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N.Z. METEOROLOGICAL OFFICE CIRCULAR NOTE NO. 18.

551.582

WEATHER CONDITIONS AT NAUSORI.

F/O R.W. McNeur.

Although it is inadvisable to attempt a summary of local weather conditions without one or two years' experience of them, yet, because of the short duration of service that has been the custom at Nausori, I feel that a summary of six months experience (August 1943-February 1944) may be of interest, and possibly assistance to forecasters who follow or who forecast for flights to Nausori.

For the purpose of conciseness this paper is divided as follows:-

I. The Situation and Environs of Nausori.

Nausori is situated on the southeast corner of Viti Levu, the main island of the Fiji Group. The SW boundary of the aerodrome lies along the bank of the Rewa River which runs in a direction approximately NNW-SSE through a delta formation to the sea. In all directions from SW-NE through South the land is flat and falls gradually from the level of the field, (12' above sea level), to the sea which is six miles away. To the north and west the land is flat in the Rewa valley with low hills on either side. The nearest hill above 1000' is Mt. Kombalevu, 1521', 9 miles to the west. Further back rise the higher peaks of Viti Levu.

II. General Weather Summary according to Wind Direction.

(a) Southeasterly winds.

Southeasterly winds predominate at Nausori especially during the trade wind season. By orographic uplift these guarantee partly cloudy to cloudy conditions with possible rain or drizzle, according to the characteristics of the air mass. Whether it is cloud or precipitation that forms, the development is more intense near the hills to the west and NW, and usually, the horizon may be seen to the SE.

The local weather associated with a trade wind gradient depends largely on the humidity of the air below the usual inversion and also on the wind force. With a comparatively dry air mass, weather will be cloudy with drizzle in the hills and isolated showers over the drome; but with a humid current drizzle or light misty rain will develop and may persist for 2-3 days. In this last situation there appears to be a diurnal variation in the intensity of precipitation with maxima during the early morning and late afternoon or evening, and minima about midday and midnight. The most suitable time for the formation of intermittent or continuous drizzle is when a migratory anticyclone centred near Northern New Zealand moves rapidly ENE giving fresh winds and moist air over Fiji. As the weather associated with a SE situation is mainly caused by orographic lifting it is apparent that an increase in the wind velocity will intensify the conditions which already exist.

(b) Northeasterly Winds.

With the passage of a migratory anticyclone to the south, winds tend to turn NE, cloud becomes more scattered, and fair weather prevails. But if NE winds herald the approach of a depression from the NW, conditions remain cloudy.

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(c) Northerly to Westerly Winds.

Winds from this quarter are rather rare and are associated with a depression to the west or SW or a synoptic situation in which the Intertropic front is to the south. Unless the humidity is extremely high, these winds blowing over 4000' peaks in the centre of the island, invariably give a sky fairly clear of low cloud. Even if rain falls from middle cloud the low cloud will remain scattered until precipitation becomes heavy. When humidity is high, as is the case when the I.T.F. is still in the vicinity, the sky remains overcast with Sc at about 4000' but this lowers appreciably in rain squalls which move in from the NW.

The katabatic wind for Nausori is a light WNW which generally blows at night when the gradient wind is below 12-15 knots. Its strength does not exceed 5 knots.

(d) Southerly to Southwesterly Winds.

With the passage of a cold front and the approach of the northern edge of an anticyclone from the SW, southerly to southwesterly winds prevail. In a moist air mass drizzle and rain with low ceilings develop on the south coast and in the hills to the west of the airfield, but the landing strip remains comparatively clear. Conditions are cloudy to overcast with a few showers, more frequent at dusk. In a dry air mass conditions remain fair generally with scattered cumulus.

III. Frontal Passage.

(a) The passage of Cold Fronts.

1. Weak cold fronts pass with an AC. sheet only or scattered towering cumulus and light showers. A southerly wind change follows bringing cloudy conditions.

2. Moderate cold fronts pass with towering cumulus, an As sheet and moderate showers. If such a front becomes stationary to the north, over Vanua Levu, the increased humidity aloft reinforces the SE effect and poor flying conditions result.

3. Vigorous cold fronts are extremely rare. Occasionally moderate fronts have the appearance of vigorous fronts when frontal thunderstorms form in the hills and move over the field.

The most important aspect for forecasting at Nausori during a frontal passage is not always the front and its intensity, but the characteristics of the air mass behind the front and the possibility of SE drizzle. Information is scarce but the Noumea Raob and the intensity of the anticyclone will give some indication.

(b) Warm Fronts.

Active warm fronts are associated with depressions which develop on quasi-stationary fronts orientated W-E to the north of Fiji. Although there is abundant cirrus and cirrostratus before these it is not always the hooked cirrus of a warm front, and the middle cloud sheet which forms later may remain broken almost until the time precipitation begins. In such cases the depression is shallow and that part of the frontal system which is "warm" has more the characteristics of a quasi-stationary front. As indicated previously the low cloud remains scattered at Nausori until heavy precipitation begins.

2. During the trade wind season, cold fronts moving from the SW are often preceded by a southerly change. It appears that weak fronts, lying quasi-stationary to the north, trail back as warm fronts and move along mainly under the influence of upper winds. A weak anticyclonic

cell forms in this "warm sector" giving a southerly change preceding the cold front. There is rarely any weather associated with this "warm" front, although isolated showers have been experienced at sea, and it usually passes with a sheet of high cloud. But a change in air mass is sometimes apparent and if this is suitable drizzle will develop. The southerly wind turns SE and remains light until reinforced by the wind behind the front.

(c) The Intertropic Front.

The weather associated with the Intertropic Front as it moves to the south or to north over Nausori corresponds to that already described for warm and cold fronts respectively.

IV. The Effect of Instability at Nausori.

1. Areas of maximum convection over Viti Levu.

During the months of December 1943, and January 1944, Communications Flight has kept a weather distribution chart of the weather encountered on the return trip from Nandi at approximately 0400 GMT each day. Of these reports, those which give most information about areas suitable for convection are those prepared when convective activity is slight. For then broken Cu and T Cu covers the island and fair visibility assists accurate reporting; whereas on days of extreme convection the island is obscured by showers. A study of the former charts shows that there are two definite areas of maximum convective activity. These are the Sambeto Range region to the N and NE of Nandi Valley, and the peaks to the west and NW of Suva; the Namosi Peaks are at the centre of this area. This latter area interests us more. If on days of slight convection showers form at these places alone, it is natural to assume that on days of greater convective activity, when showers form at various places over the island, the areas of heaviest precipitation and maximum convection will be in these areas also. It is suggested that these areas are differentiated from others by the fact that, there, convection is stimulated not only by strong surface heating but also by NW and SE sea breezes blowing on to the two respective areas.

2. Extent of Convection.

During the summer months, especially, the atmosphere is usually in a state of "conditional" instability. Then the combined effect of surface heating, which is intense in inland regions, and orographic uplifts can generally be guaranteed to stimulate convective activity during the afternoon. The vertical extent of this convection depends upon the humidity of the upper atmosphere for it will be terminated when the air is dry. Thus with an air mass which is moist to 10000' and then dry, convection will be active to that level and moderate showers develop; with an increase in the vertical thickness of the humid air the intensity and extent of showers will be proportionally increased. The conditions necessary for thunderstorm activity, therefore, are conditional or absolute instability and a liberal supply of moisture in the upper levels.

3. The Effect of Instability at Nausori.

Nausori is rarely influenced directly by instability showers but, with suitable conditions, it is affected appreciably by inland convection. The two factors which give the key to the influence of inland convection are, that the tops of T Cu or Cb tend to move with the upper winds and that the Namosi Peaks area of convective activity has a bearing of 280° T from Nausori

Therefore upper winds from W-NW will blow the cloud over the drome. The effect of this varies with the height of the westerly flow and the extent of convection, as is shown in the following examples.-

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(a) With westerly winds above 7000' and convective activity to 10000' the sky will become cloudy to overcast in the early evening with Ac or high Sc. This dissipates later.

(b) With westerly winds above 7000' and strong convection this sheet of higher stratiform cloud will become much thicker and rain will fall. With heavy rain developing the cloud base lowers.

(c) With winds from 280° starting in lower levels and slight convection the T Cu which develops will move over the field giving a light shower in the evening.

(d) Under this last situation but with strong convection a thunderstorm will form and move over the field with heavy continuous rain.

V. The Approaches to Nausori.

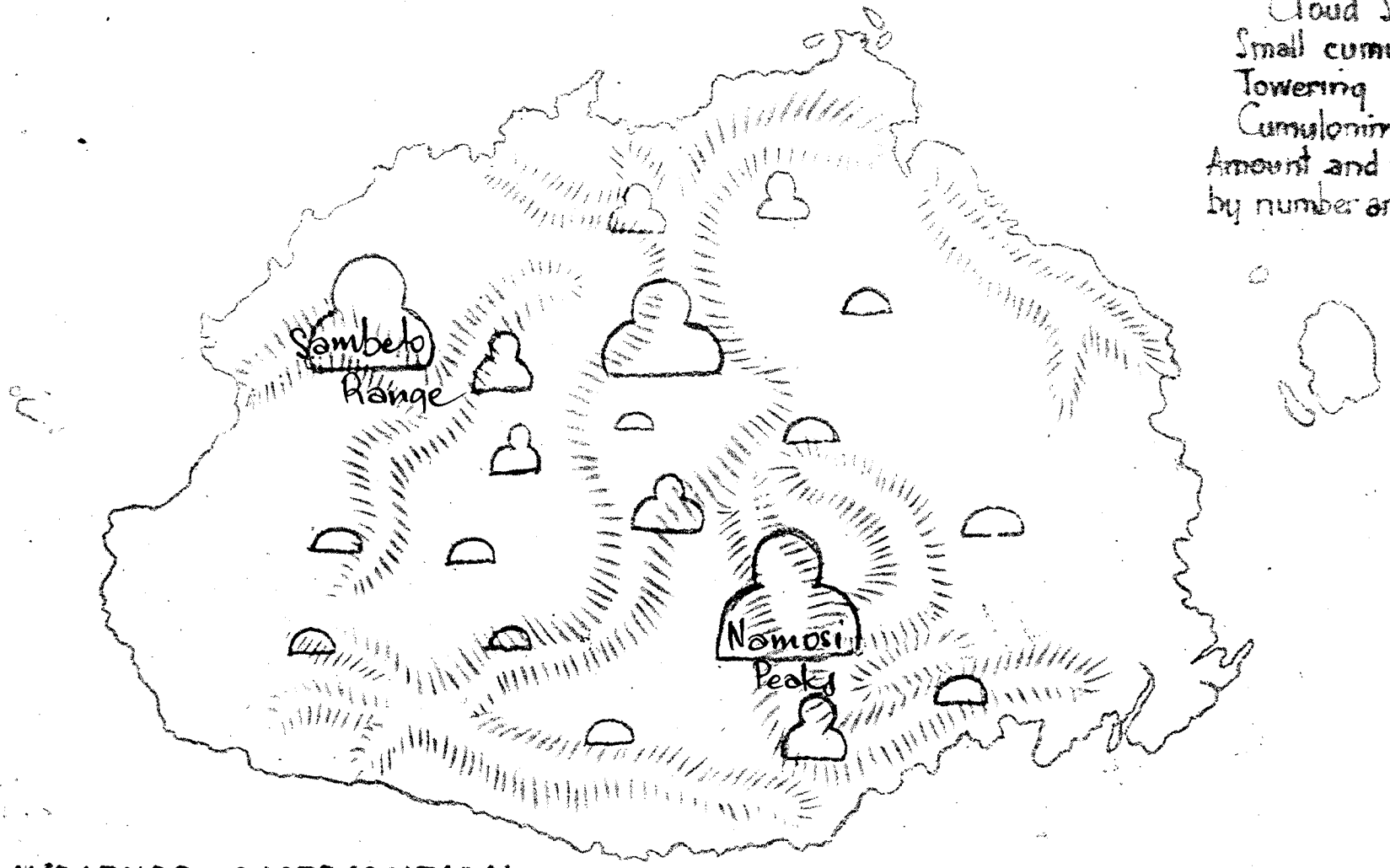
Poor flying weather associated with the SE situation is usually localized but drizzle extends along the south coast and may reach south to Kandavu. Then the approach from the south is partly closed with extensive areas of drizzle, rain and ceilings down to 100-200' in Kandavu.Passage. The N and NE coasts remain open and it is advisable to direct a plane from the west (e.g. New Hebrides) round the north coast, and a plane from New Zealand to the east of Kandavu and then to Nausori from the SE.

To pilots who have had experience at Nausori the strip remains open even in bad weather. The approach around the south coast is negotiable with low cloud base, as the reef which extends around the coast provides an excellent guide. Also conspicuous land marks near the drome, at the approaches to the N-S and E-W runways allow for landing to the E and N in poor weather.

EXAMPLES OF THE EFFECT OF INLAND INSTABILITY DURING NOVEMBER, 1943.

Upper Winds	Stability	Humidity	Resultant Weather at Nausori
	Conditionally Unstable	Dry above 10000'	Fine
SW	Cond. Unstable	Intermediate Humidity	Thunderstorm formed in western hills and moved NE
	" "	Moist	Heavy rain over NE of island. Light rain at Nausori
WNW above 1000'	Conditionally unstable	Dry above 9000'	Cloudy with showers
W above 1000'	" "	Moist	Vigorous thunderstorm
W above 10000'	" "	"	Slight thunderstorm
E. up to 15000'	" "	Moist	Thunderstorm and extensive rain over west of island
E up to 10000' NW above 10000'	" "	Dry above 10000'	Showers in easterly current

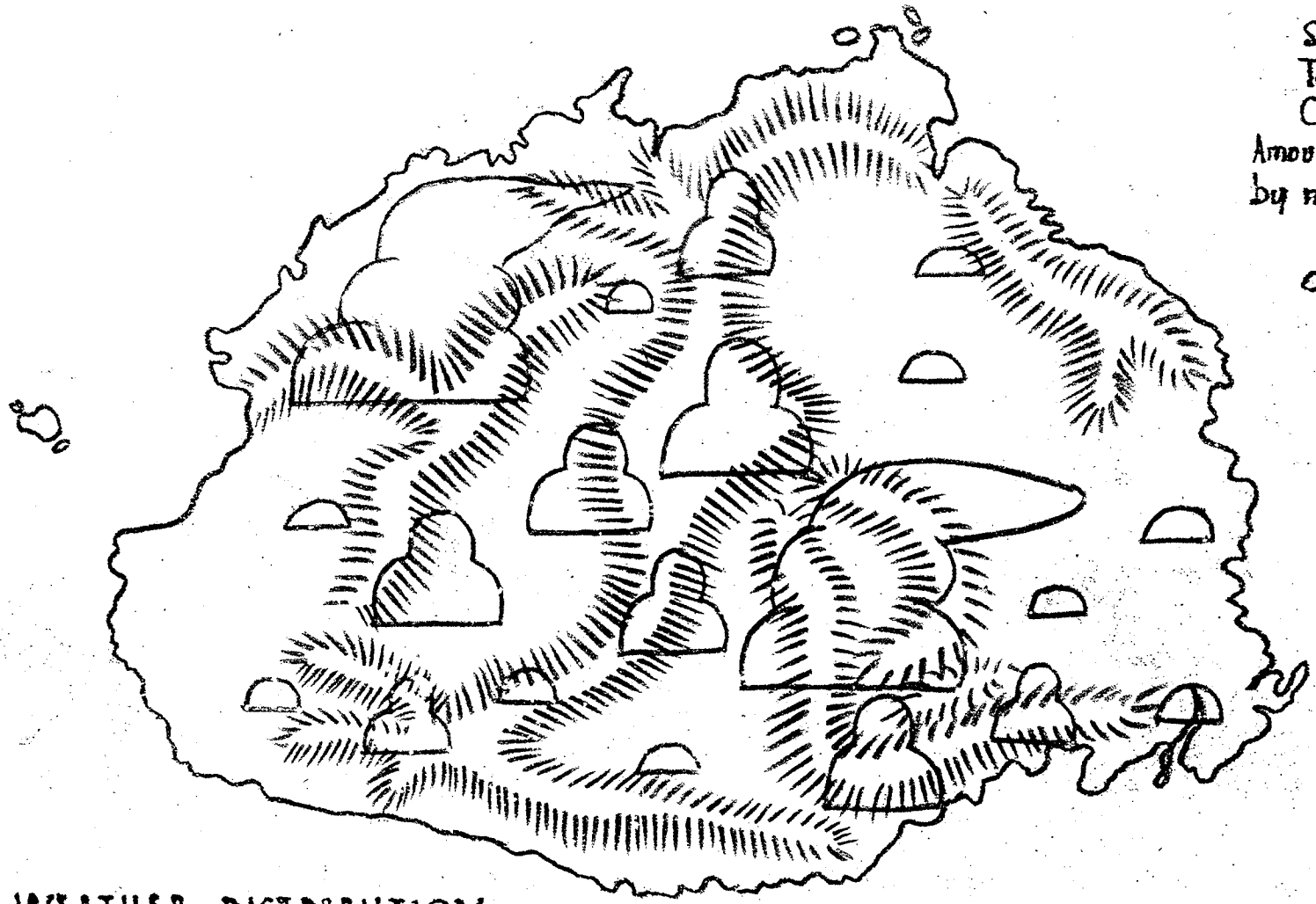
Cloud Symbols:
Small cumulus
Towering "
Cumulonimbus
Amount and size of cloud shown by number and size of symbols.



WEATHER DISTRIBUTION
OVER VITI LEVU

A typical example of cloud distribution when convective activity is slight, showing areas of maximum convection.

Time 0400 G.M.T.



WEATHER DISTRIBUTION
OVER VITI LEVU.

Cloud distribution associated with moderate convection and westerly winds aloft.

Time: 0400 G.M.T.

COMMENT BY F/O E.A. WILLIAMSON ON PARAGRAPH IV, 2.

F/O McNeur states (page 3): "The vertical extent of this convection depends upon the humidity of the upper atmosphere for it will be terminated when the air is dry."

This statement calls attention to the importance of the part played by water vapour in the stability of the atmosphere, especially in the tropics. The lapse rate, presence or absence of inversions, and vertical extent of conditional instability are more commonly regarded as the main criteria.

In many cases in the tropics the humidity and lapse rate criteria will coincide. A strong inversion is almost invariably accompanied by a marked decrease in humidity above it. The vertical extent of the layer of moist air is the same as the vertical extent of the layer of conditionally unstable air in which convection would be expected using the lapse rate alone as a criterion.

However, strong inversions are not so common at Nausori and Samto as at places nearer the centres of the sub-tropical anticyclones, Noumea and Norfolk for example. In the more normal case of a conditionally unstable atmosphere, the humidity does give invaluable information. For a given lapse rate near the surface, both the lifting condensation level and the convective condensation level will be lower when the humidity is higher, and hence cloud formation will occur more readily. In some cases, a high humidity could even outweigh a smaller and apparently more stable lapse rate. This can be the case when an air mass has a slight southwards component in its movement. Although moving into cooler surroundings in which its lapse rate becomes more stable, the effect of increasing humidity, because of a long trajectory over a warm moist ocean, may be to make convective clouds and showers more frequent instead of less frequent.

If one is considering the lifting of a whole deep layer, as at a front, the arrangement of dry air above moist air has latent instability. As the whole mass is lifted, its lower moist part would become saturated before the upper dry part. As further lifting occurred, the temperature of the lower saturated portion would decrease at the moist adiabatic lapse rate, while that of the upper, non-saturated portion would decrease more rapidly, at the dry adiabatic lapse rate. The whole layer would become more unstable, with the temperature difference between the lower and upper portions increasing.

However, we are dealing here with the uplift of a "parcel" of the lower moist air. A certain amount of the dry air may be drawn into the up-current, but on the whole, the dry air will subside in the compensating downwards current. The principles of the "layer" method of considering stability do not apply.

The combined effects of mixing, the evaporation of cloud in the dry air, and the probability of smaller lapse rates in the dry air would all tend to terminate convection at the dry layer, in agreement with F/O McNeur's statement.

15th May, 1944