

OCCURRENCE OF TROPICAL DEPRESSIONS AND CYCLONES IN THE NORTH  
EASTERN AUSTRALIAN REGION DURING THE SEASON 1957-1958

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**Abstract:** During the year ended 30 June 1958 there were sixteen incipient depressions over northeastern waters of Australia. Six of these failed to reach cyclonic stage but one was very close and gave phenomenal flood rains while continuing as a rain depression on the Central Queensland coast. This same depression executed a double looped path between Willis Island and the Central Coast. As a contrast to the 1956-57 season a much more variable direction of movement of cyclones occurred. Three moved somewhat westerly, and three in the far east decidedly south, while another far eastern storm followed an almost circular path.

Origins of depressions were between 5 and 15 degrees south latitude. The last cyclone in June (16C) off the South Coast of Queensland has been included although it was evidently an extra tropical system. The "Bowen" cyclone of 1 April 1958 was remarkable for its sudden life, restricted size and path. Tentative synoptic experience gained in forecasting and in following the cyclone histories is given.

## 1. INTRODUCTION

The classification of the tropical cyclones is as follows:-

- Type A Tropical circulations with reported or estimated wind less than 34 knots when north of latitude 28°S.
- Type B Tropical cyclonic circulations with wind speeds greater than 34 knots when north of latitude 28°S but with gale winds not extending more than 100 miles from the centre.
- Type C Tropical cyclonic circulations with wind speeds greater than 34 knots when north of latitude 28°S and with gale winds extending more than 100 miles from the centre.

Type A consists of cyclonic circulations which may have aroused suspicion of possible tropical cyclonic development, but either filled completely or behaved as tropical (rain) depressions.

Composite maps showing tracks are given in the Appendix.

With the exception of minor A types each disturbance is dealt with under the headings of development, track, features of track, rainfall, wind, seas and damage, with appropriate reference to radar, sferics and microseism results.

Points on cyclone tracks are given in the code form PFYYGG and catalogue identification in the following code form:

$$\text{NNTY}_{y_y} \quad Y_1 Y_1 Y_2 Y_2 M_o \quad (Q L_a L_a L_o L_o \text{----})$$

$$(Q L_a L_a L_o L_o)$$

The code symbols have the following interpretation:

PP = Central pressure in tens and units of millibars

YY = Date (Greenwich)

GG = Greenwich Mean Time

NN = Sequence number of the season in northeast Australia

T = Type of depression (A, B or C)

$Y_y Y_y$  = Year in tens and units

$Y_1 Y_1$  = Greenwich date of first location

$Y_2 Y_2$  = Greenwich date of last location

$M_o$  = Month of  $Y_2 Y_2$ ; January to October 1-0, November and December 1 and 2 with 50 added to  $Y_2 Y_2$ .

$Q L_a L_a L_o L_o$  = Octant of Globe (Int. Code 70 and latitude and longitude in tens and units of degrees).

2. LIST OF TROPICAL DISTURBANCES IN THE NORTH EASTERN  
AUSTRALIAN REGION 1957-1958 SEASON

Identification List		
Identification Number	Date	Area
1B	7-11-57 - 19-11-57	Ellis - Fiji Islands
2B	4-12-57 - 8-12-57	Samoa - Tonga Islands
3C	5-1-57 - 7-1-58	Ellis - Fiji - Kermadec
4A	11-1-58 - 16-1-58	Gulf of Carpentaria to Kimberleys W.A.
5A	13-1-58 - 18-1-58	Far NE Coral Sea
6A	12-2-58 - 24-2-58	Gulf of Carpentaria to eastern Coral Sea
7A	6-3-58 - 7-3-58	Central Queensland Coast
8C	11-3-58 - 17-3-58	Fiji to New Caledonia
9A	18-3-58 - 20-3-58	South Coral Sea
10B	31-3-58 - 3-4-58	Willis Island to Central Queensland Coast ("Bowen" cyclone)
11A	9-4-58	Northeastern Coral Sea
12C	2-4-58 - 11-4-58	Solomons, New Hebrides, Fiji
13B	11-4-58 - 16-4-58	Gulf of Carpentaria "San Miguel"
14C	17-4-58 - 23-4-58	Solomons - Central and southeastern Coral Sea
15C	4-6-58 - 15-6-58	Solomons - Central Coral to east New Zealand
16C	19-6-58 - 22-6-58	South Coast Queensland - North Tasman Sea

## Catalogue Identification - 1957-58

Type A	06A58	12242	(71339 71950 71753 71650 72048 72058 71659)
Type B	01B57	07691	(60579 71069 71579 60778)
	02B57	04582	(60479 62273)
	10B58	31034	(71751 71946)
	13B58	12164	(71039 71435)
Type C	03C58	01091	(71076 63076)
	08C58	11173	(71275 72371)
	12C58	02114	(71059 71775)
	14C58	17234	(71161 71754 72260)
	15C58	04156	(71162 70960 71357 71557 72361 72860 72967 73476 64177)
	16C58	19226	(72855 72755 72955 73156 73061 73367)

## 3. TENTATIVE SYNOPTIC EXPERIENCE

There has been good evidence of development over the tropical seas following upper air divergence on the warm side of a jet axis where the velocity, anticyclonic curvature and anticyclonic shear increased down stream (McRae 1956).

Mintz's steering rule in conjunction with the 1000-500 mb thickness chart was satisfactory when data was available (Mintz 1947).

Cold air injection and cooling by heavy rain seemed contributing factors to weakening of the cyclonic intensity (Palmen 1956).

Sferics outbreak seemed to occur in most cases ahead of the cyclone and a forerunner to development in some instances.

Anticyclonic flow, favourably situated to increase the field of divergence over the disturbance, was induced by an upstream "cut off", the cyclonic motion associated with the cut off becoming anticyclonic down stream due to the conservation of potential vorticity.

## References:

- |             |      |                                      |
|-------------|------|--------------------------------------|
| McRae, J.N. | 1956 | Proc. Trop. Cyclone Sympos. Brisbane |
| Mintz, Y.   | 1947 | Bull. Am. Met. Soc. 28, p.121        |
| Palmen, E.  | 1956 | Proc. Trop. Cyclone Sympos. Brisbane |

## Appendix 1 - Major cyclonic depressions

## Depression Type A 12-24 February, 1958

06A58 12242 (71339 71950 71753 71650 72048 72058 71659)

## Development:

This disturbance developed over the central parts of the Gulf of Carpentaria on 12th. Sferics activity was evident over the Gulf on the 11th and 12th and rain was reported generally from the west and east coasts of the Gulf. With a high pressure belt over southern Australia leading to a ridge along the Queensland coast there was an appreciable northeast to easterly drift over northeastern Australia. A cyclone warning was issued by Darwin Meteorological Office on the 14th but this was not continued as no cyclonic specifications were realised. At this stage barometric tendencies were the principal aid in determining an east-southeast movement.

This was the only A type depression which reached any intensity. The possibility of cyclonic development when off the Central Coast was delicately balanced but factors against it seemed to be (a) the lack of a strong field of divergence aloft and (b) cooling of the air near the surface due to intensive rain as emphasised by Bergeron (1954). See description of torrential rain under section "Rain".

## Track:

By 2300 GMT 14th the centre had moved south-eastwards to the southeastern Gulf Plains then followed a northeast movement to offshore from Cooktown at 9 p.m. that day. The disturbance then moved southeast over western Coral Sea and then northeast to be located at 2300 GMT 17th about 180 miles east-southeast of Willis Island. From this position the centre, deepening slowly, turned west-northwest past Willis Island and then curving southwest headed towards the Queensland coast. At 2230 GMT 19th Garbutt radar located the centre 40 miles to the southeast of Townsville but no spiral bands were evident. At 9 a.m. on this day the central pressure was estimated to be 994 mb. This appeared to be the lowest central pressure value during the life of the disturbance. Speed 8 kts over Peninsula, 5 to 10 kts during loop; 15 kt moving seaward.

Continuing a southwest movement the centre crossed the coast in the vicinity of Ayr about midday. After moving inland to a position about 70 miles west of Bowen at 2300 GMT 19th the disturbance again moved northeast to be located off Cape Cleveland by 2300 GMT 20th.

An east-southeast movement at about 10 kts with the centre filling was maintained for the next two days. Finally filling more rapidly the depression died away over waters to the north of Chesterfield reef.

#### Features of Track:

This depression executed a looped path in the Willis Island area and after moving inland a short distance moved out to sea to degenerate. The final movement to northeast seemed to follow a southeast change from a strong anticyclone in the south. The southeast change reached the northeast districts of Queensland on the 21st.

One of the best guides to movement was the 1000 to 500 mb thickness chart, movement of the disturbance being taken to be in accordance with Mintz's rule, the direction of motion being parallel to the isotherms with the warmer isotherms on the left hand side.

#### Rainfall:

During the early stages heavy flood rains occurred over the Gulf country, northeast Carpentaria and North Coast Barron. Extensive flooding occurred in the Gilbert River.

From the 18th when the depression started to move southwest from Willis Island torrential rain occurred along the Central Coast. Particularly on the Pioneer catchment, several 24 hourly totals to 9 a.m. on the 18th exceeded 30 in. Heaviest totals were Finch Hatton 34.58 in. and 34.0 in. at Mt. Pelion where 11.50 in. fell in  $2\frac{1}{2}$  hrs and 23.20 in. in  $6\frac{3}{4}$  hrs. Record flooding resulted in the Pioneer River and flooding was widespread in other Central Coast streams, as well as in the Isaacs River system and in inland and lower parts of the Burdekin catchment.

#### Winds:

Severe thunderstorms over the Peninsula on the 15th forced aircraft south bound to return to Thursday Island.

As the depression passed across Ayr and Home Hill about midday on the 20th violent electrical storms were experienced in the Ayr and Home Hill districts and at Claredale local wind gusts reached gale force. Apart from gusts sustained gale force winds were not recorded at any time during the life of the depression.

#### Seas:

Seas were rough along the Queensland coast between Bowen and Sandy Cape on 22 February.

## Damage:

Three lives were lost in the Mackay district where damage to bridges, dwellings and vehicles was estimated at £600,000, twenty houses being washed away. Smaller centres such as Finch Hatton also suffered from flood waters in the main streets.

## Depression Type B 7-19 November, 1957

01B57 07691 (60579 71069 71579 60778)

## Development:

This small cyclone commenced its life as a weak tropical disturbance near Lat. 5°S, Long. 180°E (in the Ellis Group) on 7 November. Two mechanisms seem to have had an influence on the deepening of this disturbance after 12 November. These mechanisms, both causing upper divergence, were (i) the association of a jet maximum in the vicinity of Norfolk Island with slight anticyclonic curvature at the 200 millibar level and (ii) the Durst-Sutcliffe effect.

Rapid weakening of the disturbance by 17th followed the injection of cold air into the middle layers of the disturbance between 15 and 16 November.

## Track:

Following a west to southwest path the disturbance was located about 300 miles beyond the northeast fringe of the Coral Sea on the 13th. The centre then turned southeast and deepened by the 14th into a small cyclone over waters east of the New Hebrides. East-southeast movement followed and on the 16th the centre was operating over waters to the north of the Fiji Islands. At this time the Nandi cyclone warning described the disturbance as a cyclone of moderate intensity. On the 17th the centre moved north to northeast and then filled rapidly. Lowest estimated pressure of 998 mbs occurred on the 16th, speed 10 kt.

## Features of Track:

This system almost executed a large circle on its path eventually filling close to the locality of origin. A significant change in direction may have occurred on the 14th when a moderate anticyclone moved across the north Tasman Sea, the disturbance then changing from a southerly to an easterly course.

The best guide to future movement of this disturbance was the daily 500 mb chart. The only failure of this forecasting tool was on 16th when the cyclone turned from an easterly to a northerly track whereas an east-northeast movement was indicated.

**Rainfall:**

Twentyfour hourly totals up to  $2\frac{1}{2}$  in. were reported from the Fijis on 15th, otherwise rains were light and mainly confined to the south-eastern and southwestern sides of the disturbance.

**Winds:**

On the 16th Nandi warning stated that winds of 40 kt were associated with the storm within 100 miles of the centre. The strongest winds actually reported, however, were of strength 30 kt at a distance of 200 miles from the centre.

**Seas:**

Rough seas were reported over waters to the north of New Hebrides between 13 and 16 November.

**Damage:**

None reported.

**Sferics:**

Sferics activity was reported to the east and northeast of the New Hebrides between 10th and 16th. This activity was ahead of the direction of motion of the disturbance up to 13th but thereafter was well to the rear of the disturbance.

Depression Type B 4-8 December, 1957

02B57 04582 (60479 62273)

**Development:**

Little is known of the conditions of development of this small cyclone which also originated in the Ellis Group.

**Track:**

Initial movement was to the south-southeast then southwest towards Fiji during which time it developed its greatest barometric intensity of 993 mb. On the 6th the centre changed direction to the southeast slowly filling. Speed 30 kt before intensifying, 15 kt afterwards.



**Features of Track:**

On 6 December an extensive southern trough passed over New Zealand and the cyclone evidently became caught in this circulation changing direction to the southeast in the northwest winds ahead of the trough which was very deep, extending above the 200 mb level.

**Rainfall:**

No reports of heavy rain were received.

**Winds:**

Gale force winds of 35 kts within 90 miles of the centre were evident on 5 December.

**Seas:**

Sea conditions were not reported.

**Damage:**

No reports received.

Depression Type B 31 March to 3 April, 1958

10B58 31034 (71751 71946)

**Development:**

Antecedent conditions were a protracted spell of east to south-east winds on the Central Queensland coast with only a weak depression apparent to the south of Willis Island. Deepening of this depression followed the establishment of a strong field of divergence aloft on the northwest side of a jet maximum associated with pronounced anticyclonic curvature at the 200 mb level.

In retrospect a possible significant feature may have been an increase in dew point at Willis Island from a steady 76 degrees to 79 degrees, indicating favourable conditions for warm core development. Considered alone, however, this could have been attributed simply to the protracted easterly weather. It was on the basis of a definite pressure fall in the Bowen area which prompted the issue of a cyclone warning which was supported shortly afterward by a report of gale force winds and heavy rain at Hayman Island.

**Track:**

This small but devastating cyclone had an apparent life of only four days.

A shallow depression was located on 31 March about 100 miles southeast of Willis Island, apparently deepening gradually it moved southwest and by midday 1 April was located about 80 miles northeast of Bowen. Rapid deepening then followed and the system now evidently cyclonic moved southwest at 10 kt. Passing about 7 miles off Gloucester Head the cyclone turned on a west-northwest path to cross the coast northward of Bowen between 0920 to 0950 GMT on 1 April. After passing across Wilmington the centre moved west and west-southwest past Clare and Collinsville areas degenerating to a rain depression. At 2300 GMT on the 1st it was located 120 miles west-southwest of Bowen after which it moved northwards losing identity in the Charters Towers area on the afternoon of the 3rd. Average speed 8 kt.

**Features of the Track:**

During its movement towards the coast the cyclone was associated with the outbreak of water spouts and tornadic squalls down the coast as far as Sarina. At 6 p.m. on the 1st the ship "Iron Wyndham" located the centre 7 miles off Gloucester Head showing an eye diameter 20 miles. Owing to shadow effect Townsville radar did not detect the storm until about 9 p.m. when the centre was inland from Bowen. The cyclone had a very steep pressure gradient near its centre as exhibited by the Bowen Post Office barograph trace. A pressure fall of 29 mb (0.86 in.) was shown on the trace in a period of 4 hrs 20 mins between 0500 and 0920 GMT on 1 April.

The lowest central pressure was estimated at 968 mb as the storm passed across the coast.

**Rainfall:**

Heavy rain accompanied both the movement of the cyclone across the coast and the filling stage of two days. Following heavy rains from the earlier depression and the antecedent easterly winds this storm resulted in record floods being experienced over the upper Burdekin basin.

**Winds:**

Gale force winds extended only 25 miles from the centre thus placing the cyclone in the B category. However, this restriction was more than made up by the violence of the winds which reached a peak of at least 112 mph at 1010 GMT 1 April. Unfortunately the Dines mast at Bowen was broken at this stage. Hurricane force winds seemed confined to within 10 to 15 miles from the centre.

At Bowen average wind speed reached near gale force of 31 kt at 6 p.m., and gale force of 42 kt at 6.30 p.m. By 7.5 p.m. the average wind speed was 63 kt with gusts to 93 kt (106 mph). Shortly afterwards the wind moderated as the eye of the cyclone passed Bowen, the wind speed dropping to an average of 42 kt at 7.45 p.m. Soon after the wind returned with greater violence reaching an average speed of 70 kt with gusts to 98 kt at 8.10 p.m. when the Bowen aerodrome anemometer mast guy wires pulled out and the mast snapped. Eye witness reports state that these hurricane force winds were sustained until about 9.30 p.m. after which time the wind speed moderated rapidly.

#### Seas:

A tidal wave of about six feet above mean high water accompanied the movement of the cyclone on to the coast.

#### Microseisms:

Microseisms showed only a small response with the cyclone increasing from 2.4 mm at Brisbane on the 31st to 3.0 mm on the 1st which could not be considered significant. At Townsville from a level of 2.7 mm on the 31st amplitude reached 4.0 mm at 0830 GMT on the 1st.

#### Damage:

The associated tornadic squalls on the coast caused local damage at Proserpine, Mackay and Sarina.

The cyclone itself, however, caused damage through gales, rain and high seas estimated at £1,000,000. Structural damage in general occurred within 25 miles of the centre of the storm. About 77 houses and various buildings including the Bowen Saltworks were destroyed, many other buildings were damaged, numerous small craft were wrecked on the beaches and small crops were ruined. In the Queens Beach area damage was the most severe. Five inch diameter iron telephone poles were bent to the ground, trees were completely defoliated, large trees up to 3 ft in diameter were uprooted and trees up to 18 inches in diameter snapped off.

Depression Type B 12-16 April, 1958

13B58 12164 (71039 71435)

#### Development:

The speed with which this disturbance deepened is comparable with the rate of deepening of the Bowen cyclone (10B58).

The ship "San Miguel" passed through the centre of the depression at 0500 GMT 12 April. At this time rotational motion was just commencing around a low pressure centre of 1002 mb but there was still a considerable component of wind blowing directly towards the centre. For example on the eastern side of the centre winds were easterly while on the northern side winds were NNW 25 kt.

At 0500 GMT on the 13th the centre was still estimated to be in the position detected by the "San Miguel" with little intensity, yet by 1700 GMT 13th gales were being experienced at Yirkalla. Hence development took place within 36 hours with major development possibly in 12 hours. It is interesting to note that sferics activity was reported from the area of development on the 11th, 13th and 14th; while there was some evidence that subsequent deepening followed the development of a field of upper divergence over the surface disturbance.

It appears that a closed cyclonic circulation up to the 500 mb level had developed by 9 p.m. 13th, vertical shear being small.

#### Track:

Remaining almost stationary for 24 hours at latitude  $10.5^{\circ}\text{S}$ ,  $139.0^{\circ}\text{E}$  longitude the centre moved southwest and deepened rapidly to 990 mb by 1700 GMT on 13th being located then 30 miles east-southeast of Yirkalla Mission in the northeast corner of Arnhem Land.

Continuing southwest and south-southwest the centre passed over Groote Eylandt between 1330 and 1400 GMT on 14th preceded by south-easterly gales and followed by northwesterly gales. The cyclone with central pressure 990 mb continued to move southwest into the south-western corner of the Gulf and at 2300 GMT 14th Rose River Mission was still reporting west-southwesterly gales. By 1100 GMT 15th the centre had crossed the coast and was filling and by 0500 GMT on 16th it was losing identity over south-eastern Arnhem Land. Speed 3 to 5 kt.

#### Features of Track:

The movement of the cyclone to the southwest on the 13th seemed to be steered by northeasterly winds between 300 and 200 mb levels. From the 15th to the 17th a steady fall in dew point from 53 to 36 degrees at Newcastle Waters followed eastward movement of an anticyclone to the south suggesting that dry air had reached the region of the cyclone.

#### Rainfall:

At Yirkalla 16 in. of rain were recorded in 24 hours ended 0800 GMT on the 14th, heaviest rain being soon after 1700 GMT on the 13th. At Rose River Mission 10 inches fell between 2300 GMT 14th and 1400 GMT 15th.

The rain gauge was blown away at Groote Eylandt. The closest station in Queensland namely Burketown received only 46 points during the period of the cyclone, although heavier rain probably fell in the unrepresented area in the extreme northwest of Queensland.

#### Winds:

The estimated average maximum wind speed at Yirkalla was southwest 50 kt. Groote Eylandt reported southeast to south 48 kt. At 1100 GMT and at Roper River Mission south-southwest winds were estimated at 48 to 53 kt. As the centre passed over Groote Eylandt gusts reached 66 kt both before and after the passage of the centre while at the same time Rose River Mission reported west-southwest 48 kt with gusts to 69 kt. At 2300 GMT on 14th Rose River reported speeds between 53 and 70 kt.

The maximum distance of gales from cyclone centre was 70 miles.

#### Seas:

Very rough seas were experienced in the Gulf of Carpentaria on the 14th and 15th by an Exploration Enterprises 40 ft launch, 30 ft waves being encountered on both days during a trip from Weipa to Gove.

#### Damage:

No information is available in regard to any serious damage.

Depression Type C 1-9 January, 1958

03C58 01091 (71076 63076)

#### Development:

A low well to the north of Fiji showed more clearly as a disturbance on the 5th, 300 miles north-northeast of Fiji and developed rapidly to its most intense stage on the 7th with pressure 974 mb to the east of Fiji.

Antecedent conditions were a general east to northeast gradient on the southern side of the equatorial trough, the region being characterised by high surface dew points of 74 to 79°F. Small vertical shear is also suggested by Nandi's upper wind reports. Although information is limited conditions appear favourable for warm core development. The "trigger" mechanism is not, however, apparent.

**Track:**

After intensifying, the disturbance moved south-southwest to south passing over the eastern islands of the Fijian group on the 7th, the direction and speed of movement following fairly closely the downstream wind field at 40,000 ft. Following capture by an eastward moving cold southern trough, the subsequent track was south-southeast to waters southeast of Kermadec Island where the disturbance lost identity on 9th. Speed of movement was 5 to 10 kt until passing the Fijis and then 15 to 25 kt.

**Features of Track:**

Probably significant on 7th was the movement of the cold southern trough to the northeast of New Zealand orientated northeast to southwest. This trough moved rapidly after 8th and it seemed likely that the structure of the cyclone was destroyed after 8th by the injection of cold air into the middle layers of the cyclone. Some evidence of this process commencing was indicated on 8th when the cyclone showed signs of weakening.

**Rainfall:**

Heavy rain was reported during the night hours of 7th between the southern Fijis and Kermadec Island.

**Winds:**

On the 7th at maximum intensity gales extended 180 miles from the centre with average maximum speed in the Fijis of 75 kt and gusts to 130 kt, which marks this cyclone as one of the most severe on record in the southwest Pacific.

**Seas:**

Reports of sea conditions are not available.

**Damage:**

Press reports indicated widespread damage in the island of Northern Lau. Houses were blown down, trees uprooted and defoliated and crops destroyed. It has been predicted that copra production from the area is likely to be reduced for the next two or three years.

## Depression Type C 11-19 March, 1958

08C58 11173 (71275 72371)

## Development:

This disturbance originated on the 11th March to the northeast of Fiji but there is no reliable evidence to assess either the maximum strength of winds and lowest central pressure as throughout its life the centre was apparently not nearer than 90 miles from the nearest reporting station. The lowest pressure indicated was 998 mb on the 15th. Mechanism for development is doubtful. Antecedent conditions were favourable for warm core development and up to 13th cyclonic circulation did not extend above the 500 mb level. By 14 March a cyclonic circulation was in evidence up to the 200 mb level but by 0500 GMT 15th this structure was collapsing, the mature stage of development being limited to a life of about 36 hrs.

## Track:

First located as a shallow depression about 350 miles north of Fiji on the 11th, the centre showing little change in intensity moved slowly south-southeast to south-southwest and when about 150 miles northwest of Nandi on the 13th deepened rapidly. Passing southwest to south over waters between Fiji and New Caledonia the cyclone reached its most intense stage on the 15th. By the 17th the cyclone had moved to about 250 miles east of Noumea and filled.

There is some suggestion that interaction of vortices was responsible for steering the disturbance during the period 13th to 16th. On these days the 20,000 feet streamline charts show an anticyclone well to the southeast of the cyclonic circulation. Other than this there is no consistent evidence of any other steering mechanism being responsible for the cyclone's track. Speed 5 kt until southwest of Noumea then 20 kt.

## Rainfall:

No heavy rain was reported.

## Winds:

Gale force winds lasted from the evening of the 13th to the morning of the 18th extending at 1100 GMT on 16th 190 miles from the centre. The strongest wind reported was 39 kt on the 13th.

## Seas:

Seas were rough over Southern Fijian and New Caledonian waters from 14th to 17th.

## Damage:

No reports received.

Depression Type C 2-11 April, 1958

12058 02114 (71059 71775)

## Development:

The earliest indication of origin of this cyclone was the formation of a fairly active depression in the equatorial trough over the southern Solomons sea area. The disturbance showed a slow intensification during a period of southeast movement but deepening commenced after a noticeable slackening of speed south of Honiara. The lowest pressure reached was 994 mb when over western Fiji.

An outbreak of thunderstorms over northeast Coral Sea waters, as reported by sferics preceded the deepening of the disturbance on 5th but the reasons for deepening are not clear. Sferics also preceded the disturbance on 7th and 8th.

## Track:

Apparently embedded in a wave in the easterlies the depression drifted westward towards Papua between 2 and 3 April but then swung southeast when about halfway between the Solomons and eastern Papua Islands. The reasons for this change of direction are not evident.

When approximately 200 miles due south of Honiara the previous 8 to 10 kt southeast speed slackened and changed to east. At this stage 2300 GMT on 5th Honiara reported a westerly gradient of 35 kt and the depression became cyclonic. Speed of movement increased to 32 kt as the cyclone moved rapidly towards Fiji gradually intensifying under the influence of a more strongly developed field of upper divergence on the northern side of a subtropical jet. Soon after passing over Yasawa (60 miles north of Nandi) it came practically to a halt and commenced fairly rapid filling. By 0200 GMT 9th it was a spent force remaining stationary in the western Fiji group and filling. No definite conclusions can be drawn concerning reasons for filling. Average speed early stages 5 to 10 kt, latter stage 20 to 32 kt.

## Features of Track:

The change in direction to the southeast when south of Honiara apparently resulted from steering by strong northwesterlies aloft with a marked increase in speed of movement. These steering winds were associated with an eastward moving deep southern trough.



## Rainfall:

Widespread rain fell over the northeast Coral Sea and adjacent areas on 5th and this rain area extended ahead of the cyclone to the Fijis as the disturbance moved east-southeast. Heaviest rain was reported from the New Hebrides group where some 24 hourly totals on 7th were approximately 5 in.

## Winds:

Gale force winds were reported up to 160 miles southeast from the centre on 8th and maximum average wind speeds were 40 kt at 1100 and 1700 GMT on 8th at Yasawa.

## Seas:

Rough seas with waves 21 ft high were reported from northeast Coral Sea waters between 5 and 7 April.

## Damage:

No damage was reported.

Depression Type C 17-24 April, 1958

14058 17234 (71161 71754 72260)

## Development:

This cyclone was a good example of a depression travelling hundreds of miles before deepening. The disturbance was first located as a 1000 mb centre over waters to the south of Solomon Islands at 2300 GMT on 17th. It reached cyclone intensity 998 mb at 0500 GMT on 22nd over the west Coral Sea. The first real evidence of this system was given by ships reports in 22 degrees south between 154 and 158 degrees east.

The cause of deepening of this disturbance over the Coral Sea is open to some conjecture. It would appear, however, that some contribution towards establishing the field of divergence over the pre-existing weak disturbance was the control exercised by the "cut off" moving eastwards across the Australian Continent on 21 April. In the vicinity of the cut off the wind field was cyclonic but further down stream the motion was anticyclonic. This change from cyclone to anticyclonic motion can be seen to be the result of conservation of potential vorticity, the expression for which is  $\frac{f + \zeta}{\Delta p} = \text{constant}$  where  $f$  = Coriolis parameter  
 $\zeta$  = relative vorticity  
 $\Delta p$  = pressure difference between top and bottom of an air column.

If considered at the level of non divergence, for which the 500 mb level is a reasonable approximation, this expression reduces to the form  $f + \frac{V}{r_s} = \text{constant}$ . So that when a cyclonic current moves towards higher latitudes with  $f$  increasing,  $r_s$  must also increase and eventually change from cyclonic to anticyclonic (Riehl 1954) ( $r_s$  is radius of curvature of streamlines).

This anticyclonic circulation was favourably situated to contribute to an increase in the field of divergence over the disturbance. Cyclogenesis was apparent on 22 April.

Fairly rapid easterly movement of the "cut off" in the next 24 hrs resulted in an injection of cold air into the disturbance on 23rd with filling resulting soon after.

Sferics near the central part of the disturbance were a feature of the deepening stage.

#### Track:

From the position south of the Solomons the depression drifted southwest and temporarily weakened to 1003 mb about 250 miles east-southeast of Willis Island on 21st. By 2300 GMT 21st the centre was moving east-southeast and by 2300 GMT 23rd it had moved southeast to about 100 miles south of Chesterfield Reef where it remained stationary and filled on 24th. The closest to the Queensland coast was at 0500 GMT on 22nd at a position 380 miles northeast of Gladstone. Speed 7 kt.

#### Features of Track:

The main feature was the protracted period without development. The general pressure conditions being a high over the Bight extending to the southwest Pacific with prevailing easterlies to the north within which the depression moved.

#### Rainfall:

The Queensland southern coast experienced showery conditions between the 22nd and 24th. Ships reported heavy rain on the southern side of the centre on 22nd.

#### Winds:

At 0500 GMT on 22nd gale force winds up to 37 kt were reported within 140 miles of the centre, these gales being confined to the southern side of the disturbance. Winds were light on the northern side of the centre as indicated by 3 hourly ship reports.

## Seas:

Moderate to rough seas occurred on the southern Queensland coast between 22nd and 24th. In the same period rough to high seas were reported from the southern Coral Sea region where 14 ft waves were reported on 23rd.

## Depression Type C 4-15 June, 1958

15058 04156 (71162 71557 72361 72860 72967 64177)

## Development:

This disturbance developed in an easterly wave moving westwards towards the Solomon Islands. Features of the weather beforehand were (i) outbreak of sferics on 4 June over a broad area of dimensions 300 by 180 miles over waters to the southeast of the Solomons and (ii) unseasonably warm weather over eastern Queensland at the time of deepening and during the previous 24 hours as shown by the following table.

Station	Daily Maximum Temperature (°F)		Monthly Average Maximum Temperature (°F) for June
	5 June	6 June	
Brisbane	78.6	77.7	69.3
Rockhampton	82.0	78.0	74.4
Townsville	83.0	84.0	77.3
Cairns	83.0	84.0	78.8

During this period dew points along the Queensland coast were 65 to 70 degrees whilst over the southeast Coral Sea and Solomon Islands dew points were 70 to 75 degrees.

The shallow disturbance oscillated over the Solomon Islands for 48 hrs and deepened rapidly at 0300 GMT 6 June, this being the first tropical cyclone to develop in the month of June in the Coral Sea region since year 1941 when a tropical cyclone developed over the northwest Coral Sea between Willis Island and the Queensland north coast. Deepening of the June 1958 cyclone appears to follow a similar pattern to that of 17 to 23 April 1958 tropical cyclone. On 3 June a well developed "cut off" was located over southwestern Queensland. This circulation moved northeastwards to be located very close to Cairns at 2300 GMT 5 June indicated at that time on the 40,000 ft stream line chart by 170 deg. 8 kt at Cairns and 050 deg. 64 kt at Townsville. Down stream anticyclonic motion associated with fairly strong horizontal shear is evident to the south of the region of development. The strength of horizontal shear cannot be stated with certainty, but is indicated by 40,000 ft winds at Lae (7.5° S) 350 deg. 16 kt and at Nandi (17.6° S) 260 deg. 60 kt.

## Track:

The disturbance moved south-southwest for 24 hours then turned south-southeast at about 1100 GMT 7 June, the change in direction being associated with a decrease in speed of movement from 15 to 5 kt. Accelerating to 15 to 25 kt south-southeast movement continued for the next 36 hrs, lowest central pressure during this stage being 988 mb. Then moving more slowly at 5 to 10 kt and weakening slightly the centre moved south to south-southwest. At 2100 GMT 10th, the storm, with central pressure 994 mb, was at its closest position to the coast about 350 miles east of Brisbane in position 27.7° S, 159.6°E. At this time ship "Polynesie" reported it was inside the eye, the wind speed having dropped from 60 to 30 kt and the weather having improved from heavy rain to fine weather with five eighths cloud comprising two eighths Cb base 300 to 600 ft and three eighths A.Cu. and CiCu.

Soon after the storm turned on a 5 kt southeast to east track passing within 40 miles of Norfolk Island between 1100 GMT and 1700 GMT 13th. During this period the storm appeared to extra-tropicalise for it had deepened again to a central pressure of 982 mb when near Norfolk Island. By 2300 GMT 14th the storm was moving south-eastwards and accelerating, passing the eastern side of New Zealand 24 hrs later at a speed of 35 kt. Speed 5 to 10 kt for most of the period but 25 to 35 kt in last 36 hrs.

## Features of Track:

The 1000 to 500 mb chart was a particularly valuable guide to movement of this disturbance. Strong blocking control was exercised by southern systems during the period 8th to 11th resulting in very slow movement and probably providing sufficient time for modification of the type of storm to take place. The acceleration of the deep southern cold trough over southeastern Australia after the 11th was eventually responsible for carrying the storm away rapidly in a southeast direction.

Sferics became very active again to the southeast of the centre on 10th and continued until 13th. This development on 10th could possibly be taken as an early sign that the storm was extra-tropicalising.

## Rain:

In the three day period from 2300 GMT 7th to 2300 GMT 10th heavy flood rains fell over Queensland South Coast Moreton districts with lighter registrations in other parts of the southeast quarter of Queensland. In South Coast Moreton many 24 hourly totals exceeded 3 in. with a few over 6 in., heaviest being 766 pts Springbrook and 692 pts Bald Knob. Three day total at Springbrook was 1839 pts. These rains caused high level flooding in South Coast Moreton streams, particularly in the Mary and Nerang Rivers, flooding further inland in the drainage systems of the Darling Downs and southern parts of the Central Highlands being of a more moderate nature.

Over the Coral Sea itself heavy rain was reported around the disturbance in the early stages but as the cyclone moved further south, particularly from 9 June onwards, heavy rain was confined to the southern quadrants.

#### Wind:

Light gale force winds were first reported on 6th but within 24 hrs gales up to 60 kt were being experienced 30 miles from the centre. By 2300 GMT 7th gales were extending 400 miles from the centre and by 8th to 500 miles at which stage the storm was fully developed as a tropical cyclone. In general a slight diminution of maximum wind speed to 50 kt and of extent of gales to 400 miles accompanied the extra-tropical development but in the closing stages when passing New Zealand, gales were being reported at a distance of 700 miles north of the centre. It is interesting to observe that when at a distance of 60 miles from Norfolk Island at 2300 GMT 13 June the surface wind there was 230 deg. 31 kt, whereas the upper winds in the lower levels were 250 deg. 84 kt at 3000 ft, 200 deg. 77 kt at 5000 ft, 220 deg. 61 kt at 7000 ft and 230 deg. 48 kt at 10,000 ft.

#### Seas:

Rough to high seas prevailed for several days between the central Coral Sea and the central Tasman Sea and along the east coast of Australia from the southern New South Wales coast to the central Queensland coast. Shipping in and about the port of Brisbane was almost brought to a standstill during the period 8th to 11th. This included suspension of whaling operations outside Moreton Bay and delay in departure of American destroyers. Waves over 30 ft high were reported from the eastern fringes of Moreton Bay to a distance 400 miles seaward.

#### Damage:

The persistent pounding seas and strong to gale force winds are reported to have caused serious erosion on Queensland south coast beaches. The American schooner "Venturer" was wrecked on reefs near Lady Musgrave Island 62 miles northeast of Bundaberg but no lives were lost.

Minor injuries were suffered by passengers on the tourist liner "Manoora", Brennan Shoal buoy lights off Cape Moreton were extinguished, and cargo aboard the "Sierra" broke adrift causing some damage.

On the coast no serious flood damage was reported although high-ways leading from Brisbane were cut in several places causing traffic dislocation.

## Depression Type C 19-21 June, 1958

16058 19226 (72855 72755 72955 73156 73061 73367)

## Development:

This cold cored disturbance might be more correctly described as two disturbances the birth of both being due to the strong field of divergence associated with one upper "cut off". On 18 June this "cut off" was moving slowly east to east-northeast over southeast Queensland and by 2300 GMT 18 June a disturbance had developed to cyclonic proportions in the pre-existing trough lying off the Queensland south coast. Slow movement of the "cut off" held the storm in approximately the same position for 48 hrs. However, following rapid movement of the "cut off" which was still active, this first disturbance appeared to fill and secondary development took place further east over waters to the northeast of Lord Howe Island at 2300 GMT 20th. This development was not as marked as in the first instance and with the "cut off" weakening this disturbance filled on 22nd.

## Track:

After becoming cyclonic this cyclone gradually deepened to a 1006 mb centre, moved about one degree northwards and then retreated southwards again to be located 24 hours later at 2300 GMT 19 June, approximately the position of its birth. With the "cut off" now moving very slowly southeast, the surface disturbance behaved in similar fashion and showed a very slow east-southeast movement of less than 5 kt until 0500 GMT 20th. Slow southerly movement followed with the disturbance weakening rapidly at 1700 GMT 20th. Speed 5 kt.

At 2300 GMT 20th the secondary development was evident about 120 miles northeast of Lord Howe Island where central pressure was 1007 mb. For the next 12 hrs this disturbance moved slowly southeast but then accelerated to 25 to 30 kt under the influence of the advancing cold trough and eventually filled over waters between Norfolk Island and New Zealand at 1100 GMT 22nd.

## Features of Track:

The pronounced control exercised by the upper "cut off" was the main feature of this disturbance. Ship reports seem to have located the weakening centre fairly well at 1700 GMT 20th whereas six hours later the centre was approximately 300 miles to the east-northeast. It has therefore been concluded that the 2300 GMT position is the result of secondary development.

**Rain:**

Moderate to heavy rain fell about the Queensland border areas and over southern quadrants of the disturbance within 200 miles of the centre between 2300 GMT 18th and 2300 GMT 19th, the 24 hourly total at Coolangatta being 276 points. The rain influence associated with this first disturbance then weakened. Associated with the secondary development moderate to heavy rain was reported on the eastern and southeastern sides to a distance of 400 miles from the centre in the period 1100 GMT 20th to 1100 GMT 21st.

**Wind:**

Following deepening, gales rapidly extended to a distance of 100 miles from the centre within 6 hours, the strongest wind reported being 44 kt at Cape Byron at a distance of 100 miles from the centre at 1100 GMT 19th. By 1700 GMT 19th gales were reported 270 miles from the centre, persisted for the next 12 hours and then moderated. No gales were reported in association with the secondary development.

**Seas:**

Rough to high seas were reported along the northern New South Wales coast over adjacent Queensland border waters and on the southern side of the disturbance on 19th and 20th waves reaching a height of 16 ft. On the northern side of the centre seas were rough with waves to a height of 10 ft.

**Damage:**

The persistence of rough weather following so soon after that of the June tropical cyclone caused additional erosion on Queensland south coast beaches.

## Appendix 2 - Minor Depressions

No. 4A - Tropical Disturbance Western Gulf of  
Carpentaria Waters 11-16 January 1958

A tropical disturbance with central pressure 1005 mb was located off the northeast tip of Arnhem Land on 11 January. At midday 12th the disturbance was centred over the Western Gulf waters and at this stage Darwin Meteorological Office suspected that the disturbance might develop into a tropical cyclone. This alert was maintained whilst the centre moved slowly southwards to be located in the southwestern corner of the Gulf at 3 a.m. 13th. During the morning the centre turned westwards and moved slowly across Arnhem Land and the Kimberleys to eventually lose identity on 20th off the northwest coast of Western Australia.

When the centre was over the Gulf of Carpentaria the strongest wind reported was 20 kt, the lowest central pressure being 1004 mb. The evidence indicates that this disturbance did not develop into a tropical cyclone and is therefore classified as a tropical disturbance type A.

## No. 5A Tropical Disturbance Coral Sea 13-18 January 1958

This disturbance was first located over the northeastern Coral Sea on 13 January when the lowest pressures in the area were 1003 mb. The centre moved slowly south-southwest for a few days showing little change. However on 16th when the centre was approaching longitude 160°E, it was decided to alert shipping and move into the advisory stage of the warning program. Advisories were continued until 19th by which time it was evident that the disturbance had filled.

Ships in the area during the period were the "Elm Hill" and "Scottish Trader". The strongest winds reported in the vicinity of the disturbance being 15 kt. At a distance of 200 to 300 miles the maximum wind speed was 25 to 27 kt. It appears that winds did not reach gale force and this system is therefore classified as a tropical disturbance type A.

## No. 7A - Suspicion of Cyclogenesis 6-7 March 1958

On 6 March a rain depression was located inland from St. Lawrence and moving out to sea.

It was suspected that this depression might deepen after moving seawards. Although the depression moved north-northeast it continued to weaken and filled over the northwest Coral Sea between Willis Island and the coast on 7 March.



No. 9A - Tropical Disturbance Southern Coral Sea 18-20 March 1958

This disturbance remained stationary over waters to the west of Chesterfield Reef and on 18th it was suspected that the disturbance might develop into a tropical cyclone. Cyclone advisories were issued. These suspicions were not confirmed however, it being evident on 20th that the system was weakening.

Strongest winds reported were 30 kt, 350 miles away. Near the centre ships reported only light winds and it has been assumed that the 30 kt winds were due mainly to the fairly energetic high centred over southern waters at the time.

No. 11A - Tropical Disturbance Northern Coral Sea 9 April 1958

On the afternoon of 9th a 1000 mb depression was located over the northern Coral Sea. At a distance of 120 to 130 miles ships were reporting 28 kt winds and the possibility of the centre deepening was suggested.

However by 2300 GMT 9th i.e. on the morning of the 10th, the depression was weakening and warnings, in the Cyclone Advisory stage, ceased.









