at 9p.m. is enough to prevent fog formation.

4. The average amount of temperature fall after sunset for clear nights for the months of November to March can be read from the cooling curve.

5. Most radiation fogs form about 4 or 5a.m. and clear by 9a.m.

6. In the majority of cases when fogs occur at Waipapakauri, Whenuapai, Onerahi and Tauranga are clear.

FIG. 1



Average cooling at Waipapakauri for clear nights during Nov. & Dec. 1942, Jan., Feb., & Mar. 1943.