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ROYAL OBSERVATORY, HONG KONG

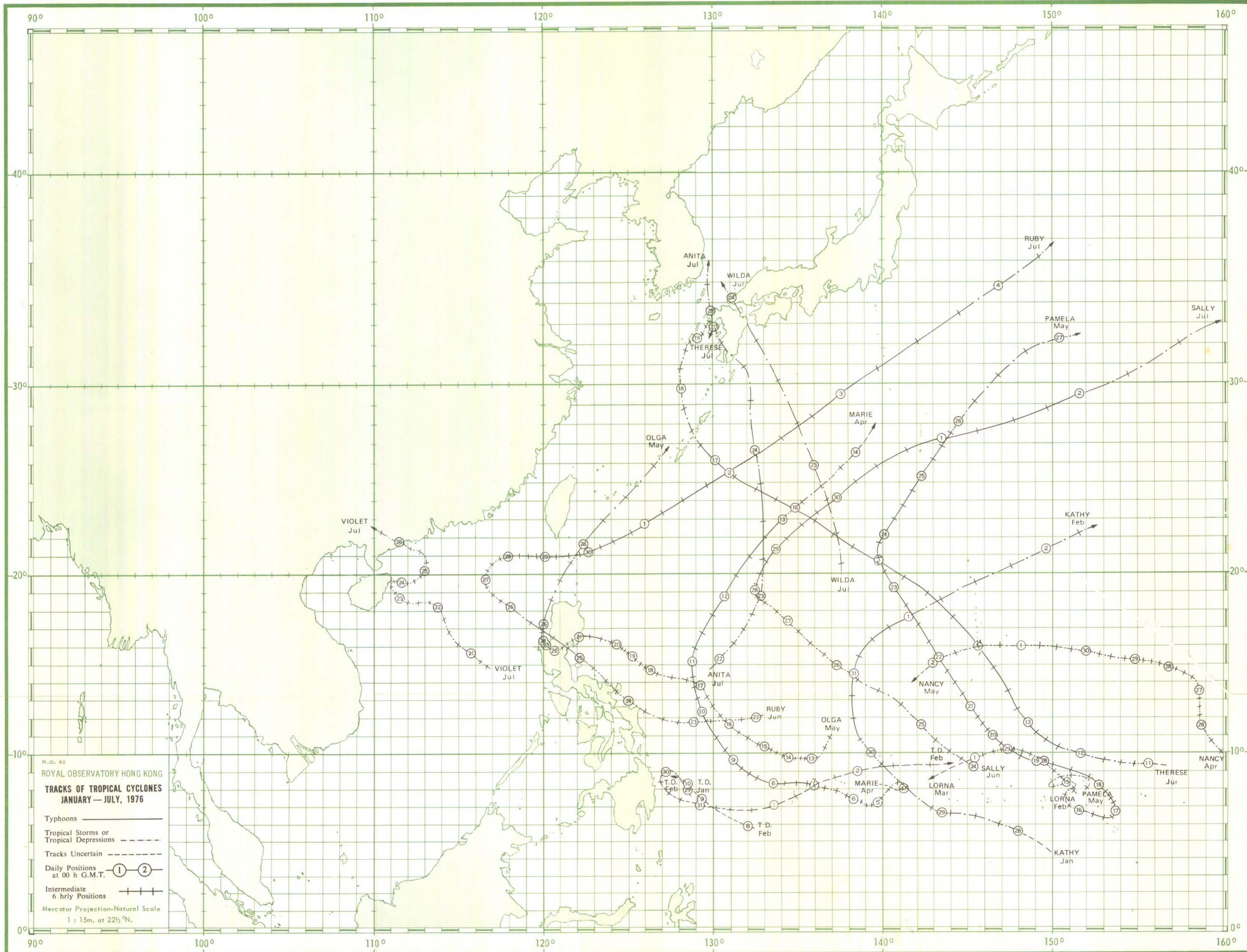
METEOROLOGICAL RESULTS
1976

PART III—TROPICAL CYCLONE SUMMARIES



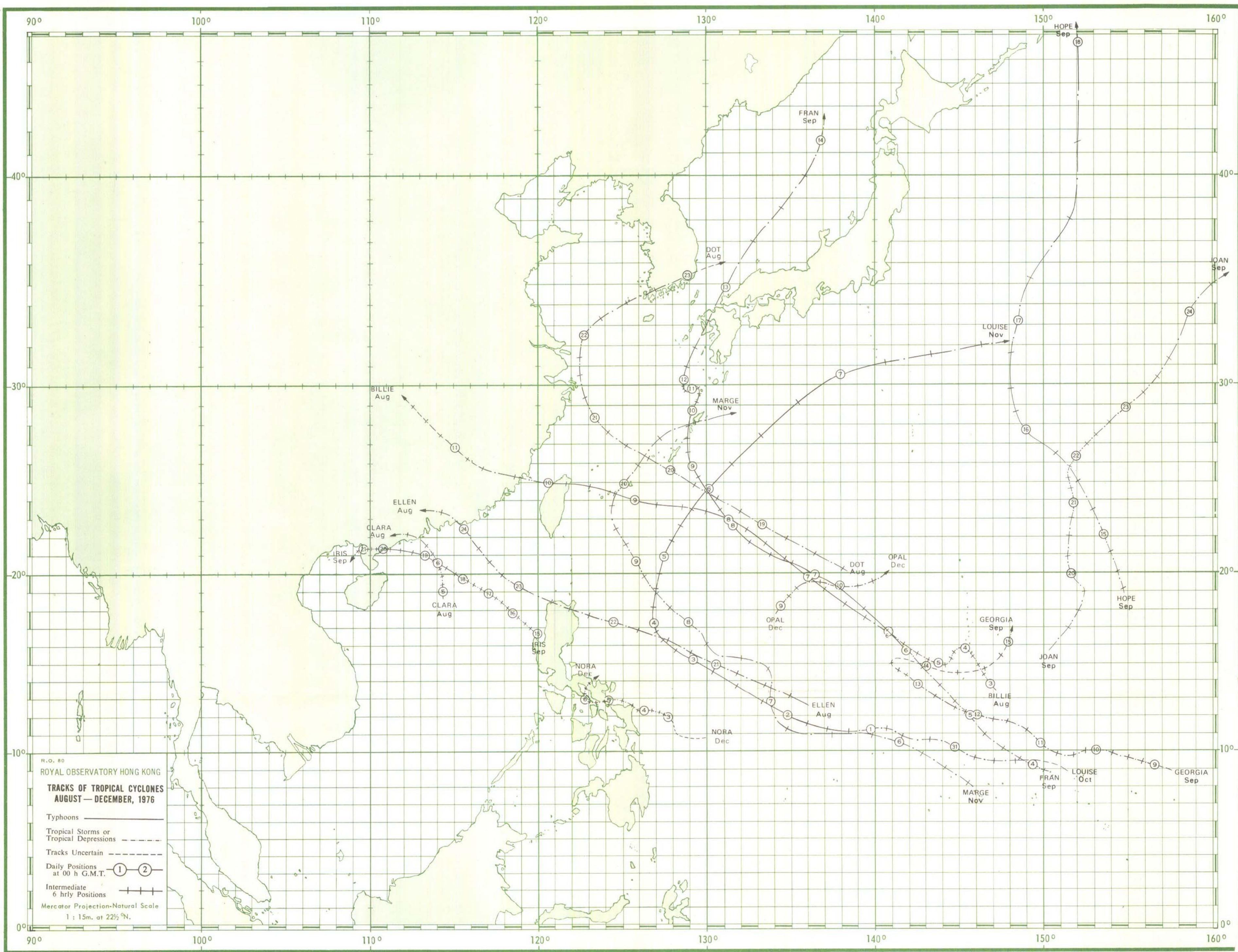
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1977



R.O. 80
 ROYAL OBSERVATORY HONG KONG
TRACKS OF TROPICAL CYCLONES
JANUARY — JULY, 1976

Typhoons —————
 Tropical Storms or
 Tropical Depressions - - - - -
 Tracks Uncertain - - - - -
 Daily Positions
 at 00 h G.M.T. ① ②
 Intermediate
 6 hrly Positions + + + + +
 Mercator Projection-Natural Scale
 1 : 15m. at 22½°N.



R.O. 80
ROYAL OBSERVATORY HONG KONG

**TRACKS OF TROPICAL CYCLONES
AUGUST—DECEMBER, 1976**

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METEOROLOGICAL RESULTS

1976

PART III—TROPICAL CYCLONE SUMMARIES

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FRONTISPIECE: Tracks of tropical cyclones in the western North Pacific and the South China Sea, 1976.

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INTRODUCTION

Apart from a short break 1940–1946, surface observations of meteorological elements since 1884 have been summarized and published in the Royal Observatory's Meteorological Results. Upper-air observations were begun in 1947 and from then onwards the annual volumes were divided into two parts, namely Part I—Surface Observations and Part II—Upper-air Observations.

During the period 1884–1939, reports on destructive typhoons were occasionally prepared and were included as Appendices to the Meteorological Results. However, after 1947, this practice was extended and an account of all tropical cyclones which caused gales in Hong Kong was included in the Annual Departmental Reports. The first issue of a new series—'Meteorological Results, Part III—Tropical Cyclone Summaries' was introduced in 1971. It contained information about all tropical cyclones over the western North Pacific and the South China Sea (i.e. the area bounded by the Equator, 45°N, 100°E and 160°E) that occurred in the year 1968.

Tracks of tropical cyclones in the western North Pacific and the South China Sea were published in Meteorological Results, Part I up to 1967. During the period 1884–1960, the tracks were plotted with day circle positions only. The time of the day circle varied to some extent but remained fixed at 0000 G.M.T. after 1944. The day circle times used for earlier tropical cyclones are given in the Royal Observatory Technical Memoir No. 11, Volume 1. From 1961 onwards, 6-hourly positions were shown on the tracks of all tropical cyclones.

Provisional reports on individual tropical cyclones affecting Hong Kong have been prepared since 1960; this was done in order to meet the immediate needs of the press, shipping companies and others. These reports were cyclostyled and were supplied on request. Initially, reports were only written on those tropical cyclones for which gales or storm signals had been hoisted in Hong Kong, but by 1968 it had become necessary to produce a report on every tropical cyclone during which any tropical cyclone warning signal was raised.

In this publication, tropical cyclones are classified into the following four categories according to the maximum sustained winds within their circulations:

A TROPICAL DEPRESSION (T.D.) has maximum sustained winds of less than 34 knots and at this stage the centre is often not very clearly defined and cannot always be fixed precisely.

A TROPICAL STORM (T.S.) has maximum sustained winds in the range 34–47 knots.

A SEVERE TROPICAL STORM (S.T.S.) has maximum sustained winds in the range 48–63 knots.

A TYPHOON (T.) has maximum sustained winds of 64 knots or more.

The Royal Observatory has a network of anemographs to record surface winds in Hong Kong. The instruments used are all Dines pressure-tube anemographs or M.O. Mark IV cup generator type anemographs manufactured by R.W. Munro Ltd. Quick-run mechanisms are also fitted to the anemographs at the Hong Kong Airport (Southeast), Waglan Island, Tate's Cairn and Cheung Chau for recording the fine structure of the wind flow in typhoons for research purposes. Details of these stations are given below.

Station	Position		Elevation of barometer above M.S.L.	Elevation of ground above M.S.L.	Head of anemometer above M.S.L.	Type of anemometer
	Latitude N	Longitude E				
Royal Observatory	22° 18'	114° 10'	(m) 33	(m) 32	(m) 61	Dines, Cup
Hong Kong Airport (Southeast)	22° 20'	114° 11'	24	4	16	Dines, Cup
Hong Kong Airport (Northwest)	22° 20'	114° 11'	24	4	14	Dines, Cup
Waglan Island	22° 11'	114° 18'	62	55	75	Dines, Cup
Tate's Cairn	22° 22'	114° 13'	*	575†	588	Dines
Cheung Chau	22° 12'	114° 01'	79	72	92	Dines
King's Park	22° 19'	114° 10'	66	65	78	Cup
Star Ferry	22° 18'	114° 10'	*	3	17	Cup
Green Island	22° 17'	114° 07'	*	76	90	Cup
Tsim Bei Tsui	22° 29'	114° 00'	*	26	44	Dines
Tai O	22° 15'	113° 51'	*	76	90	Cup
Cape D'Aguilar	22° 13'	114° 15'	*	5	14	Cup
Castle Peak	22° 23'	113° 59'	*	5	16	Dines

* No barometer.

† Level of the ground floor of the building compound of the Radar Station.

Wind measurements are also made by China Light & Power Co. Ltd. at Hok Un and Tsing Yi Island, by Cable & Wireless Ltd. at Stanley, by the R.A.F. at Tai Mo Shan and by the Chinese University at Ma Liu Shui.

The reports in Section 5 present a general description of the life history of each tropical cyclone affecting Hong Kong from formation to dissipation including:

- (a) how the tropical cyclone affected Hong Kong;
- (b) the sequence of display of tropical cyclone warning signals;

- (c) the maximum gust peak speeds and maximum winds recorded at various stations in Hong Kong;
- (d) the lowest barometric pressure recorded in Hong Kong;
- (e) the daily amount of rainfall recorded at the Royal Observatory; and
- (f) the times and heights of the highest tides and maximum storm surges recorded in Hong Kong.

Whenever practical, radar photographs and pictures received from weather satellites are included together with information and data* obtained from reconnaissance aircraft.

It has proved necessary to use different times in different contexts in this publication. The reference times of tropical cyclone warnings for shipping are given in G.M.T., records of meteorological observations are kept in standard time (G.M.T. +8 hours), while Local Time used is either standard time or summer time (G.M.T. + 9 hours). In 1976, summer time was in use from 3.30 a.m. (standard time) on 18 April until 3.30 a.m. (summer time) on 17 October.

The following convention is used in this publication:

- (a) Unlabelled times given in hours and minutes (e.g. 1454) on a 24-hour clock are in standard time;
- (b) Times expressed as a.m. or p.m. are in Hong Kong Local Time;
- (c) Times labelled 'G.M.T.' are in Greenwich Mean time.

Distances are generally given in international nautical miles (n mile), 1 international nautical mile being 1852 metres exactly. In order to shorten the text, the words 'international' and 'nautical' are usually omitted. The unit of speed is one international knot (kn), which is equal to 1.852 km/h or about 0.514 m/s.

* The data from reconnaissance aircraft were taken directly from eye-fix messages received operationally at the Royal Observatory, Hong Kong. No attempt has been made to convert the wind speeds into equivalent '10-minute mean winds' to make them comparable with reports from surface stations.

DESCRIPTION OF TABLES

Table 1 is a list of tropical cyclones in 1976 in the western North Pacific and the South China Sea (i.e. in the area bounded by the Equator, 45°N, 100°E and 160°E). The names of these tropical cyclones are those used by the U.S. Fleet Weather Central/Joint Typhoon Warning Center, Guam. The dates cited cover the period during which the track of each tropical cyclone lay within the above-stated region and may not necessarily represent its full life-span. This limitation applies to all other elements in the table.

Table 2 gives the number of tropical cyclone warnings for shipping issued by the Royal Observatory, Hong Kong in 1976, the duration of these warnings and the time of validity of the first and last warnings for all tropical cyclones in Hong Kong's area of responsibility (i.e., the area bounded by 10°N, 30°N 105°E and 125°E). Times are given in hours G.M.T.

Table 3 presents a summary of the occasions on which the tropical cyclone warning signals were hoisted during 1976. The sequence of the signals displayed and the number of tropical cyclone warning bulletins issued for each tropical cyclone are also given. Times are given in hours and minutes in standard time which is 8 hours ahead of G.M.T.

Table 4 presents a summary of the occasions on which the tropical cyclone warning signals were hoisted between 1946 and 1976. The Strong Wind Signal, No 3, was not introduced until 1956 and the Gale or Storm Signals 5, 6, 7 and 8 were renumbered as 8 NW, 8 SW, 8 NE and 8 SE respectively with effect from 1 January, 1973.

Table 5 gives the annual number of tropical cyclones in Hong Kong's area of responsibility between 1946 and 1976. The annual number of tropical cyclones which caused tropical cyclone warning signals to be raised in Hong Kong is also included.

Table 6 shows the maximum, mean and minimum duration of display of each tropical cyclone warning signal during the period 1946-1976.

Table 7 presents the casualties and damage figures associated with tropical cyclones in Hong Kong for the period 1937-1976. The information is compiled from local newspapers and from the Marine Department's records.

Table 8 contains the particulars of ships sunk, damaged, grounded, etc., by various tropical cyclones during the period 1974-1976. The information is compiled from local newspapers and from the Marine Department's records.

Table 9 presents the maximum storm surge (the excess, in metres, of the actual water level over that predicted in the Tide Tables) for each tropical cyclone affecting Hong Kong in 1976. Data on the nearest approach, the maximum winds at the Royal Observatory and Waglan Island, the minimum sea-level pressure and the total rainfall recorded at the Royal Observatory are also included together with an estimate of the minimum central pressure of each tropical cyclone during its closest approach.

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TROPICAL CYCLONE SUMMARIES FOR 1976

A total of twenty-seven tropical cyclones was reported over the western North Pacific and the South China Sea in the year 1976, and fourteen attained typhoon intensity. Of the five tropical cyclones which crossed the coast of China, one passed over Taiwan. Four tropical cyclones crossed the Philippines but none moved westwards across the South China Sea to affect Vietnam. Four tropical cyclones struck Japan while one skirted the southern coast of Korea. The monthly distribution of these tropical cyclones is shown in Figure 1 and a brief summary of their tracks is contained in Table 1. The monthly mean frequency of occurrence of tropical cyclones during the past thirty years 1947–1976 is given in Figure 2 for comparison.

During the year, there were less tropical cyclones than usual that passed within Hong Kong's area of responsibility for tropical cyclone warnings for shipping (i.e., the area bounded by 10°N, 30°N, 105°E and 125°E). Seven tropical cyclones entered this area while another three developed in it. Altogether 225 warnings for shipping were issued by the Royal Observatory, Hong Kong to warn these ten tropical cyclones. Two typhoons, two severe tropical storms and one tropical storm affected Hong Kong and resulted in the display of tropical cyclone warning signals. The total rainfall associated with tropical cyclones passing within 300 miles of Hong Kong during the year amounted to 1133.8 mm which was double the average figure and represented more than half of the annual total of 2197.2 mm. It was also the fourth consecutive year that Hong Kong has had an above average tropical cyclone rainfall. The wettest tropical cyclone was Tropical Storm Ellen in August, which brought a total rainfall of 516.1 mm to Hong Kong, the fourth highest on record since 1884 for any individual tropical cyclone. The driest tropical cyclone was Typhoon Ruby in June which produced less than 5 mm of rainfall at the Royal Observatory.

There were two tropical cyclones in January and the first tropical cyclone reported in the year was Typhoon Kathy which formed near the Caroline Islands on 28 January and dissipated over the Pacific to the northeast of Guam. A tropical depression developed to the east of Mindanao of the Philippines on 29 January and dissipated near the Caroline Islands.

Two tropical cyclones were reported in February. The tropical depression which formed on 8 February to the east of Mindanao moved northwestwards but dissipated without encountering land. Tropical Storm Lorna developed and dissipated near the Caroline Islands at the end of the month.

No tropical cyclones were detected in March. In April, two tropical cyclones were observed. Typhoon Marie developed near the Caroline Islands and dissipated east of the Ryukyu Islands. Tropical Storm Nancy formed near the Marshall Islands and dissipated west of Guam.

Two typhoons, Olga and Pamela, formed over the Pacific in May and caused widespread damage and severe flooding in the Philippines and in Guam respectively. Olga which originated as a low over the Pacific east of the Philippines was the first tropical cyclone to enter Hong Kong's area of responsibility in 1976. During 21–25 May, the typhoon crossed Luzon on a northwesterly track into the South China Sea and then changed course to move eastwards dissipating near the Ryukyu Islands. Pamela which formed near the Caroline Islands on 15 May passed directly over Guam and became extratropical to the east of Japan.

There were two tropical cyclones over the western North Pacific in June. Typhoon Ruby was the first tropical cyclone in the year for which tropical cyclone warning signals were in display in Hong Kong. Ruby formed east of the Philippines on 22 June and moved northwestwards across Luzon into the South China Sea. When it came near to Pratas Island, it recurved and passed south of Taiwan, subsequently dissipating over the Pacific east of Japan. Typhoon Sally formed south of Guam and became extratropical to the east of Japan.

Among the four tropical cyclones that developed in July, only one affected Hong Kong while the other three struck western Japan during the week 18–25 July and gave rise to widespread damage and flooding in Kyushu. Severe Tropical Storm Violet formed over the central part of the South China Sea on 20 July and moved northwestwards. The typhoon turned abruptly northeastwards when coming near to Hainan Island, but it changed course to move northwestwards again when centred about 100 miles southwest of Hong Kong, and subsequently degenerated into an area of low pressure over west Kwangtung.

In August, four tropical cyclones were observed. Typhoon Billie brought widespread damage to Taiwan and crossed the coast of east China near Amoy. Tropical Storm Dot passed to the east of Shanghai and dissipated over the Sea of Japan after skirting the coast of South Korea. Both Severe Tropical Storm Clara and Tropical Storm Ellen came within 100 miles of Hong Kong and caused strong to gale force winds and heavy rain over the territory. The rainstorms in the wake of Ellen gave rise to disastrous landslips in Hong Kong and altogether twenty seven people were killed.

A total of five tropical cyclones developed in September over the western North Pacific and the South China Sea, but only Typhoon Iris affected Hong Kong. Although sustained gales were experienced, the damage to property in Hong Kong was slight. Typhoon Fran caused torrential rain and severe flooding in Japan, particularly in Kyushu. About 163 people were killed and more than 300,000 people were made homeless. The total cost of

damage to property amounted to more than US\$660 million. Tropical Storm Georgia dissipated over the Pacific to the east of the Philippines while both Typhoon Hope and Typhoon Joan moved generally northwards after their formation and became extratropical to the east of Japan.

Only one tropical cyclone was reported in each month of October and November. Tropical Storm Louise became extratropical over the Pacific to the east of Japan while Severe Tropical Storm Marge dissipated near the Ryukyu Islands.

There were two tropical cyclones in December. Tropical Storm Nora dissipated over the Philippines after claiming at least 25 lives and causing some serious landslips. Tropical Storm Opal formed and dissipated to the east of Luzon.

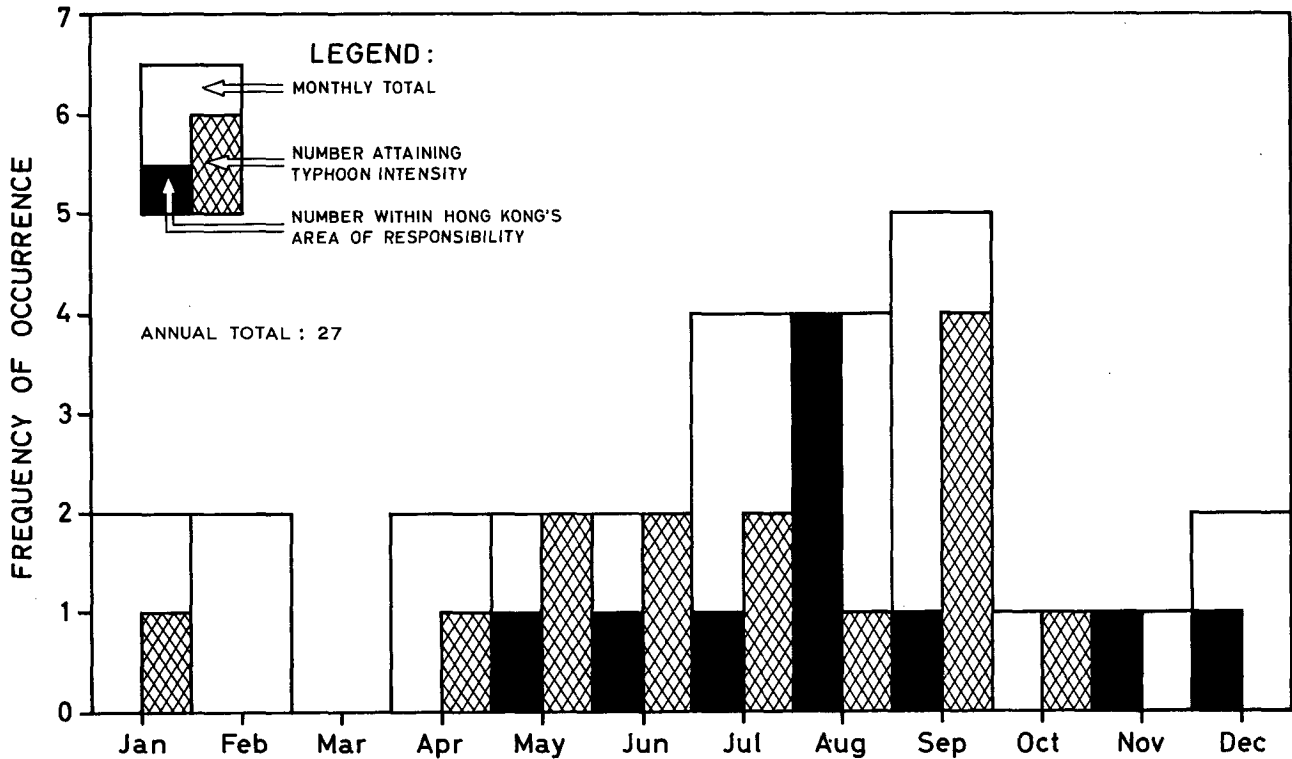


Figure 1. Monthly distribution of the frequency of occurrence of tropical cyclones and typhoons in the western North Pacific and the South China Sea in 1976 (classified in accordance with the month of the first day circle of each track)

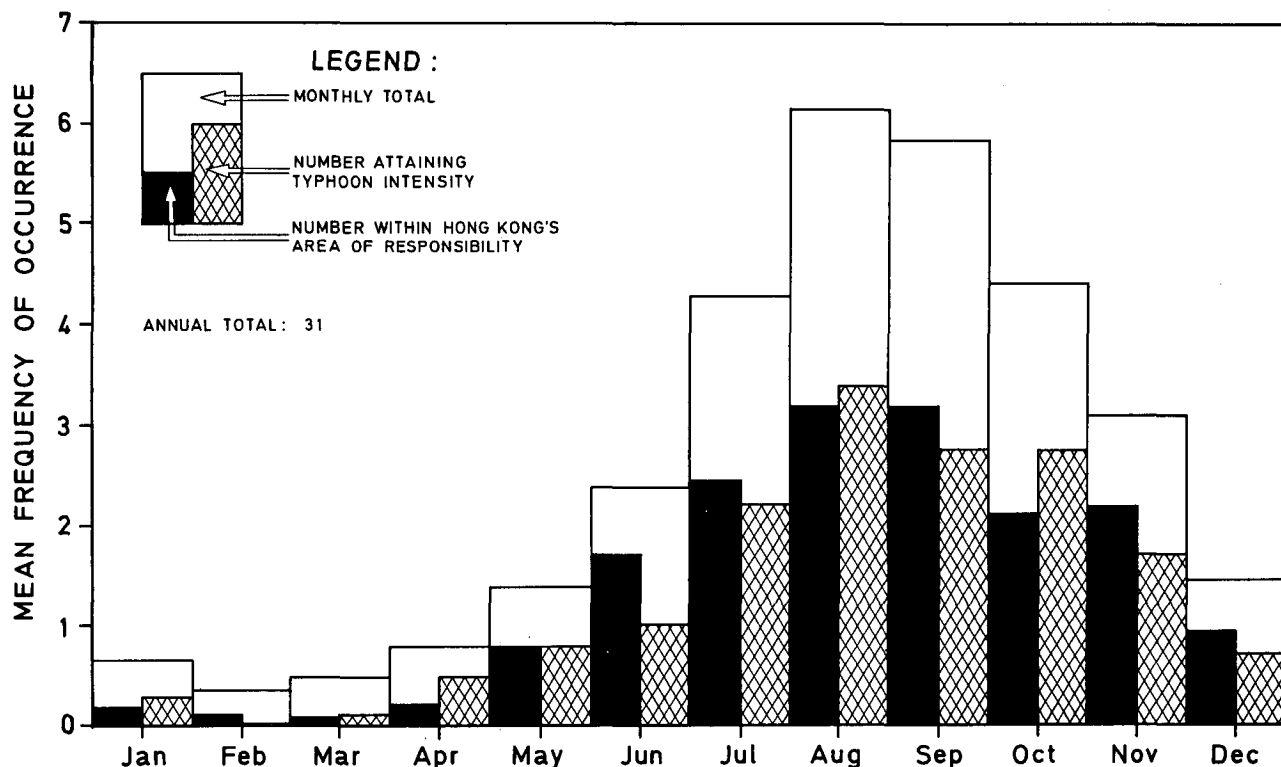


Figure 2. Monthly distribution of the mean frequency of occurrence of tropical cyclones and typhoons in the western North Pacific and the South China Sea, 1947-1976 (classified in accordance with the month of the first day circle of each track)

REPORTS ON TROPICAL CYCLONES AFFECTING HONG KONG IN 1976

TYPHOON RUBY

22 June-4 July 1976

The track of this typhoon is shown in Figure 3

Typhoon Ruby was first located as a tropical depression over the western North Pacific to the east of the southern Philippines on 22 June 1976. It moved westwards at about 8 knots and intensified to a tropical storm near the east coast of Luzon on 23 June when it changed to a northwesterly course. It attained typhoon intensity early the following day. At 6.00 a.m. on 25 June, a reconnaissance aircraft reported that the maximum surface winds near the centre of Ruby had reached 80 knots. Satellite pictures received at the Royal Observatory on the same morning indicated that there was an extensive cloud mass in the southwest quadrant of the typhoon (Figure 4) and the maximum winds near its centre were estimated to be about 77 knots.

On 25 June Ruby weakened into a severe tropical storm as it crossed the mountains of north Luzon into the South China Sea. At 9.30 a.m. on 26 June, a reconnaissance aircraft reported winds of only 40 knots near the centre of Ruby. As Ruby continued to move northwestwards in the general direction towards Hong Kong, the Stand

By Signal, No. 1, was hoisted at 10.30 a.m. on 26 June when the centre was about 320 miles away. The Stand By Signal was replaced by the Strong Wind Signal, No. 3, at 9.30 p.m. on the same day when Ruby was centred about 270 miles to the southeast of Hong Kong.

The severe tropical storm slowed down during the evening of 26 June and throughout the following day it remained almost stationary near Pratas Island where maximum winds of 34 knots and minimum sea-level pressure of 984.2 millibars were reported. In Hong Kong, the lowest mean sea-level pressure was 996.8 millibars recorded at Cheung Chau at 6.00 p.m. on 27 June. The presence of a ridge at 850 and 700 millibar levels north of Ruby prevented its northward movement, and possibly due to the Fujiwara effect with Typhoon Sally (Figure 5), Ruby drifted eastwards into the Bashi Channel.

Ruby regained typhoon intensity on the morning of 28 June when it drifted to the east of Pratas Island. Winds of 60 knots were reported by a ship about 65 miles northeast of the typhoon centre. Satellite pictures received at the Royal Observatory on the same morning revealed that the typhoon had a very large eye about 60 miles in diameter and there were very few spiral cloud bands in its northwest quadrant (Figure 6). The maximum winds estimated near its centre were about 90 knots. The Strong Wind Signal was replaced by the Stand By Signal at 9.40 a.m. on 28 June when Ruby was centred about 230 miles to the east-southeast and the danger of persistent strong winds in Hong Kong receded.

The typhoon continued to move slowly eastward through the Bashi Channel and all signals were lowered at 7.15 a.m. on 29 June when Ruby was centred about 320 miles east-southeast of Hong Kong. Ruby changed to a northeasterly course the next morning and after passing to the east of the Ryukyu Islands on 2 July, it became extratropical to the east of Japan on 4 July.

In Hong Kong, winds were generally moderate to fresh easterly on 26 June and became strong and gusty during the same evening. Winds gradually turned to northerly overnight and moderated slowly the following day. The maximum winds and maximum gusts recorded at various locations were as follows:—

<i>Location</i>	<i>Maximum mean hourly wind in points and knots</i>		<i>Maximum gust in points and knots</i>	
Royal Observatory	ENE	21	ENE	40
Hong Kong Airport (SE)	E	24	E	40
Hong Kong Airport (NW)	E	19	E	44
Waglan Island	ENE	32	ENE	43
Tate's Cairn	NNE	27	ENE	46
Cheung Chau	E	22	E	35
King's Park	E	19	E	35
Star Ferry	E	25	E	39
Green Island	ENE	31	ENE	45
Tsim Bei Tsui	E	16	ESE	31
Tai O	NNE	16	NE	37
Cape D'Aguilar	—	20	—	30

The weather was fine and very hot on 26 June but became cloudy with scattered showers in the evening and the following day. However, Ruby did not bring much rain to Hong Kong and the weather was once again fine and very hot on 28 and 29 June although some isolated showers and thunderstorms were still reported on the evening of 29 June. Maximum temperatures of 36.5°C were reported at Tai O on 26 June and 35.1°C at Cheung Chau on 29 June respectively.

The following amounts of rainfall were recorded at the Royal Observatory:

26 June	Nil
27 June	1.1 mm
28 June	Nil
29 June	3.2 mm
Total:	4.3 mm

During the passage of Ruby, the strong currents and waves in the beaches and waterfront caused the death of three people with two missing and another two hospitalized. There was some interruption in sea traffic, but there were no reports of damage to property.

The times and heights of the highest tides and maximum storm surges recorded at various locations in Hong Kong during the display of tropical cyclone warning signals were as follows:

Location	Highest Tide Above Chart Datum			Maximum Storm Surge Above Predicted Level		
	Height (m)	Date	Time	Height (m)	Date	Time
North Point	2.6	28 Jun.	10.10 a.m.	0.6	27 Jun.	12.30 p.m.
Tai Po Kau	2.6	28 Jun.	11.30 a.m.	0.8	27 Jun.	6.30 a.m.
Chi Ma Wan (Lantau Island)	2.7	28 Jun.	10.45 a.m.	0.7	26 Jun.	midnight

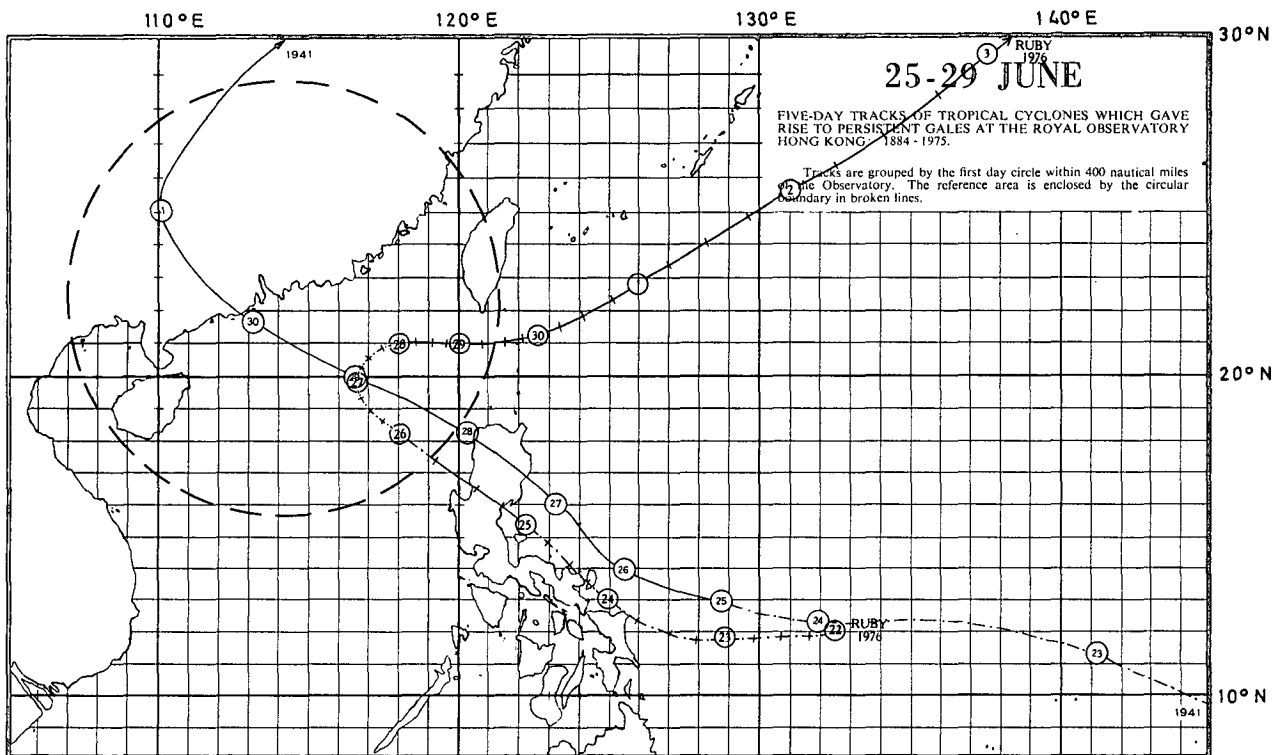


Figure 3. Track of Typhoon Ruby: 22 June-4 July 1976

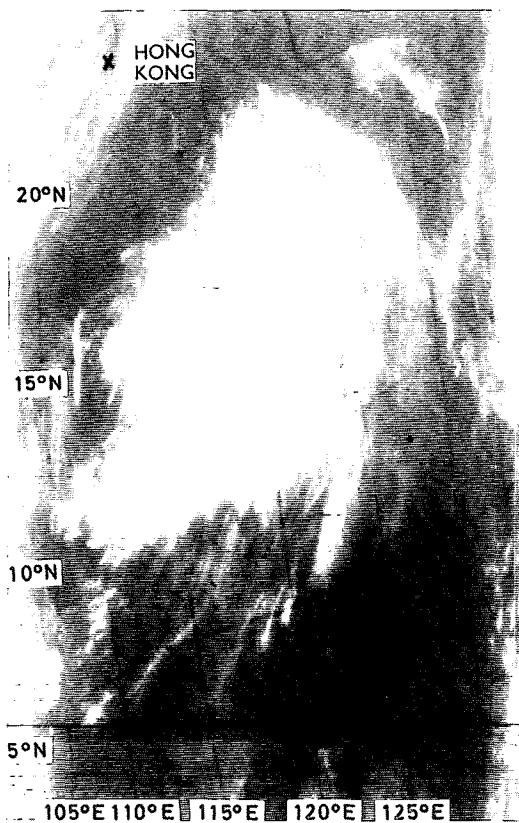


Figure 4. NOAA-4 APT picture of Typhoon Ruby taken from 9.37 a.m. to 9.45 a.m. on 25 June 1976

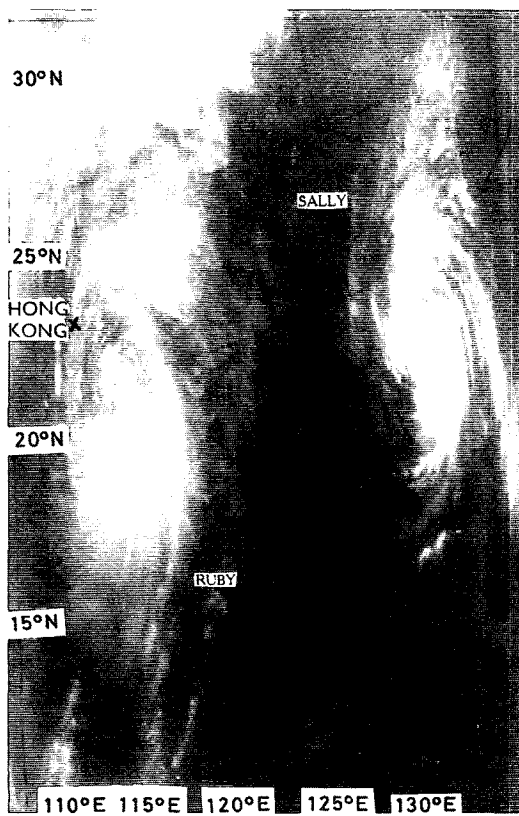


Figure 5. NOAA-4 APT picture of Typhoon Ruby taken from 9.30 a.m. to 9.38 a.m. on 27 June 1976

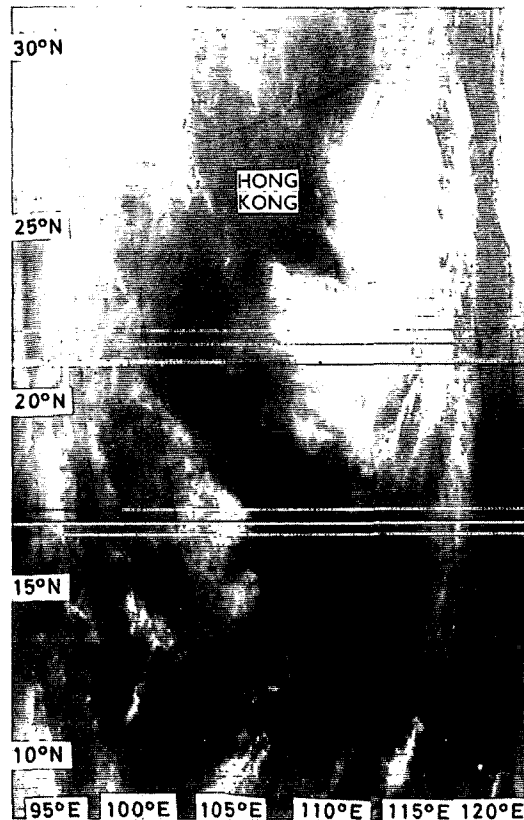


Figure 6. NOAA-4 APT picture of Typhoon Ruby taken from 10.25 a.m. to 10.33 a.m. on 28 June 1976

SEVERE TROPICAL STORM VIOLET

20-26 July 1976

The track of this severe tropical storm is shown in Figure 7

On 20 July, a tropical depression developed over the central part of the South China Sea about 250 miles west of Manila and moved northwestwards at about seven knots towards the south China coast to the west of Hong Kong. Satellite pictures received at the Royal Observatory the next evening indicated that the depression had intensified into a tropical storm and maximum surface winds were estimated to be about 40 knots near its centre (Figure 8). In Hong Kong, the Stand By Signal, No. 1, was hoisted at 11.30 p.m. on 21 July when Tropical Storm Violet was centred about 300 miles to the south.

Violet changed to a westerly course on the morning of 22 July and headed towards Hainan Island. However, when it reached a position about 60 miles off the eastern coast of the island, it changed course again and moved slowly north-northwestwards. After skirting the northeastern tip of Hainan Island late on 23 July, Violet changed its direction of movement abruptly and by the next evening, it was moving northeastwards at about four knots towards the Pearl River Estuary.

Satellite pictures received at the Royal Observatory on the morning of 24 July indicated that Violet was well organized with Hong Kong just within its circulation (Figure 9). Radar observations at the Royal Observatory during the same afternoon also indicated an extensive area of rain associated with the storm (Figure 10). At 7.00 p.m., Violet was upgraded to a severe tropical storm when it was centred about 200 miles southwest of

Hong Kong. Its eye was then well defined on the radar and maximum winds were estimated to be about 55 knots near its centre (Figure 11). Satellite pictures received at the Royal Observatory in the evening also indicated that there were well organized spiral cloud bands associated with the circulation and confirmed the maximum winds estimated from the radar observations (Figure 12). At 11.00 p.m. on 24 July the Stand By Signal was replaced by the Strong Wind Signal, No. 3, when Violet was centred about 180 miles southwest of Hong Kong and was moving northeastwards at about 4 knots.

Some unusual aspects of Violet were detected on the Royal Observatory's radar on 25 July, especially during the afternoon. The radar indicated that there were intense rainbands in the southwest sector of the storm but the northeast sector was free from rain (Figure 13) and even the near side of the eye wall was not discernible unless the aerial was elevated 2°. However, to the east of Hong Kong, an extensive area of rain orientated approximately north to south was observed moving towards the northeast.

Violet changed its course again during the afternoon of 25 July and headed northwestwards at about 7 knots towards west Kwangtung. The mean sea-level pressure in Hong Kong dropped to a minimum of 995.3 millibars at 7.00 p.m. At 9.00 p.m. on the same day, the centre passed about 35 miles to the south of St. John's Island where winds of 46 knots with gusts up to 66 knots and a mean sea-level pressure of 984.9 millibars were reported. As it crossed the coast a pressure of 984.8 millibars was also reported. According to newspapers, a passenger on an incoming flight from Kuala Lumpur around this time had a clear view of the eye of Violet. He said that Violet had a big black eye with a white rim encircling it. This unusual sighting might be attributable to the unusual structure of the storm mentioned in the previous paragraph. Violet crossed the coast of south China about 150 miles west-southwest of Hong Kong early on the morning of 26 July and then gradually degenerated into an area of low pressure within the following 24 hours. In Hong Kong, all signals were lowered at 9.30 a.m. on 26 July when Violet was centred overland about 160 miles west-southwest of Hong Kong.

Moderate to fresh gusty easterly winds prevailed in Hong Kong on 23 and 24 July. Winds gradually increased in strength overnight and became strong throughout 25 July and during the following morning. Shortly after midday on 26 July, winds began to subside and remained moderate or fresh southeasterly during the rest of the day. The maximum winds and maximum gusts recorded at various locations were as follows:

<i>Location</i>	<i>Maximum mean hourly wind in points and knots</i>		<i>Maximum gust in points and knots</i>	
Royal Observatory	E	24	E	42
Hong Kong Airport (SE)	ESE	28	ESE	45
Hong Kong Airport (NW)	ESE	24	E	46
Waglan Island	ESE	30	E	46
Tate's Cairn	S	33	S	58
Cheung Chau	SE	33	SE	52
King's Park	ESE	23	ESE	43
Star Ferry	ESE	27	ESE	46
Green Island	SE	32	SE	47
Tsim Bei Tsui	E	23	SSE	43
Tai O	ESE	32	SE	47
Cape D'Aguilar	—	20	—	32
Castle Peak	SE	21	SSE	48

Although Violet did not cause sustained gales in Hong Kong, it brought much rain to our territory and is one of the wettest tropical cyclones during the past thirty years. The following amounts of rainfall were recorded at the Royal Observatory:

21 July	Nil
22 July	13.6 mm
23 July	4.3 mm
24 July	105.9 mm
25 July	49.0 mm
26 July	61.6 mm
27 July	55.2 mm
28 July	25.2 mm
29 July	11.4 mm
Total:	326.2 mm

During the passage of Violet, damage was slight in Hong Kong. Two huts were destroyed and some trees were blown down in the western part of the territory. There was also some minor flooding. Three swimmers were washed out to sea by big waves on 24 July and two of them were drowned while one is still missing. Violet did not disrupt flights but ferry services to Macau and the outlying islands and from the Central to Mei Foo Sun Chuen were all suspended on the afternoon of 25 July. More than 3000 Hong Kong residents were stranded in Macau during the weekend.

The times and heights of the highest tides and maximum storm surges recorded at various locations in Hong Kong during the display of tropical cyclone warning signals were as follows:

Location	Highest Tide Above Chart Datum			Maximum Storm Surge Above Predicted Level		
	Height (m)	Date	Time	Height (m)	Date	Time
North Point	2.5	26 Jul.	8.45 a.m.	0.5	24 Jul.	midnight
Tai Po Kau	2.6	26 Jul.	7.00 a.m.	0.7	26 Jul.	2.00 p.m.
Chi Ma Wan (Lantau Island)	2.7	26 Jul.	8.15 a.m.	0.8	26 Jul.	7.15 p.m.

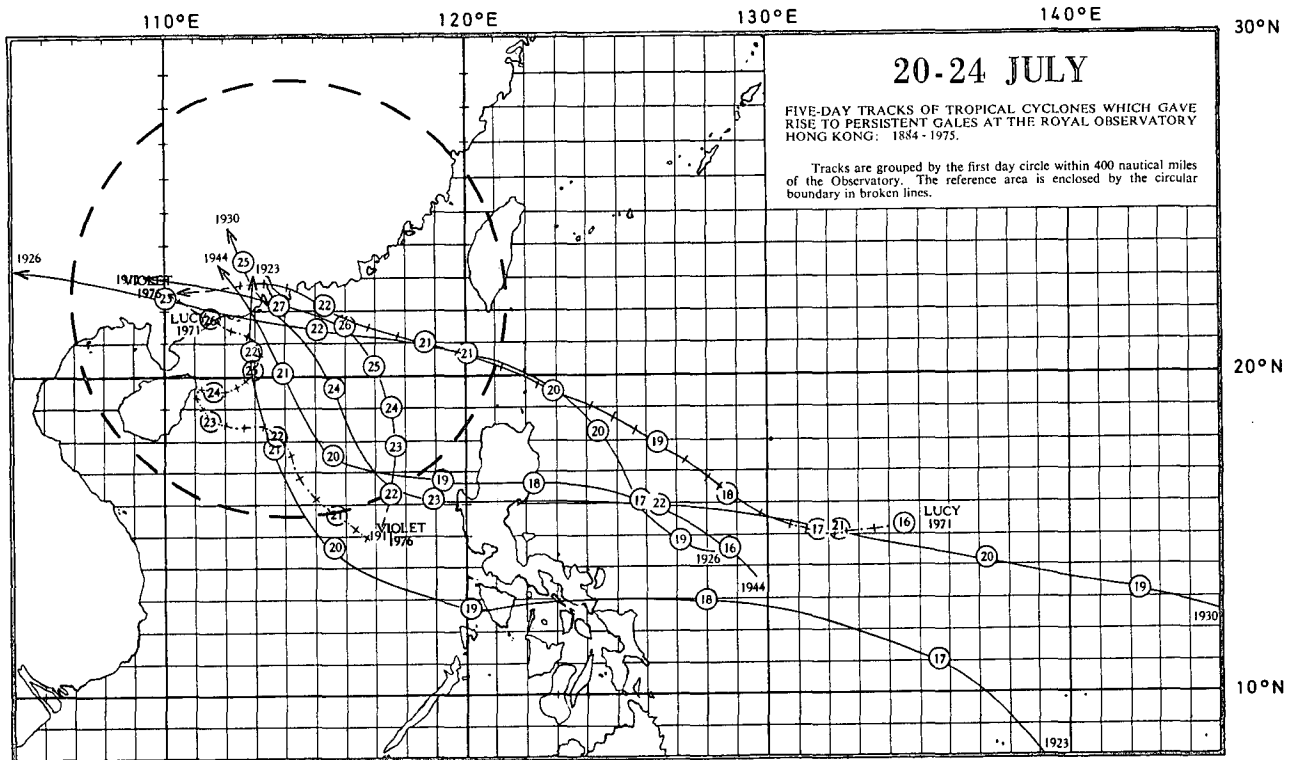


Figure 7. Track of Severe Tropical Storm Violet: 20-26 July 1976

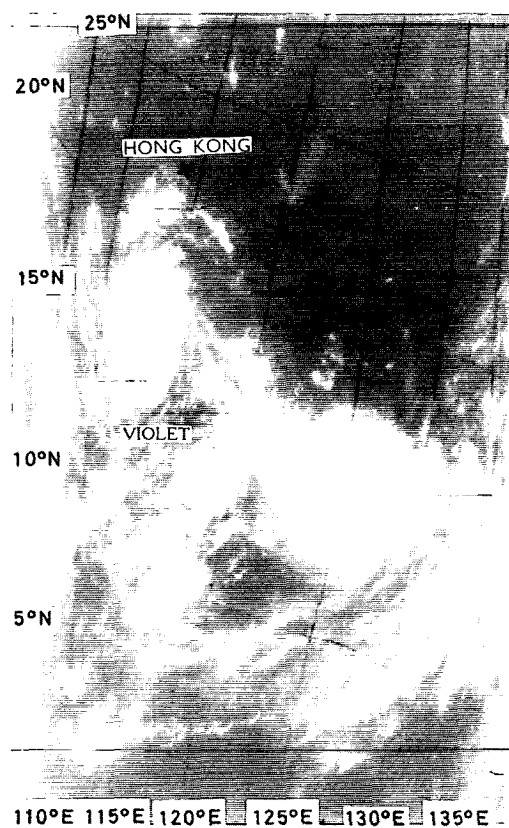


Figure 8. NOAA-4 APT picture of Severe Tropical Storm Violet taken from 9.09 p.m. to 9.17 p.m. on 21 July 1976

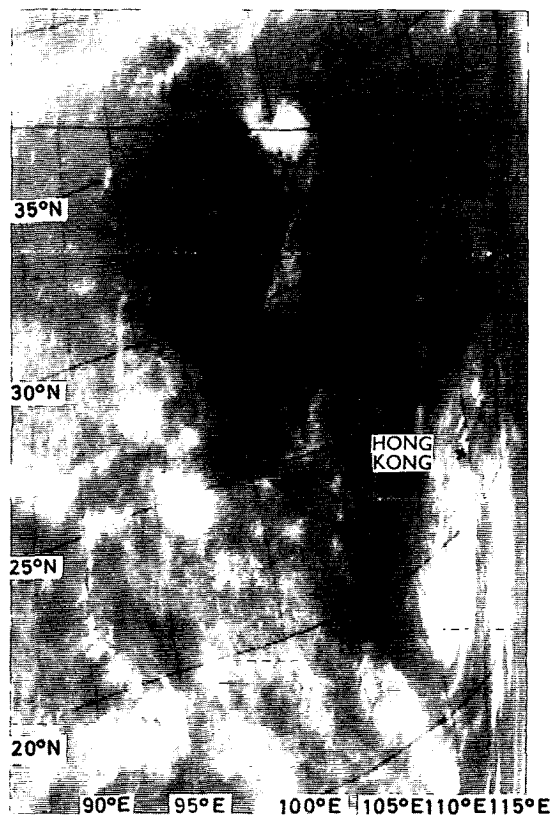


Figure 9. NOAA-4 APT picture of Severe Tropical Storm Violet taken from 11.12 a.m. to 11.20 a.m. on 24 July 1976

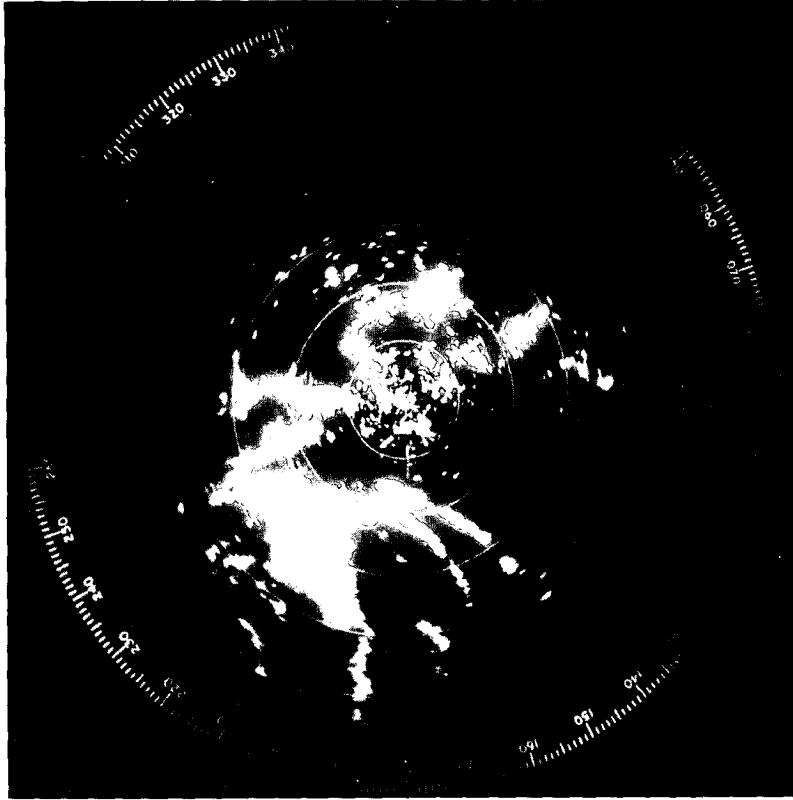


Figure 10. Radar picture of Severe Tropical Storm Violet taken at 6.10 p.m. on 24 July 1976 (Range markers at 40-mile intervals)

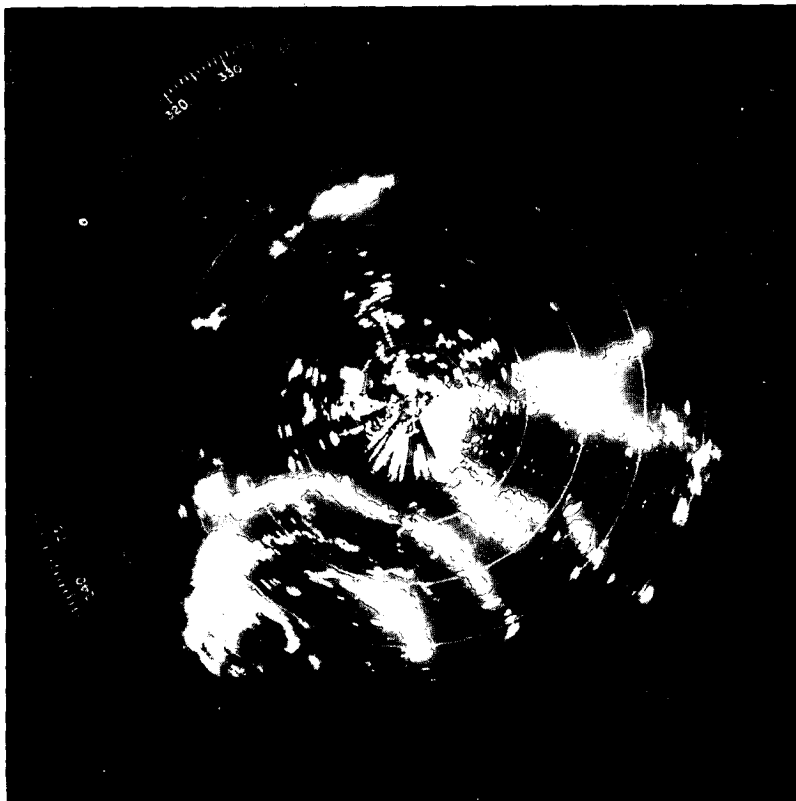


Figure 11. Radar picture of Severe Tropical Storm Violet taken at 9.00 p.m. on 24 July 1976 (Range markers at 40-mile intervals)

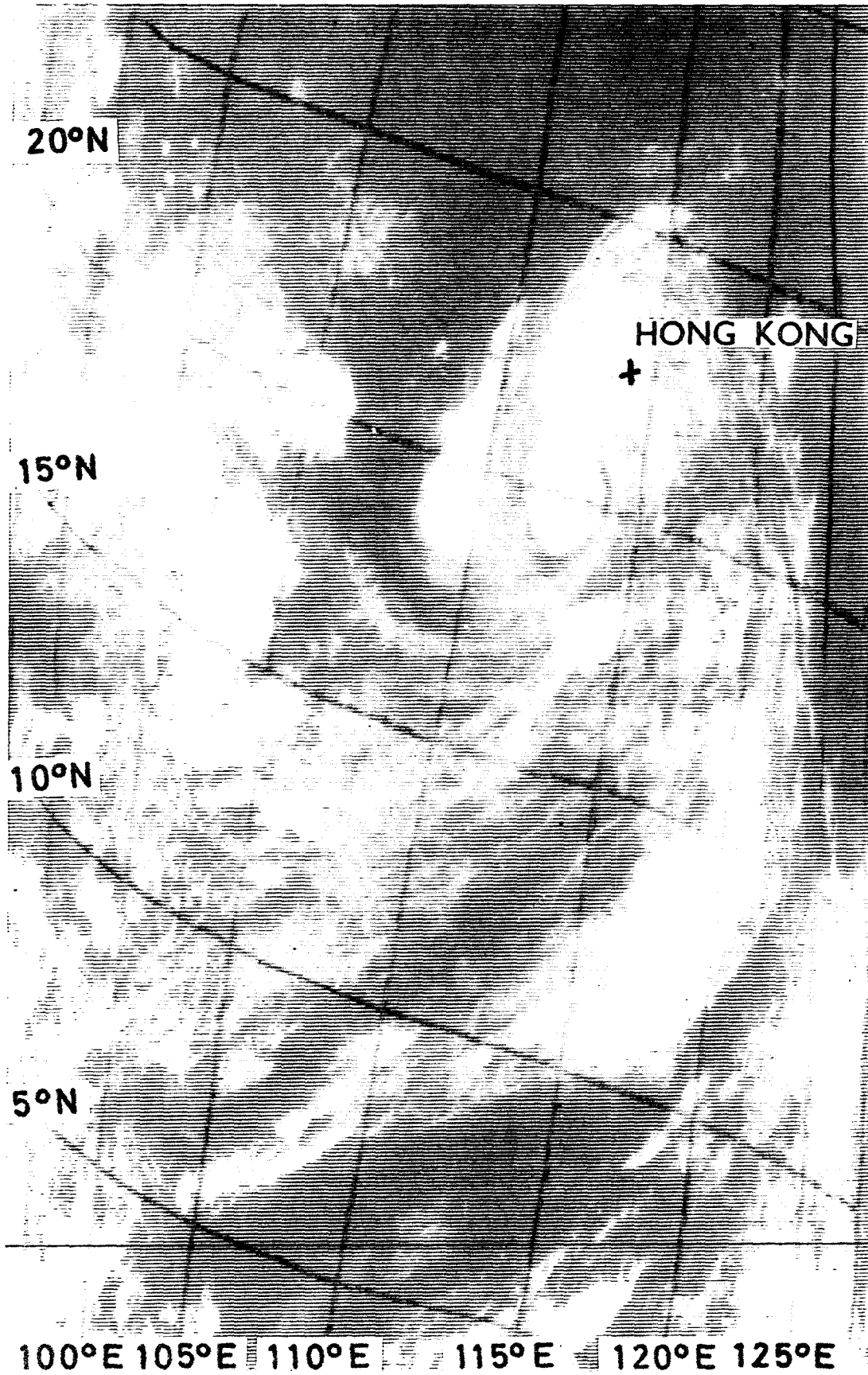


Figure 12. NOAA-4 APT picture of Severe Tropical Storm Violet taken from 10.00 p.m. to 10.08 p.m. on 24 July 1976



Figure 13. Radar picture of Severe Tropical Storm Violet taken at 9.13 a.m. on 25 July 1976 (Range markers at 40-mile intervals)

SEVERE TROPICAL STORM CLARA

5-7 August 1976

The track of this severe tropical storm is shown in Figure 14

Severe Tropical Storm Clara first developed as a tropical depression over the northern part of the South China Sea about 200 miles south of Hong Kong early on 5 August and moved northwards at about four knots towards the Pearl River Estuary. In Hong Kong, the Stand By Signal, No. 1, was hoisted at 11.00 a.m. on the same day when the depression was centred about 180 miles to the south. The upper air soundings at the Paracel Islands indicated that strong southwesterlies were feeding into the depression, and convergence of air took place from surface all the way up to the 300-millibar level. Clara intensified to a tropical storm later in the afternoon when a ship near its centre reported winds of 37 knots and a mean sea-level pressure of 990.3 millibars. Satellite pictures received at the Royal Observatory later the same evening indicated that there were well organized spiral cloud bands associated with Clara's circulation and maximum winds were estimated to be about 55 knots near the centre (Figure 15). The Royal Observatory radar also revealed that the circulation of the tropical storm was well defined and that it was coming closer to Hong Kong (Figure 16). The Stand By Signal was therefore replaced by the Strong Wind Signal, No. 3, at 11.30 p.m. on 5 August when Clara was about 130 miles south of Hong Kong.

During the night of 5 August, Clara further intensified to a severe tropical storm and gradually changed to a north-northwesterly course. It was heading towards St. John's Island but still getting closer to Hong Kong. Clara maintained its strength as a severe tropical storm as revealed by satellite pictures received at the Royal Observatory on the morning of 6 August (Figure 17). During the afternoon, winds in Hong Kong were strong and gusty and gales were reported by a ship only 50 miles away to the southeast. The Strong Wind Signal was replaced by the No. 8 SOUTHEAST Gale or Storm Signal at 4.20 p.m. on 6 August when Clara was centred about 75 miles south-southwest of Hong Kong. The sea-level pressure in Hong Kong fell steadily to a minimum of 996.8 millibars recorded at Cheung Chau around 5 p.m.

At 9.00 p.m. when Clara was about 70 miles southwest of Hong Kong, St. John's Island reported winds of 40 knots with gusts of 58 knots and a mean sea-level pressure of 990.7 millibars. During the evening Clara weakened considerably and maximum winds estimated from satellite pictures were only about 45 knots (Figure 18). Clara crossed the coast 80 miles west-southwest of Hong Kong around 11.00 p.m. and dissipated rapidly overland. In Hong Kong all signals were lowered at 4.00 a.m. on 7 August when Clara was centred about 140 miles to the west.

In Hong Kong winds were moderate easterly on 5 August but gradually increased in strength becoming strong overnight. On the following evening they turned to southeasterly and gales were reported at times mainly in the western parts of the territory. Winds dropped rapidly later in the night and were moderate by morning. The maximum winds and maximum gusts recorded at various locations were as follows:—

<i>Location</i>	<i>Maximum mean hourly wind</i>		<i>Maximum gust</i>	
	<i>in points and knots</i>		<i>in points and knots</i>	
Royal Observatory	E	19	ENE	41
Hong Kong Airport (SE)	E	26	E	54
Hong Kong Airport (NW)	ESE	23	ESE	45
Waglan Island	E	35	E	45
Tate's Cairn	E	33	E	56
Cheung Chau	SE	37	SE	49
King's Park	ESE	25	ESE	42
Star Ferry	E	28	E	44
Green Island	ENE	33	ESE	52
Tsim Bei Tsui	SE	24	SSE	38
Tai O	SE	31	SE	51
Cape D'Aguiar	—	23	—	33
Castle Peak	SE	20	SE	50

The weather was cloudy with scattered showers on 5 August but deteriorated overnight. Frequent heavy and squally showers persisted until the early morning of 7 August. The weather improved rapidly on that day and long sunny periods were experienced in the afternoon.

The following amounts of rainfall were recorded at the Royal Observatory:

5 August	12.9 mm
6 August	69.5 mm
7 August	34.0 mm
Total:	116.4 mm

Damage was slight in Hong Kong and no flooding was reported. Four people were injured by flying glass. Eight incoming and six outgoing scheduled flights were cancelled. Ferry services to Macau were suspended after 5.00 p.m. on 6 August. Ferries to outlying islands and minibuses to Po Shan Road and the Peak were suspended during the evening and bus and tram services were reduced.

The times and heights of the highest tides and maximum storm surges recorded at various locations in Hong Kong during the passage of Clara were as follows:

Location	Highest Tide Above Chart Datum			Maximum Storm Surge Above Predicted Level		
	Height (m)	Date	Time	Height (m)	Date	Time
North Point	2.3	6 Aug.	6.30 a.m.	0.4	6 Aug.	10.00 a.m.
Tai Po Kau	2.3	6 Aug.	4.00 a.m.	0.5	6 Aug.	3.00 a.m.
Chi Ma Wan (Lantau Island)	2.4	6 Aug.	6.00 a.m.	0.5	6 Aug.	4.15 a.m.

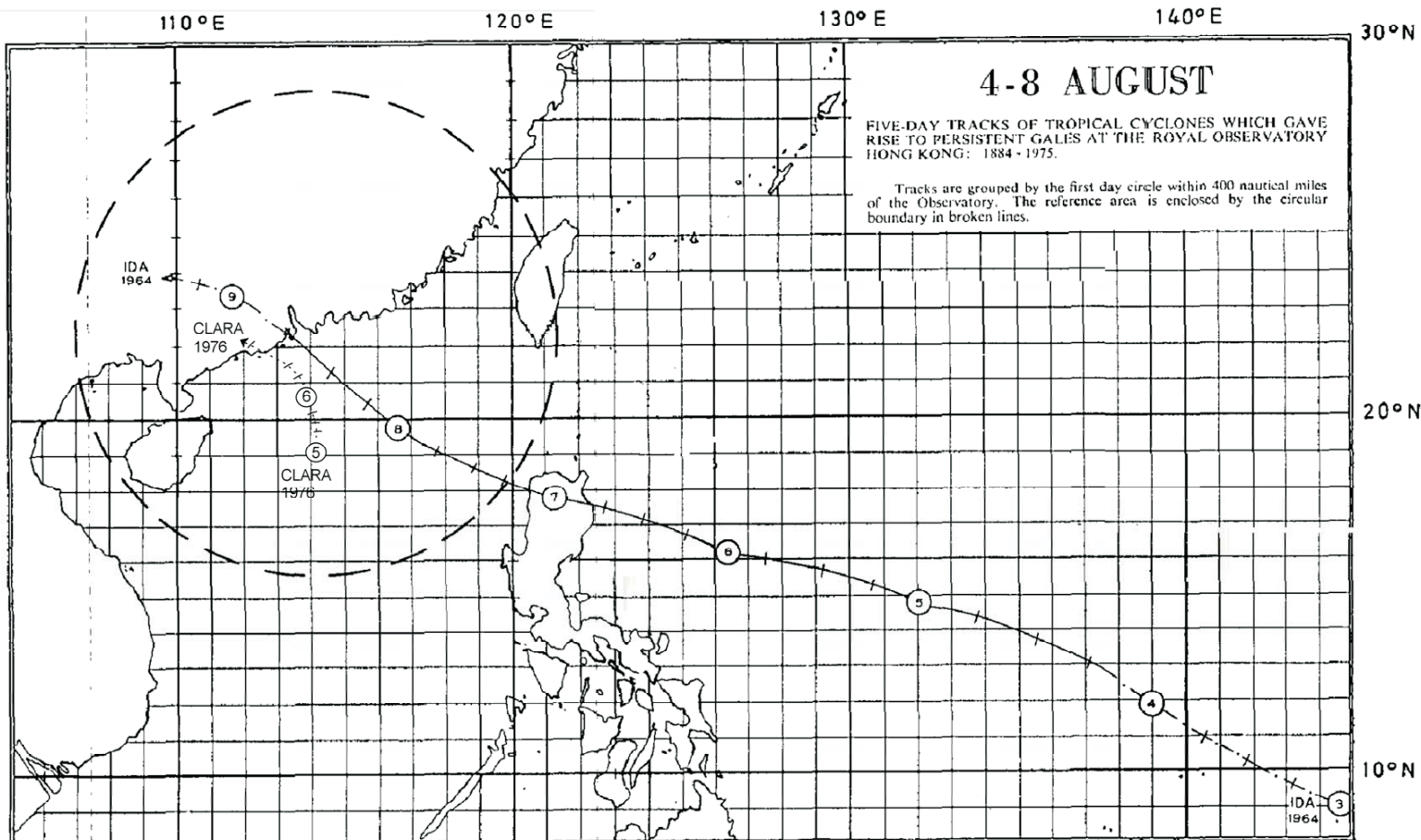


Figure 14. Track of Severe Tropical Storm Clara: 5-7 August, 1976

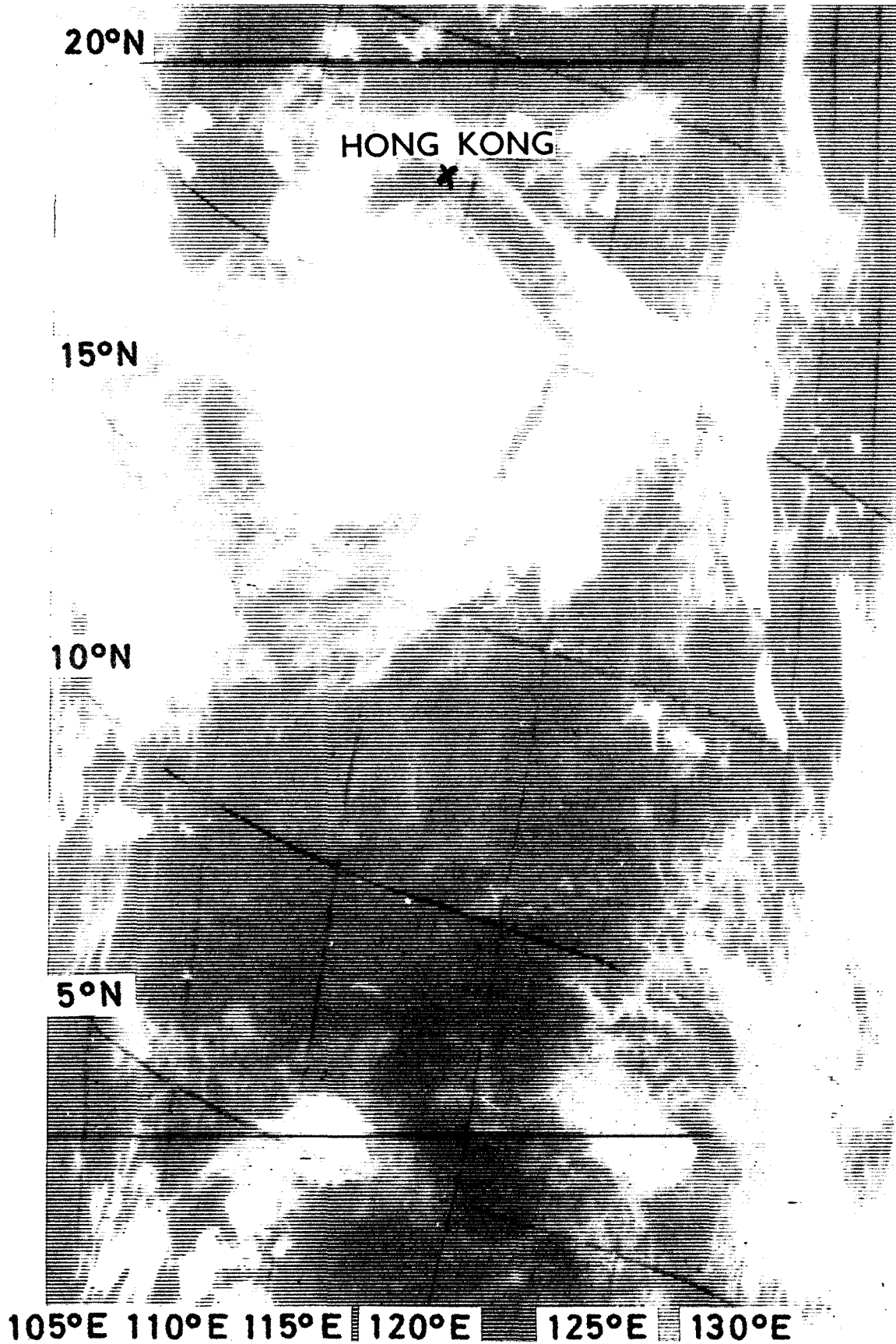


Figure 15. NOAA-4 APT picture of Severe Tropical Storm Clara taken from 9.29 p.m. to 9.37 p.m. on 5 August 1976

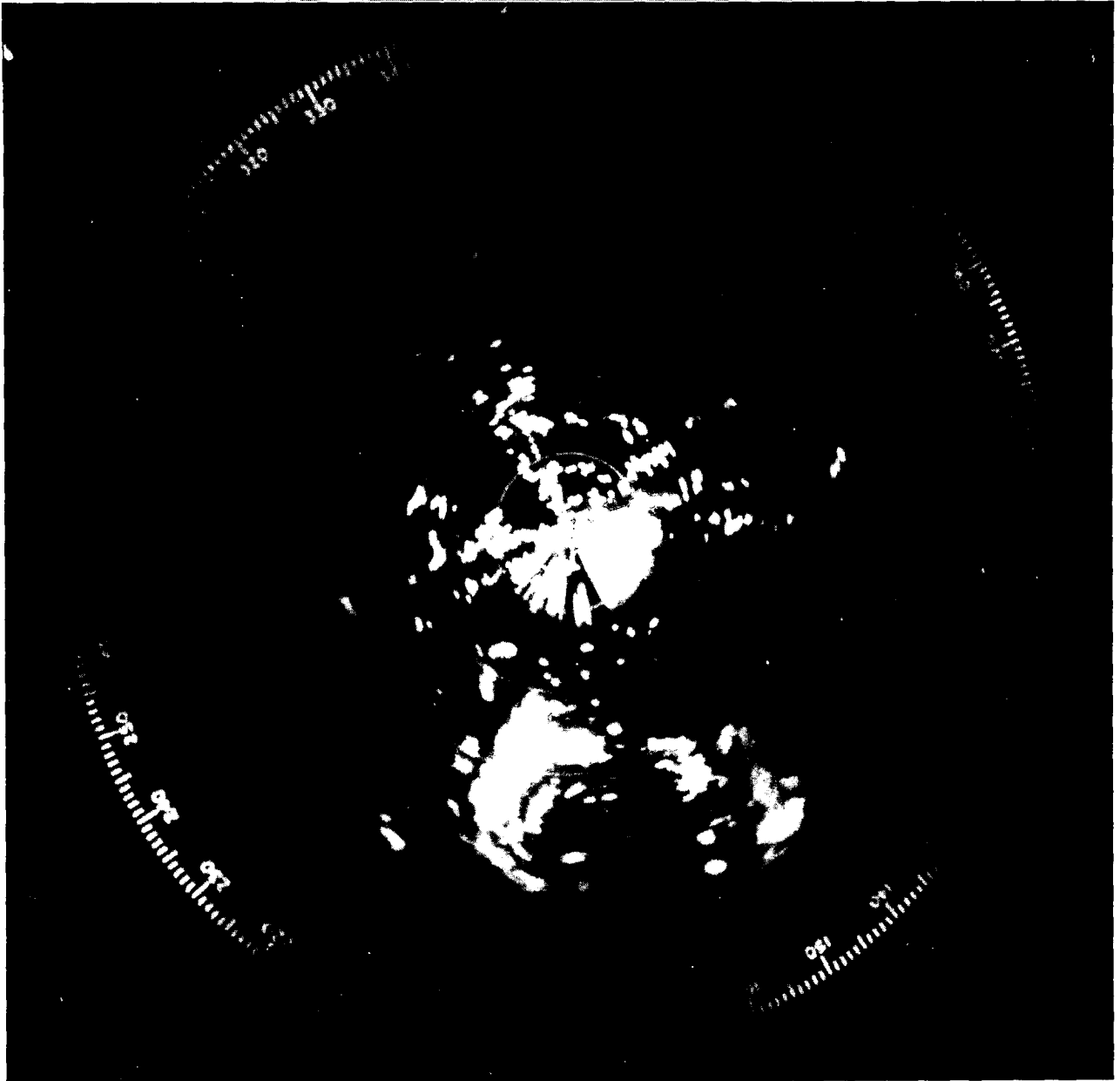


Figure 16. Radar picture of Severe Tropical Storm Clara taken at 9.12 p.m. on 5 August 1976 (Range markers at 40-mile intervals)

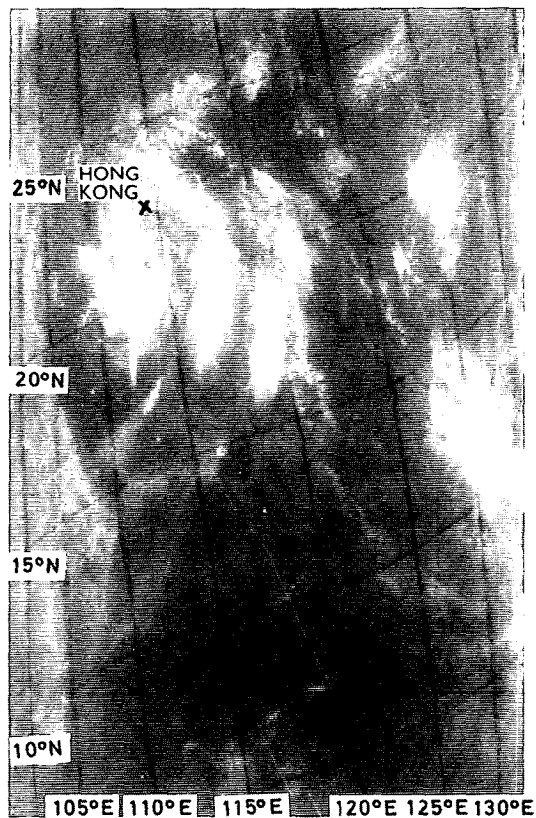


Figure 17. NOAA-4 APT picture of Severe Tropical Storm Clara taken from 9.48 a.m. to 9.56 a.m. on 6 August 1976

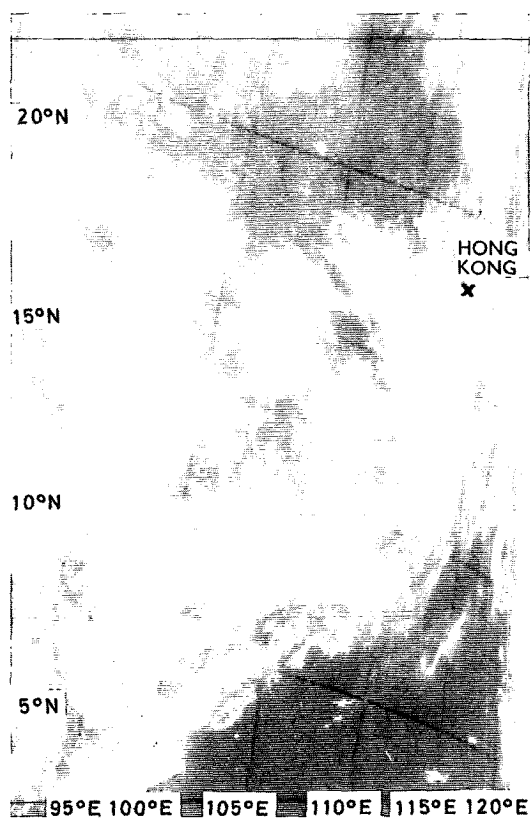


Figure 18. NOAA-4 APT picture of Severe Tropical Storm Clara taken from 10.25 p.m. to 10.33 p.m. on 6 August 1976

TROPICAL STORM ELLEN

20-25 August 1976

The track of this tropical storm is shown in Figure 19

Although the circulation of Tropical Storm Ellen was never very well organized and did not cause sustained gales in Hong Kong, the violent thunderstorms and heavy rain that developed after it had moved inland across the south China coast were the most intense since 19 July 1926.

A disturbance was first located from satellite pictures on the morning of 20 August about 870 miles east of Manila (Figure 20). Maximum winds were estimated to be about 30 knots. On 21 August, it intensified to a tropical storm as it moved northwestwards at the unusually high speed of 14 knots. At 11.49 a.m. on 22 August, a reconnaissance aircraft reported a minimum sea-level pressure of 999 millibars at its centre and the maximum surface winds were estimated to be about 35 knots. During the afternoon, Ellen crossed the northern tip of Luzon Island and entered the South China Sea around midnight.

On 23 August, Ellen intensified slightly (Figure 21) and the Stand By Signal, No. 1, was hoisted in Hong Kong at 10.25 a.m. Although there was still no wall cloud and 'eye' discernible on the Royal Observatory's radarscope, a reconnaissance aircraft at 11.45 a.m. estimated that the maximum winds were around 60 knots. During the evening, however, the centre passed very close to Pratas Island where maximum winds of only 34 knots and a minimum pressure of 992.8 millibars were reported.

The Strong Wind Signal, No. 3, was hoisted at 10.45 p.m. when the centre was about 190 miles southeast of Hong Kong. It continued to move northwestwards at about 10 knots and the strongest wind reported was by a ship about 50 miles east-southeast of Hong Kong, which reported westerly winds of 46 knots at 6 a.m. on 24 August when Hong Kong recorded a minimum sea-level pressure of 995.1 millibars at Waglan Island. Tropical Storm Ellen crossed the south China coast about 65 miles east-northeast of Hong Kong around noon on 24 August.

Much of Hong Kong is relatively sheltered from northerly winds and the strongest winds and squalls reported were from the southwest around 4 p.m. after the centre had passed inland. All signals were lowered at 5.40 p.m. as the winds began to subside.

After crossing the coast Ellen turned onto a more westerly course and passed about 60 miles north of Hong Kong around 2 p.m. on 24 August. It was still a well marked vortex on the upper-air charts with winds exceeding 40 knots at the 850-millibar level (about 1500 metres above mean sea-level).

There were violent thunderstorms, southwesterly squalls and long periods of heavy rain. 416.2 mm of rainfall were recorded at the Royal Observatory between 11 a.m. on 24 August and 11 a.m. on 25 August. This is the highest 24-hour rainfall ever recorded in August and the third highest in any month. Ellen ranked the fourth wettest tropical cyclone since records began in 1884 and contributed more than two-thirds to the monthly total rainfall. The rainfall on the two days 24 and 25 August amounted to 511.6 mm which is a new record for August and has only been exceeded on two occasions in May 1889 and in July 1926. Hong Kong was unfortunate in that the movement of the centre caused the most active rainbands to stay overhead for a long time (Figures 22 to 26). Both Canton and Macau had far less rain. Weather improved on 26 August when only 4.5 mm of rain were recorded at the Royal Observatory.

The heavy rain caused widespread flooding and disastrous landslips in many areas. Eighteen people were killed in one landslip in Sau Mau Ping, which completely buried the ground floor of block 9 with mud and rubble. Nine people were killed in other incidents and three people were still missing. Floodwater rose to four feet in King's Road, Quarry Bay, and parked cars floated into nearby shops. Several mid-level blocks on Hong Kong Island were evacuated and part of Caine Road collapsed. Some two thousand people were made homeless. The railway bridge over the Shing Mun River was undermined and all train services between Kowloon and Shatin were suspended.

The maximum mean hourly winds and maximum gusts recorded at various places during Tropical Storm Ellen were as follows:—

<i>Location</i>	<i>Maximum mean hourly wind in points and knots</i>		<i>Maximum gust in points and knots</i>	
Royal Observatory	WSW	18	SW	50
Hong Kong Airport (SE)	SE	26	SSE	47
Hong Kong Airport (NW)	NW	18	NW	39
Waglan Island	SE	40	S	63
Tate's Cairn	S	36	S	61

<i>Location</i>	<i>Maximum mean hourly wind in points and knots</i>		<i>Maximum gust in points and knots</i>	
Cheung Chau	WSW	28	WSW	49
King's Park	SW	25	SW	45
Star Ferry	WSW	25	WSW	48
Green Island	SSW	32	ESE	51
Tsim Bei Tsui	WNW	25	NW	45
Tai O	SE	27	S	45
Cape D'Aguilar	—	26	—	52
Castle Peak	NW	23	WSW	51

The times and heights of the highest tides and maximum storm surges recorded at various locations in Hong Kong during the display of tropical cyclone warning signals were as follows:

Location	Highest Tide Above Chart Datum			Maximum Storm Surge Above Predicated Level		
	Height (m)	Date	Time	Height (m)	Date	Time
North Point	2.7	24 Aug.	8.30 a.m.	0.4	24 Aug.	7.30 a.m.
Tai Po Kau	2.6	24 Aug.	6.30 a.m.	0.7	24 Aug.	6.30 a.m.
Chi Ma Wan (Lantau Island)	2.7	24 Aug.	8.30 a.m.	0.6	24 Aug.	10.15 a.m.

The daily rainfall amounts recorded at the Royal Observatory during the period 23–26 August were as follows:

23 August	Nil
24 August	250.3 mm
25 August	261.3 mm
26 August	4.5 mm
Total:	516.1 mm

Rainfall data of other stations in Hong Kong are given in the following tables:

RAINFALL DATA FOR TROPICAL STORM ELLEN
24-26 AUGUST 1976
(in millimetres)

STATION	24 AUGUST 1976			25 AUGUST 1976			26 AUGUST 1976			72-HOUR TOTAL RAINFALL UP TO 10 A.M. ON 26 AUG. 1976
	4 p.m. on 23 AUG to 10 a.m.	10 a.m. to 4 p.m.	24-hour total ending at 4 p.m.	4 p.m. on 24 AUG to 10 a.m.	10 a.m. to 4 p.m.	24-hour total ending at 4 p.m.	4 p.m. on 25 AUG to 10 a.m.	10 a.m. to 4 p.m.	24-hour total ending at 4 p.m.	
Royal Observatory	59.6	45.2	104.8	361.2	19.0	380.2	26.6	0.1	26.7	511.6
King's Park	60.2	36.3	96.5	378.6	20.9	399.5	21.9	0.4	22.3	517.9
Hong Kong Airport	62.5	43.5	106.0	415.5	29.0	444.5	30.5	Trace	30.5	581.0
Tate's Cairn	55.7	46.6	102.3	427.2	35.6	462.8	15.5	Trace	15.5	580.6
Kwun Tong District Branch Office	—	—	94.2	—	—	469.4	10.7	Trace	10.7	574.3
Haven of Hope Sanatorium	45.2	47.4	92.6	394.5	14.4	408.9	13.6	Nil	13.6	515.1
Jubilee Reservoir	45.5	65.0	110.5	367.0	106.1	473.1	15.9	Nil	15.9	599.5
Kowloon Byewash	42.2	20.5	62.7	329.3	90.0	419.3	14.0	Nil	14.0	496.0
Pokfulam Reservoir	41.4	57.6	99.0	394.2	82.4	477.6	20.3	Nil	20.3	596.9
Wong Nai Chung	28.2	39.2	67.4	119.2	55.6	174.8	15.6	0.2	15.8	258.0
Aberdeen Upper Reservoir	37.4	70.5	107.9	408.6	48.2	456.8	18.0	Nil	18.0	582.7
Aberdeen Lower Reservoir	36.9	68.5	105.4	397.3	47.5	444.8	17.8	Nil	17.8	568.0
Green Island	35.0	79.3	114.3	412.5	35.4	447.9	15.5	Nil	15.5	577.7
Tai Lam Chung Reservoir	43.0	65.0	108.0	263.0	81.0	344.0	11.0	0.2	11.2	463.2
Cheung Chau	24.5	19.8	44.3	349.4	5.2	354.6	7.7	Nil	7.7	406.6
Silver Mine Bay	40.0	132.0	172.0	304.0	51.8	355.8	4.2	Nil	4.2	532.0
Shek Pik	67.0	82.0	149.0	318.5	24.8	343.3	51.9	2.1	54.0	546.3
Tai O	24.2	50.4	74.6	199.6	23.9	223.5	41.4	2.2	43.6	341.7
Waglan Island	24.0	22.8	46.8	218.5	32.0	250.5	7.4	Trace	7.4	304.7
Macau	—	—	†30.0	—	—	†110.0	—	—	†133.0	*273.0
Canton	—	—	†31.0	—	—	† 69.0	—	—	† 3.0	*103.0

Remarks: † 24-hour rainfall ending at 9 a.m.

* 72-hr total rainfall ending at 9 a.m. on 26 AUG 1976.

**HOURLY RAINFALL IN MILLIMETRES RECORDED AT
THE LOCAL METEOROLOGICAL STATIONS**

24 AUGUST 1976

Hour Hong Kong Standard Time	Station	Royal Observatory	Hong Kong Airport	Cheung Chau	Tate's Cairn	King's Park
01		—	—	—	—	—
02		Trace	Trace	Trace	—	—
03		2.4	1.0	0.2	3.2	1.7
04		4.7	6.0	0.8	4.6	5.3
05		2.3	2.5	1.5	3.9	1.9
06		6.3	7.5	2.5	20.3	5.6
07		18.6	23.0	3.9	12.7	21.2
08		18.2	13.0	6.6	6.3	16.0
09		7.1	9.5	9.0	4.7	8.5
10		6.9	5.5	3.9	7.3	5.6
11		4.2	6.5	3.0	10.9	4.4
12		1.7	1.0	1.9	3.4	1.1
13		6.1	3.5	1.5	4.2	4.9
14		12.2	14.5	2.3	8.7	10.3
15		14.1	12.5	7.2	12.1	10.0
16		5.9	5.0	1.2	2.6	4.0
17		Trace	2.0	0.3	2.6	0.1
18		2.1	2.5	1.6	5.0	3.6
19		8.0	4.0	15.6	5.6	5.2
20		23.7	19.0	34.6	25.6	18.8
21		29.4	25.0	36.3	17.1	25.0
22		31.9	55.0	16.7	40.0	46.5
23		13.5	11.5	15.1	17.7	10.5
24		31.0	44.0	47.2	35.0	32.5
TOTAL		250.3	274.0	212.9	253.5	242.7

25 AUGUST 1976

Hour Hong Kong Standard Time	Station	Royal Observatory	Hong Kong Airport	Cheung Chau	Tate's Cairn	King's Park
01		39.1	57.5	21.5	58.6	44.7
02		9.4	12.5	6.9	15.2	8.2
03		10.1	5.0	24.1	12.7	18.0
04		28.3	37.0	9.2	27.9	25.2
05		5.9	10.0	5.5	5.3	5.0
06		7.2	8.0	11.9	6.1	7.0
07		17.4	14.0	30.1	13.2	17.7
08		51.5	50.0	55.9	55.0	57.5
09		46.8	53.5	15.7	82.0	49.1
10		16.7	25.0	0.9	32.0	18.4
11		—	Trace	0.6	1.1	0.1
12		0.5	3.0	0.6	0.6	1.0
13		0.1	—	2.8	1.5	0.2
14		1.6	1.0	0.2	0.4	1.2
15		0.1	Trace	0.1	—	—
16		—	—	—	—	—
17		10.3	13.0	1.3	4.6	7.1
18		0.4	0.5	—	0.7	0.7
19		2.2	1.0	2.7	2.1	1.7
20		13.5	14.0	0.2	5.9	12.2
21		0.1	0.5	0.1	—	0.2
22		—	—	—	0.2	—
23		0.1	1.5	1.9	0.9	—
24		Trace	—	0.2	—	—
TOTAL		261.3	307.0	192.4	326.0	275.2

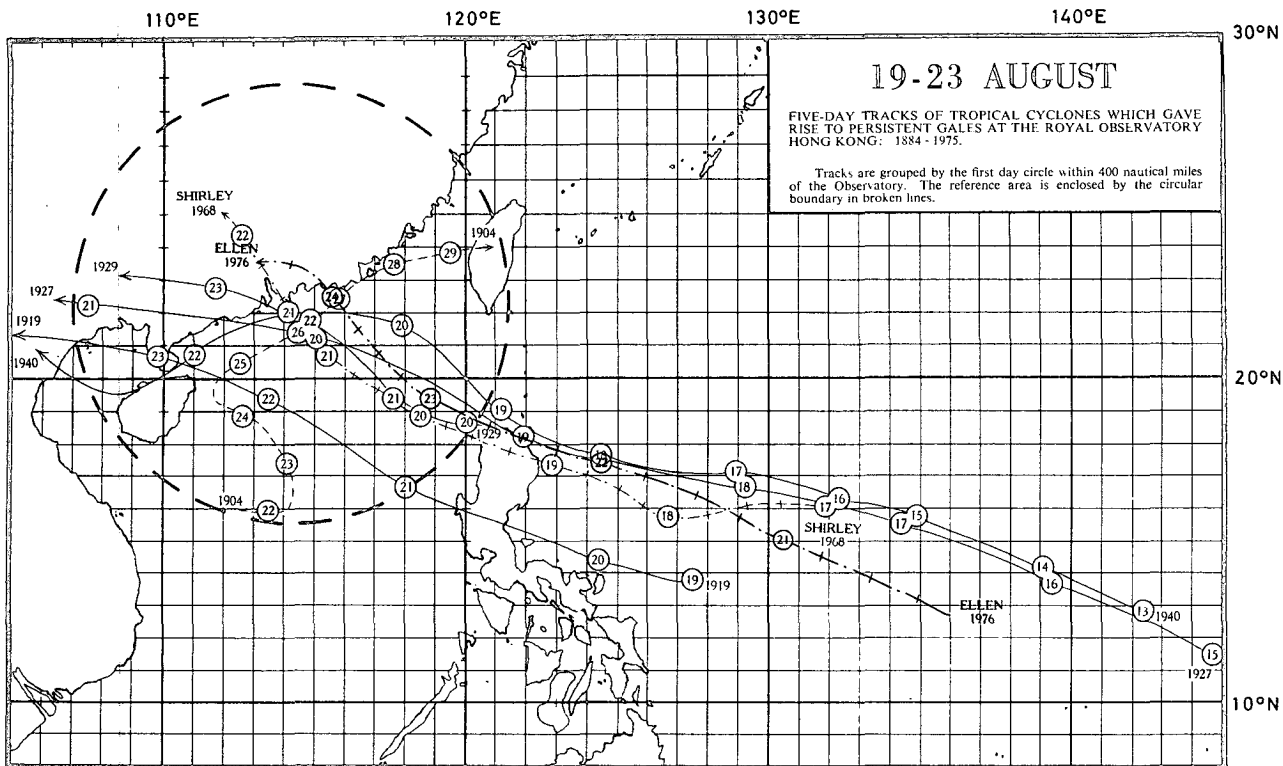


Figure 19. Track of Tropical Storm Ellen: 20-25 August 1976

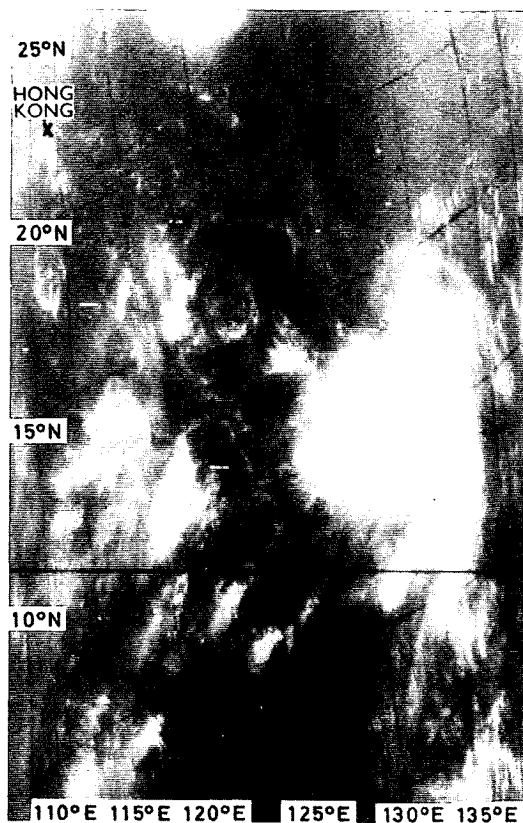


Figure 20. NOAA-4 APT picture of Tropical Storm Ellen taken from 9.14 a.m. to 9.22 a.m. on 20 August 1976

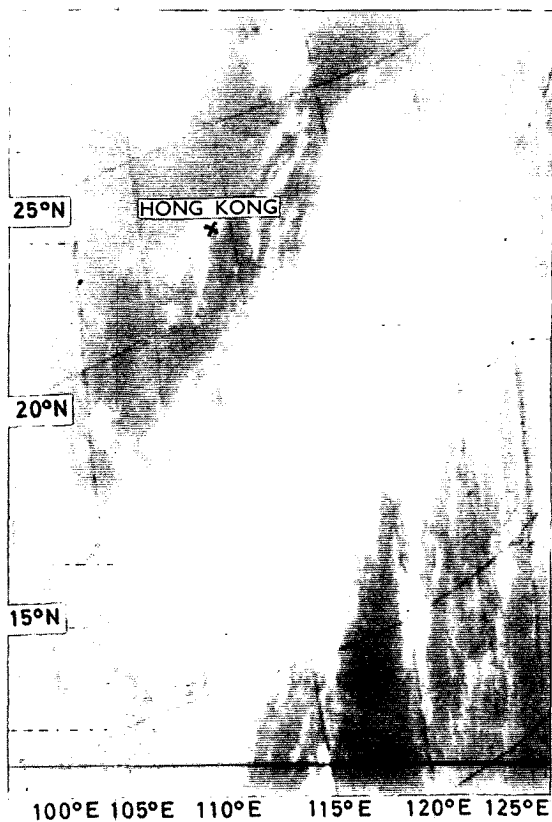


Figure 21. NOAA-4 APT picture of Tropical Storm Ellen taken from 10.03 a.m. to 10.11 a.m. on 23 August 1976

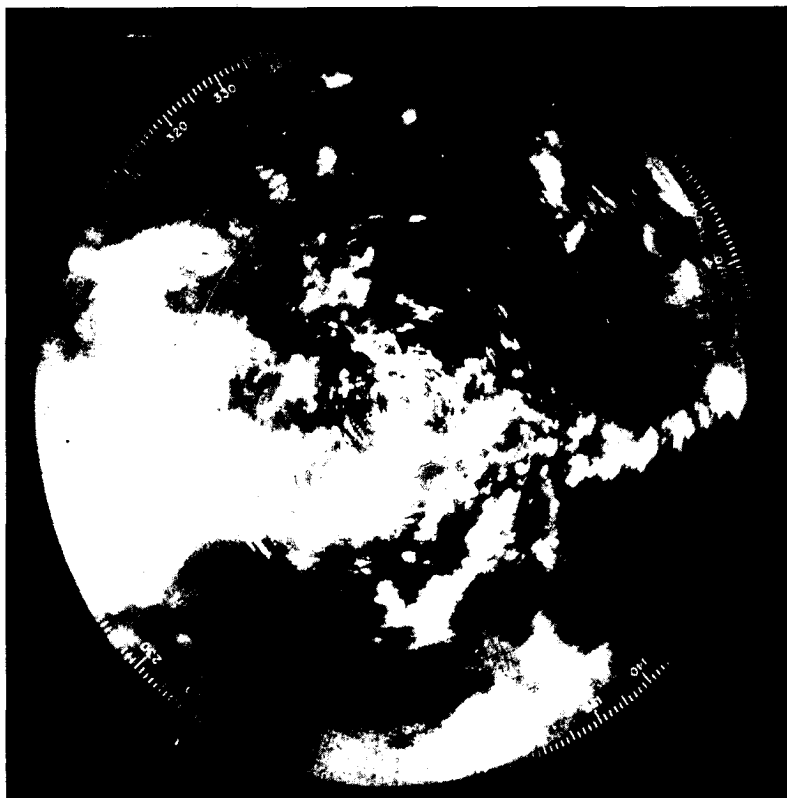


Figure 22. Radar picture of Tropical Storm Ellen taken at 2.32 p.m. on 24 August 1976 (Range marker at 40-mile interval; Elevation at 2°)



Figure 23. Radar picture of Tropical Storm Ellen taken at 10.55 p.m. on 24 August 1976 (Range marker at 40-mile interval; Elevation at 2°)

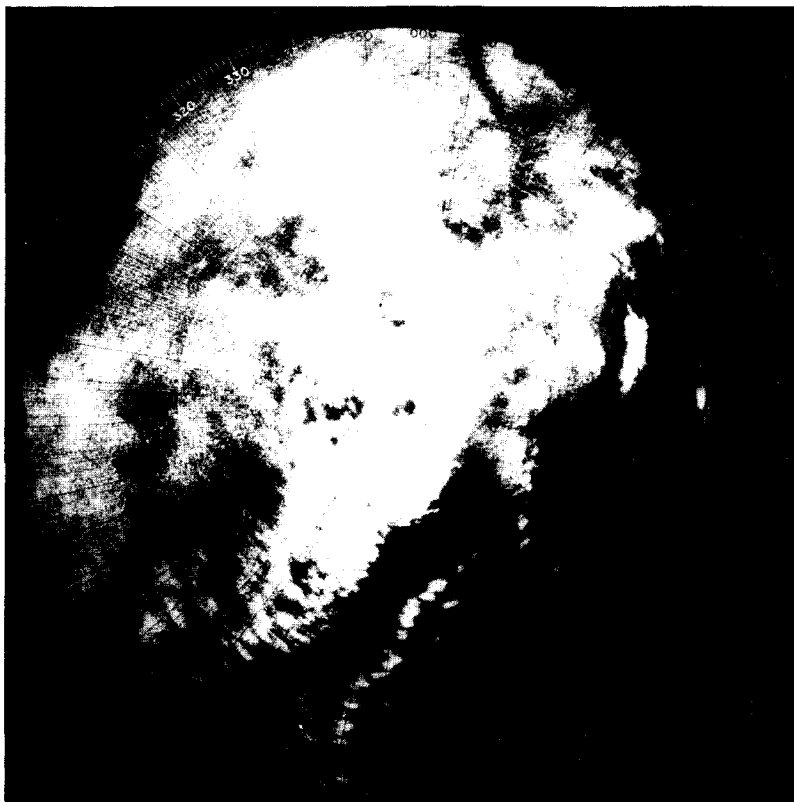


Figure 24. Radar picture of Tropical Storm Ellen taken at 4.27 a.m. on 25 August 1976 (Range marker at 40-mile interval; Elevation at 2°)

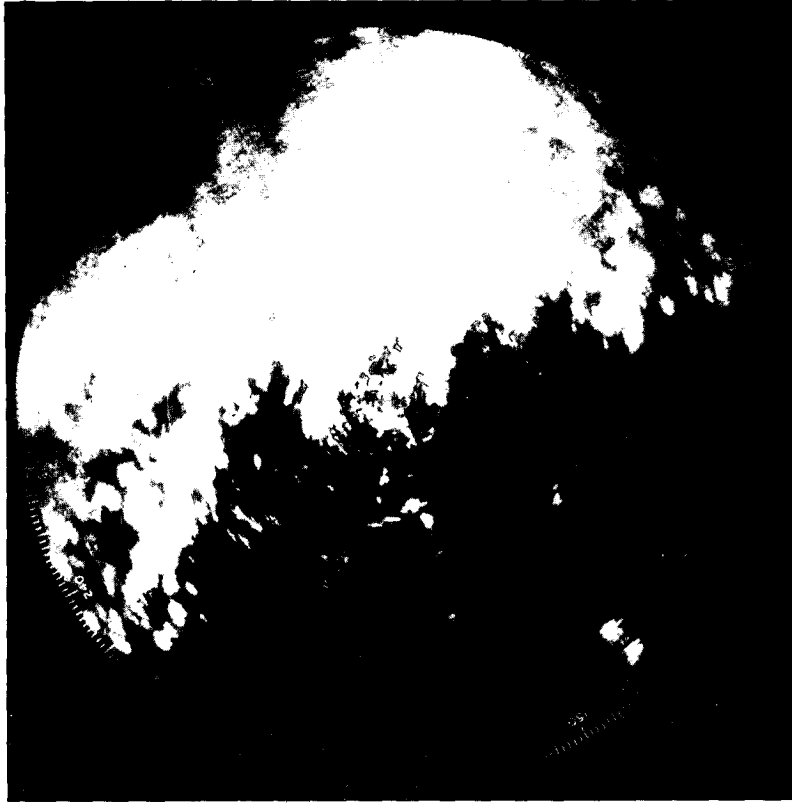


Figure 25. Radar picture of Tropical Storm Ellen taken at 10.39 a.m. on 25 August 1976 (Range marker at 40-mile interval; Elevation at 2°)

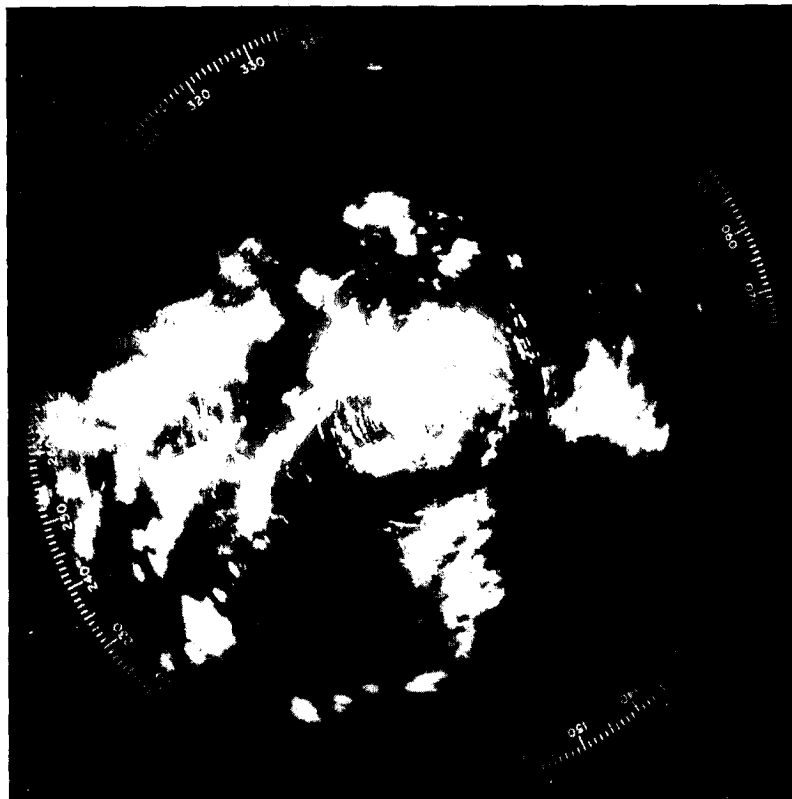


Figure 26. Radar picture of Tropical Storm Ellen taken at 8.55 p.m. on 25 August 1976 (Range marker at 40-mile interval; Elevation at 2°)

TYPHOON IRIS

15–21 September 1976

The track of this typhoon is shown in Figure 27

Typhoon Iris first developed as a tropical depression near the west coast of Luzon early on 15 September (Figure 28) and moved slowly northwestwards at about four knots towards the western part of Kwangtung Province. It intensified to a tropical storm named Iris later in the day and the minimum mean sea-level pressure near its centre reported by a reconnaissance aircraft at 2.00 p.m. was 983 millibars.

In Hong Kong, the Stand By Signal, No. 1, was hoisted at 11.15 p.m. when Iris was centred about 400 miles to the southeast. Iris intensified to a severe tropical storm the next day (Figure 29) and became a typhoon during the evening of 17 September when satellite pictures received at the Royal Observatory indicated that there were well organized spiral cloud bands associated with the circulation and maximum winds were estimated to be about 77 knots near the centre (Figure 30). As the typhoon was heading closer to Hong Kong, the Stand By Signal was replaced by the Strong Wind Signal, No. 3, at 10.45 p.m. on 17 September when Iris was centred about 190 miles south-southeast of the territory.

Early on 18 September, Iris accelerated to about seven knots and moved west-northwestwards towards the coast of Kwangtung to the west of Hong Kong. At 7.00 a.m., the Royal Observatory weather radar indicated that Iris had a rather large eye with a diameter of about 60 miles and there were only a few rainbands associated with the circulation (Figure 31). Satellite pictures also indicated that the rainfall intensities associated with Iris would be less than those of an average typhoon (Figure 32). However, during the afternoon, the eye decreased rapidly to about 30 miles in diameter as the typhoon further intensified (Figure 33).

Winds over Hong Kong gradually increased from the northeast and became strong gusty later in the afternoon. As Iris continued to move closer, the Strong Wind Signal was replaced by the No. 8 NORTHEAST Gale or Storm Signal at 9.15 p.m. when the centre was about 110 miles south of Hong Kong (Figures 34 and 35). This was followed by the No. 8 SOUTHEAST Gale or Storm Signal at 6.10 a.m. on 19 September when the northeast gales which set in during the previous evening gradually turned to southeasterly.

The lowest sea-level pressure in Hong Kong was 997.2 millibars recorded at Cheung Chau around 5 a.m. on 19 September when Iris was at its nearest approach to Hong Kong about 95 miles to the south-southwest and was moving west-northwestwards at six knots. During the morning, it slowly changed to a more westerly course and passed about 35 miles south of St. John's Island where maximum surface winds of 60 knots with gusts of 76 knots and a minimum sea-level pressure of 988.1 millibars were reported. Gales over Hong Kong gradually subsided during the day and the No. 8 SOUTHEAST Gale or Storm Signal was replaced by the Strong Wind Signal at 5.30 p.m. on 19 September when Iris was centred about 140 miles to the west-southwest.

The typhoon entered the west coast of Kwangtung near the Luichow Peninsula early next morning and all signals were lowered at 7.45 a.m. on 20 September when Iris was about 200 miles west-southwest of Hong Kong. Iris weakened rapidly and degenerated into an area of low pressure over the Gulf of Tonkin on 21 September. This low pressure area persisted for an unusually long time.

During the passage of Typhoon Iris, sustained gale force winds were experienced in Hong Kong during the evening of 18 September and early next morning. Waglan Island recorded 15 hours of gales while in Victoria Harbour, continuous gales were reported for 13 hours. The maximum winds and maximum gusts recorded at various locations were as follows:

<i>Location</i>	<i>Maximum mean hourly wind in points and knots</i>		<i>Maximum gust in points and knots</i>	
Royal Observatory	E	31	ENE	67
Hong Kong Airport (SE)	NE	32	NE	59
Hong Kong Airport (NW)	E	30	ENE	58
Waglan Island	ENE	53	ENE	70
Tate's Cairn	E	48	ENE	78
Cheung Chau	ESE	45	E	73
King's Park	E	33	E	68
Star Ferry	E	40	E	65
Green Island	ENE	53	ENE	75
Tsim Bei Tsui	ESE	31	ESE	53
Tai O	ESE	38	ESE	63
Cape D'Aguilar	—	37	—	53
Castle Peak	E	20	E	49

The weather was fine and sunny on 16 September but became cloudy the next day. Scattered showers set in on 18 September and the weather remained unsettled with occasional showers. The daily rainfall amounts recorded at the Royal Observatory during the period 16–21 September were as follows:

16 September	Nil
17 September	Nil
18 September	11.6 mm
19 September	29.5 mm
20 September	7.6 mm
21 September	6.3 mm
TOTAL:	55.0 mm

During the passage of Typhoon Iris, the maximum wind-generated waves recorded at Waglan Island at 7.07 a.m. on 19 September were about 9.5 metres with a period of 10 seconds. The times and heights of the highest tides and maximum storm surges recorded at various locations in Hong Kong during the passage of Iris were as follows:

Location	Highest Tide Above Chart Datum			Maximum Storm Surge Above Predicated Level		
	Height (m)	Date	Time	Height (m)	Date	Time
North Point	2.6	19 Sep.	6.00 a.m.	0.8	18 Sep.	6.30 p.m.
Tai Po Kau	2.7	19 Sep.	6.30 a.m.	0.9	19 Sep.	7.00 a.m.
Chi Ma Wan (Lantau Island)	2.9	19 Sep.	5.15 a.m.	0.9	19 Sep.	5.15 a.m.

Damage was slight in Hong Kong and no serious casualties were reported. There were 21 reports of fallen scaffolding and signboards and some minor flooding. 27 people were slightly injured by flying glass and other objects and 7 of them were hospitalized. Nearly 500 people evacuated their homes and took temporary accommodation in typhoon shelters or police stations. Most of the ferry services, including those to Macau, the peak tram and a few bus services were suspended during the evening of 18 September and the next morning. 17 commercial airline flights were cancelled of which 11 were outgoing and 6 incoming. In addition, 34 flights were delayed.

Four freighters broke their moorings in the harbour and three of them managed to anchor safely afterwards. The 'Olympic Dale' was not so lucky; it went aground at Hang Hau in Junk Bay and damaged a fish breeding farm there (Figures 36 and 37). Another freighter 'Chieh Lee' ran into difficulty near the centre of Iris when it was about 220 miles southeast of Hong Kong and subsequently sank. There were only 13 survivors out of a crew of 28.

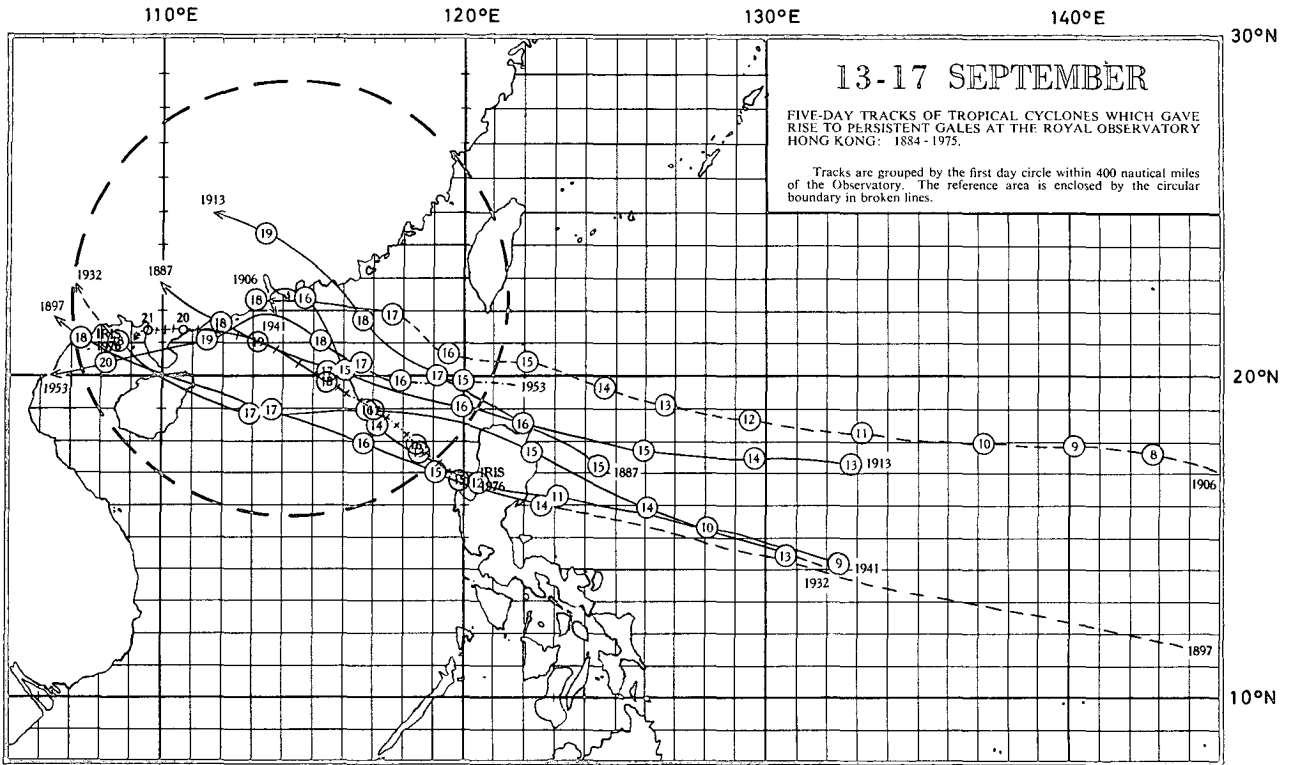


Figure 27. Track of Typhoon Iris: 15-21 September 1976

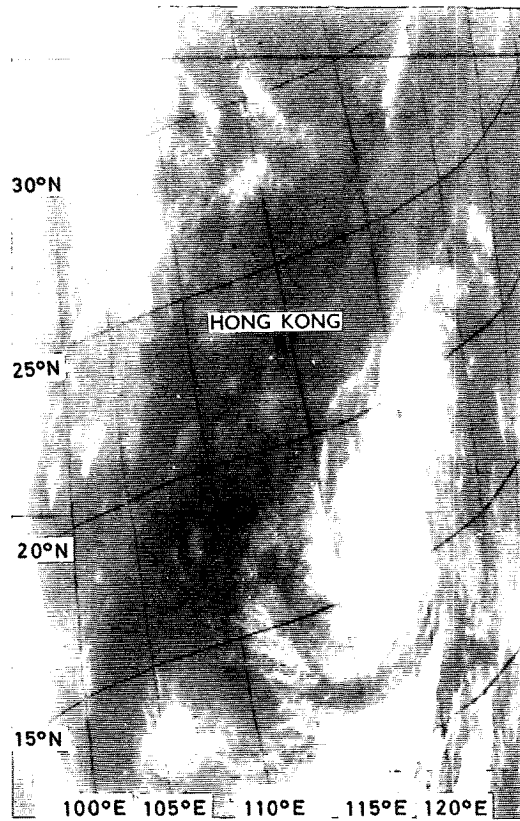


Figure 28. NOAA-4 APT picture of Typhoon Iris taken from 10.15 a.m. to 10.23 a.m. on 15 September 1976

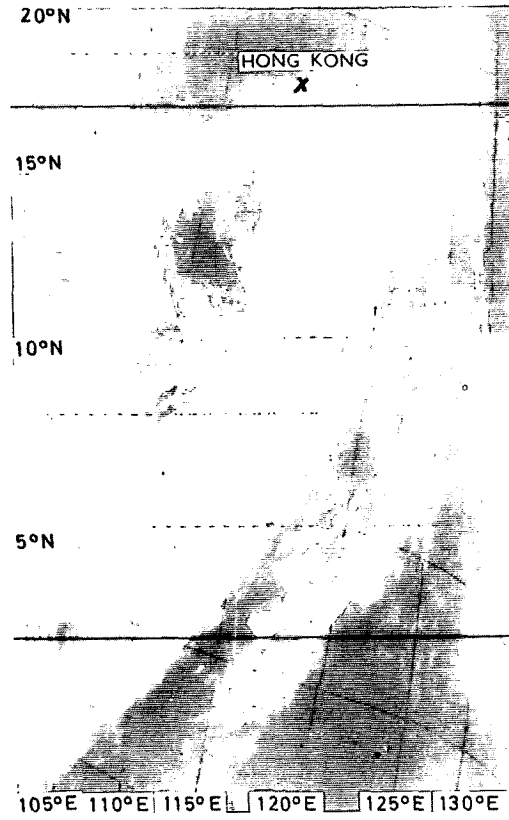


Figure 29. NOAA-4 APT picture of Typhoon Iris taken from 9.41 p.m. to 9.47 p.m. on 16 September 1976

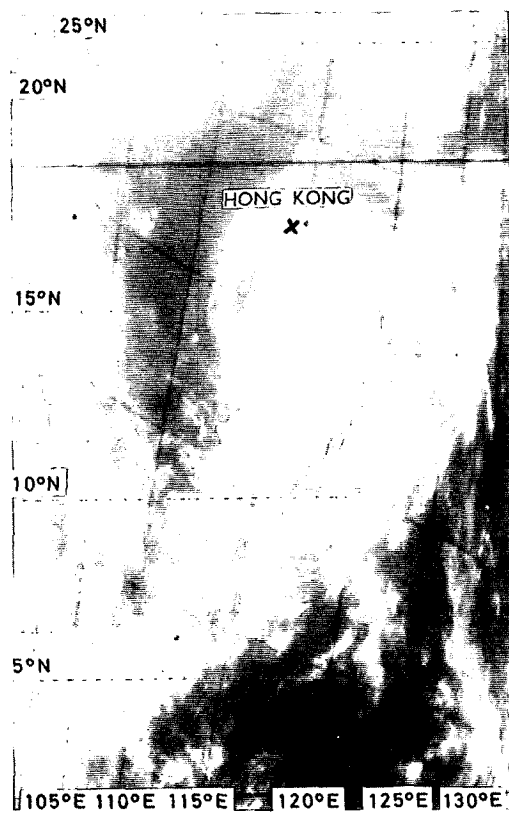


Figure 30. NOAA-4 APT picture of Typhoon Iris taken from 9.37 p.m. to 9.45 p.m. on 17 September 1976



Figure 31: Radar picture of Typhoon Iris taken at 7.00 a.m. on 18 September 1976 (Range markers at 40-mile intervals)

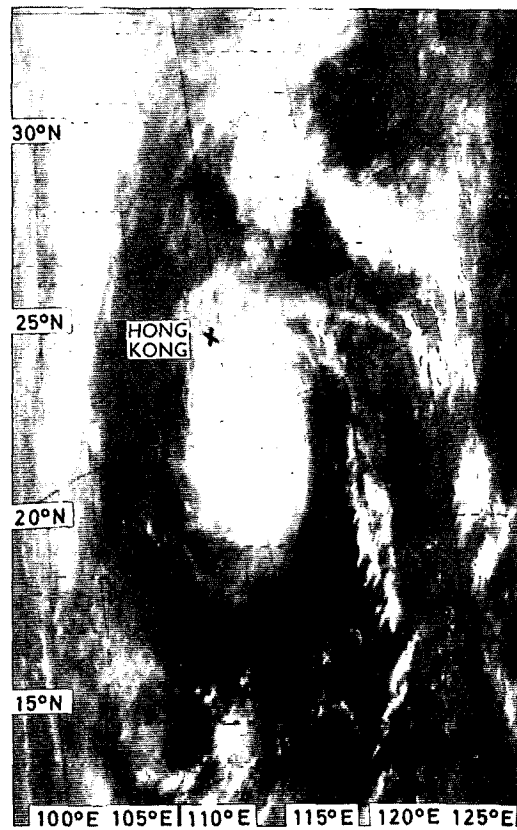


Figure 32. NOAA-4 APT picture of Typhoon Iris taken from 10.01 a.m. to 10.18 a.m. on 18 September 1976

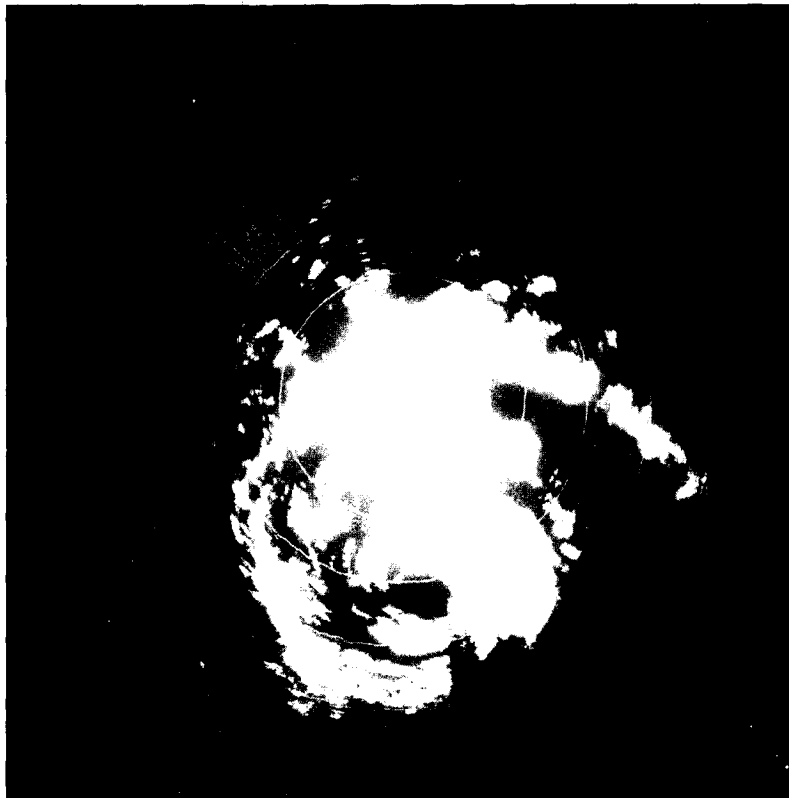


Figure 33. Radar picture of Typhoon Iris taken at 6.00 p.m. on 18 September 1976 (Range markers at 40-mile intervals)



Figure 34. Radar picture of Typhoon Iris taken at 9.30 p.m. on 18 September 1976 (Range markers at 40-mile intervals)

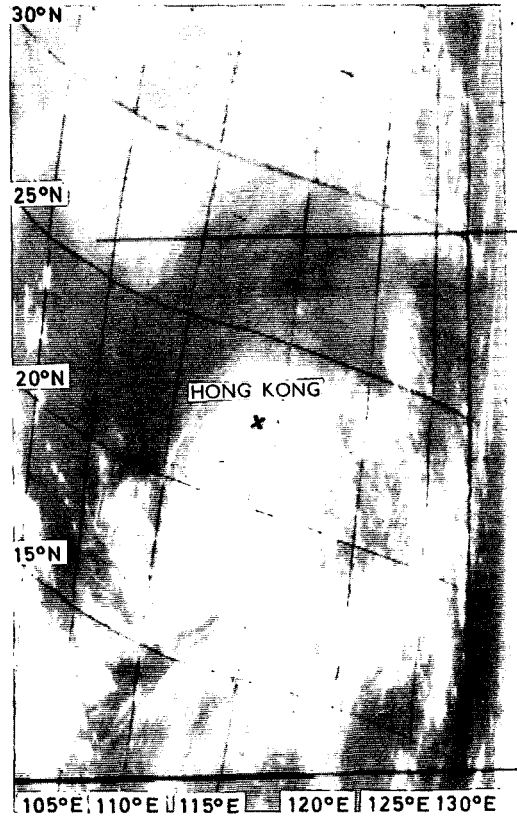


Figure 35. NOAA-4 APT picture of Typhoon Iris taken from 9.38 p.m. to 9.46 p.m. on 18 September 1976

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Figure 36. The Olympic Dale hard aground at Hang Hau in Junk Bay after breaking her moorings at the height of Typhoon Iris (By courtesy of South China Morning Post)

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(Tel.: 2926 8250)

TABLE 1. LIST OF TROPICAL CYCLONES IN THE WESTERN NORTH PACIFIC AND THE SOUTH CHINA SEA IN 1976

Name of Tropical Cyclone	Beginning of Track					First day circle	Last day circle	Ending of Track				
	Date	Time	Position		Date			Time	Position			
			G.M.T.	°N					°E	G.M.T.	°N	°E
1 Typhoon Kathy	January	28	0000	5.7	148.1	28	2	February	2	0600	22.3	151.7
2 Tropical Depression	January	29	0000	8.0	128.5	29	2	February	2	1200	9.4	142.9
3 Tropical Depression	February	8	0000	6.0	132.0	8	10	February	10	0000	8.3	128.4
4 Tropical Storm Lorna	February	27	0600	7.9	151.3	28	1	March	1	0000	9.7	145.6
5 Typhoon Marie	April	3	0600	8.3	140.3	4	14	April	14	0000	26.6	138.5
6 Tropical Storm Nancy	April	25	1200	10.1	160.0	26	2	May	2	0000	15.1	143.1
7 Typhoon Olga	May	12	0600	10.8	136.9	13	26	May	26	1800	25.8	126.5
8 Typhoon Pamela	May	14	0600	8.1	152.1	15	27	May	27	0000	32.3	150.5
9 Typhoon Ruby	June	22	0000	12.0	132.5	22	4	July	4	0600	36.2	149.3
10 Typhoon Sally	June	24	0000	9.4	145.4	24	2	July	2	1200	32.0	157.6
11 Typhoon Therese	July	11	0000	9.5	155.7	11	20	July	20	0000	32.9	130.1
12 Severe Tropical Storm Violet	July	20	1200	15.0	116.6	21	26	July	26	0600	22.4	110.4
13 Tropical Storm Wilda	July	22	0600	20.6	137.7	23	24	July	24	0000	34.3	131.0
14 Typhoon Anita	July	22	0000	15.3	130.4	22	25	July	25	0600	34.8	129.7
15 Typhoon Billie	August	3	0000	13.9	146.8	3	11	August	11	1800	28.9	112.5
16 Severe Tropical Storm Clara	August	5	0000	19.1	114.2	5	6	August	6	1800	22.1	112.1
17 Tropical Storm Dot	August	18	0600	20.3	138.1	19	23	August	23	0000	35.4	128.8
18 Tropical Storm Ellen	August	20	0600	13.2	134.8	21	24	August	24	0600	23.3	114.2
19 Typhoon Fran	September	3	1800	9.0	150.0	4	14	September	14	0000	41.5	136.8
20 Tropical Storm Georgia	September	9	0000	9.3	156.5	9	15	September	15	0000	16.2	147.9
21 Typhoon Hope	September	14	0600	19.2	154.7	15	18	September	18	0000	45.6	152.1
22 Typhoon Iris	September	15	0000	16.7	119.7	15	21	September	21	0600	21.3	109.3
23 Typhoon Joan	September	19	0600	17.1	151.4	20	24	September	24	0600	35.0	160.0
24 Typhoon Louise	October	30	0600	9.5	148.3	31	7	November	7	1800	32.0	146.3
25 Severe Tropical Storm Marge	November	5	0600	8.3	145.5	6	10	November	10	1800	28.1	129.3
26 Tropical Storm Nora	December	3	0000	12.0	127.8	3	6	December	6	1800	13.9	122.9
27 Tropical Storm Opal	December	9	0000	18.2	134.4	9	10	December	10	1200	19.6	139.8

N.B. Kate was east of 160°E

TABLE 2. TROPICAL CYCLONE WARNINGS FOR SHIPPING ISSUED IN 1976

Tropical Cyclone	No. of Warnings Issued	Date and Time† of Issue of				Duration of Warnings (hours)
		First Warning		Last Warning		
Typhoon Olga	33	May	181200	May	261200	192
Typhoon Ruby*	42	June	240000	June	301800	162
Severe Tropical Storm Violet*	42	July	201200	July	260600	138
Typhoon Billie	7	August	090600	August	100900	27
Severe Tropical Storm Clara*	14	August	050000	August	061500	39
Tropical Storm Dot	5	August	201200	August	210900	21
Tropical Storm Ellen*	16	August	220000	August	240900	57
Typhoon Iris*	49	September	150000	September	210600	150
Severe Tropical Storm Marge	6	November	090600	November	100300	21
Tropical Storm Nora	11	December	041200	December	070000	60
Total	225					867

* Tropical cyclones for which tropical cyclone warning signals were hoisted in Hong Kong

† Times are given in hours G.M.T.

TABLE 3. TROPICAL CYCLONE WARNING SIGNALS HOISTED IN HONG KONG AND NUMBER OF WARNING BULLETINS ISSUED IN 1976

SUMMARY

Signal	No. of Occasions	Total Duration	
1	6	176 h	25 min
3	6	143	10
8 NORTHWEST	-	-	-
8 SOUTHWEST	-	-	-
8 NORTHEAST	1	8	55
8 SOUTHEAST	2	23	00
9	-	-	-
10	-	-	-
Total	15	351	30

DETAILS

Tropical Cyclone	No. of Warning Bulletins Issued	Signal	Hoisted		Lowered	
			Date	Time*	Date	Time*
Typhoon Ruby	26	1	June	26 0930	June	26 2030
		3	June	26 2030	June	28 0840
		1	June	28 0840	June	29 0615
Severe Tropical Storm Violet	48	1	July	21 2230	July	24 2200
		3	July	24 2200	July	26 0830
Severe Tropical Storm Clara	27	1	August	5 1000	August	5 2230
		3	August	5 2230	August	6 1520
		8 SE	August	6 1520	August	7 0300
Tropical Storm Ellen	17	1	August	23 0925	August	23 2145
		3	August	23 2145	August	24 1640
Typhoon Iris	56	1	September	15 2215	September	17 2145
		3	September	17 2145	September	18 2015
		8 NE	September	18 2015	September	19 0510
		8 SE	September	19 0510	September	19 1630
		3	September	19 1630	September	20 0645

* standard time

TABLE 4. FREQUENCY AND TOTAL DURATION OF DISPLAY OF TROPICAL CYCLONE WARNING SIGNALS : 1946-1976

Year	Signals	1	3*	8 NW†	8 SW†	8 NE†	8 SE†	9	10	Total	Total Duration (hours)
1946	7	-	1	0	1	2	1	1	13	154	
1947	6	-	1	0	1	0	0	0	8	124	
1948	5	-	1	1	3	2	0	0	112	112	
1949	4	-	0	0	1	1	1	0	7	67	
1950	2	-	0	0	1	1	1	0	5	102	
1951	4	-	0	0	2	3	1	0	10	133	
1952	2	-	0	0	1	1	0	0	4	74	
1953	2	-	1	1	2	1	1	0	8	116	
1954	5	-	0	0	3	2	2	0	12	133	
1955	0	-	0	0	0	0	0	0	0	0	
1956	5	4	0	0	0	0	0	0	9	191	
1957	4	9	1	1	2	2	0	0	20	296	
1958	4	5	0	0	1	0	0	1	10	214	
1959	1	1	0	0	0	0	0	0	2	37	
1960	11	7	0	2	2	2	1	1	26	433	
1961	6	7	1	2	1	0	1	1	19	193	
1962	4	3	0	1	1	0	1	1	11	158	
1963	4	5	0	0	1	0	0	0	10	176	
1964	11	14	1	3	5	3	3	2	42	570	
1965	7	6	0	0	1	1	0	0	15	240	
1966	6	5	0	0	2	2	0	0	15	285	
1967	8	6	0	0	2	1	0	0	17	339	
1968	7	7	0	1	1	0	1	1	18	290	
1969	4	2	0	0	0	0	0	0	6	110	
1970	6	8	2	1	2	0	0	0	19	287	
1971	9	10	1	3	2	2	1	1	29	323	
1972	8	6	0	0	1	1	0	0	16	288	
1973	8	6	1	1	1	0	1	0	18	417	
1974	12	10	0	0	2	1	1	0	26	526	
1975	8	6	1	0	0	1	1	1	18	292	
1976	6	6	0	0	1	2	0	0	15	352	
Total	176	133	12	17	43	31	18	10	440	7032	
Mean	5.7	6.3	0.4	0.5	1.4	1.0	0.6	0.3	14.2	226.8	

* The Strong Wind Signal, No. 3, was introduced in 1956

† Gale or Storm Signals, 5, 6, 7 and 8 were renumbered as 8 NW, 8 SW, 8 NE, 8 SE respectively with effect from 1 January 1973

TABLE 5. NUMBER OF TROPICAL CYCLONES IN HONG KONG'S AREA OF RESPONSIBILITY AND THE NUMBER THAT NECESSITATED THE DISPLAY OF TROPICAL CYCLONE WARNING SIGNALS IN HONG KONG : 1946-1976

YEAR	Number in Hong Kong's Area of Responsibility	Number Necessitating the Display of Signals in Hong Kong
1946	9	6
1947	21	6
1948	15	4
1949	16	4
1950	13	4
1951	12	5
1952	22	7
1953	19	9
1954	19	6
1955	17	7
1956	14	3
1957	23	5
1958	12	6
1959	14	5
1960	19	2
1961	20	9
1962	22	6
1963	16	4
1964	13	4
1965	25	4
1966	16	10
1967	16	6
1968	16	6
1969	12	8
1970	11	6
1971	21	4
1972	17	6
1973	14	9
1974	17	5
1975	21	9
1976	12	11
	10	7
		5
Total	505	190
Mean	16.3	6.1

TABLE 6. MEAN AND EXTREME VALUES OF DURATION OF DISPLAY OF TROPICAL CYCLONE WARNING SIGNALS IN HONG KONG : 1946-1976

Signal	Duration for each occasion						Duration per year					
	Mean		Maximum		Minimum		Mean		Maximum		Minimum	
1	18 h	20 min	102 h	10 min	1 h	20 min	104 h	06 min	273 h	15 min	0 h	0 min
3*	20	49	71	45	1	00	131	52	268	45	8	45
8 NW †	7	26	13	00	1	30	2	53	13	00		0
8 SW †	5	30	11	10	2	30	3	01	16	10		0
8 NE †	11	30	35	35	2	15	15	57	61	45		0
8 SE †	7	21	17	20	0	20	7	21	28	52		0
8	8	47	35	35	0	20	29	11	82	25		0
9	3	49	6	30	1	10	2	13	11	00		0
10	6	05	9	10	2	30	1	58	12	10		0

* 1956 - 1976

† Gale or Storm Signals, 5, 6, 7 and 8 were renumbered as 8NW, 8SW, 8NE and 8SE respectively with effect from 1 January 1973

TABLE 7. CASUALTIES AND DAMAGE CAUSED BY TROPICAL CYCLONES IN HONG KONG : 1937-1976

Tropical Cyclone	Ocean-going Vessels in Trouble	Junks Sunk or Wrecked	Junks Damaged	Persons Dead	Persons Missing	Persons Injured
1937 Typhoon	28	545	1,255	11,000	*	*
1957 T. Gloria	5	2	Several	8	*	111
1960 T. Mary	6	352	462	11	11	127
1961 T. Alice	*	*	*	4	0	20
1962 T. Wanda	36	1,297	756	130	53	*
1964 T. Viola	5	18	18	0	0	41
T. Ida	3	7	60	5	4	56
T. Ruby	20	32	282	38	6	300
T. Sally	0	0	0	9	0	24
T. Dot	2	31	59	26	10	85
1966 S.T.S. Lola	0	*	6	1	0	6
1968 T. Shirley	1	*	3	0	0	4
1970 T.D. (1-3 Aug.)	0	0	0	2 ⁺	0	0
T. Georgia	2	0	*	0	0	0
1971 T. Freda	8	0	0	2	0	30
T. Lucy	10	0	0	0	0	38
T. Rose	33**	303	*	110	15	286
1972 T. Pamela	3	0	0	1	0	8
1973 T. Dot	14	*	*	1	0	38
1974 T. Dinah	1	*	*	0	0	0
T. Ivy	2	*	*	0	0	0
T. Carmen	4	*	*	1	0	0
T. Della	1	*	*	0	0	0
1975 T.D. (10-14 Aug.)	2	1	*	2	1	0
T. Elsie	5	3	*	0	0	46
S.T.S. Flossie	1	*	*	0	0	0
1976 T. Ruby	0	0	0	3	2	2
S.T.S. Violet	0	0	0	2	1	1
S.T.S. Clara	0	0	0	0	0	4
T.S. Ellen	0	4	7	27	3	65
T. Iris	5	0	1	0	0	27

N.B. Information compiled from Hong Kong newspapers and from the Marine Department's records

* Data unavailable

+ Struck by lightning

**Note: Number of Ocean-going vessels in trouble is revised on 30 Jul 2021.

TABLE 8. SHIPS SUNK, DAMAGED, GROUNDED, ETC., BY TROPICAL CYCLONES IN HONG KONG : 1974-1976

Year	Name of Tropical Cyclone	Name of Ship	Location of Grounding, etc.	Nature of Incident	Remarks
1974	Typhoon Dinah	S.S. Silver Shelton	Victoria Harbour	Adrift	Slight damage to both vessels Minor damage to both vessels
	Typhoon Ivy	S.S. Asmari S.S. Hwalung	East of Tsing Yi Kellett Bank	Adrift Dragging Anchor	
	Typhoon Carmen	S.S. Terryusan Maru S.S. Uniparagon S.S. Oriental Hero	Off Po Toi Island South of Stonecutters Island Southwest of Stonecutters Island	Dragging Anchor Adrift Adrift and in collision with S.S. Bright Sea Dragging Anchor	
	Typhoon Della	S.S. Pearl Star S.S. Lela	Western Anchorage South of Stonecutters Island	Collision with S.S. Taolin	
1975	T.D. (10-14 Aug.)	S.S. Wuxi S.S. Hong Kong Truth	Hung Hom Ferry Pier Northwest of Stonecutters Island	Aground Adrift and in collision with S.S. Dehua	Slight damage to S.S. Dehua
	Typhoon Elsie	S.S. Man Wah S.S. Sea Concord	Kowloon Bay Western Anchorage	Adrift Dragging anchor and in collision with S.S. Caribbean Sea	
		S.S. Yu Heng S.S. Teresa	North of West Point North of Lantau	Adrift Dragging anchor and in collision with S.S. Olympic Sky	
		S.S. Slidre S.S. Shinpoku Maru	Northwest of Green Island Off Stonecutters Island	Adrift Aground	
1976	T. Iris	S.S. Olympic Dale S.S. United Glory S.S. Oriental Ruler S.S. Nantao S.S. Oceanic Constitution	Junk Bay Victoria Harbour Western Anchorage Western Anchorage	Aground Dragging Anchor Dragging Anchor Dragging Anchor Dragging Anchor and in collision with S.S. Oriental Empress	Causing damage to a fish breeding farm

N.B. Information compiled from Hong Kong newspapers and from the Marine Department's records

TABLE 9. A SUMMARY OF METEOROLOGICAL OBSERVATIONS RECORDED IN HONG KONG DURING THE PASSAGES OF TROPICAL CYCLONES IN 1976

Name of tropical cyclone	Month	Nearest approach to Hong Kong							Minimum hourly M.S.L. pressure at the Royal Observatory			Maximum storm surge		
		Day	Time	Dir.	Dist.	Movement		Estimated minimum central pressure	Day	Time	Pressure	North Point	Tai Po Kau	Chi Ma Wan
				points	n mile	points	knots	mbar			mbar	m	m	m
T. Ruby	Jun	27	1600	SE	180	NE	5	975 ⁽¹⁾	28	1700	998.4	0.6	0.8	0.7
S.T.S. Violet	Jul	25	1800	SW	105	NW	6	970 ⁽²⁾	25	1700	995.3	0.5	0.7	0.8
S.T.S. Clara	Aug	6	2000	SW	70	NW	12	980 ⁽³⁾	6	1700	998.5	0.4	0.5	0.5
T.S. Ellen	Aug	24	1300	N	60	W	12	990 ⁽⁴⁾	24	0600	996.3	0.4	0.7	0.6
T. Iris	Sep	19	0500	SSW	95	WNW	6	965 ⁽⁵⁾	19	0400	999.8	0.8	0.9	0.9

N.B. Times are given in standard time

- (1) Estimation based on surface reports. Pressure at Pratas Island at 1700 hours was 984.2 mbar when centre of Ruby was about 20 n miles south of the island.
- (2) Estimation based on surface reports. Pressure at St. John's Island at 2000 hours was 984.9 mbar when centre of Violet was about 35 n miles south of the island.
- (3) Estimation based on surface reports. Pressure at St. John's Island at 2000 hours was 990.7 mbar when centre of Clara was about 30 n miles east-southeast of the island.
- (4) Estimation based on surface reports. Pressure at Canton at 1400 hours was 995.7 mbar when centre of Ellen was about 40 n miles to the east.
- (5) Estimation based on surface reports. A ship about 35 n miles south-southeast of Iris reported a minimum pressure of 979.2 mbar at 2300 hours on 18 September.

TABLE 9. (CONT'D)

Name of tropical cyclone	Month	Max. 60-min mean wind in points and knots		Max. 10-min mean wind in points and knots		Max. gust peak speed in points and knots		Rainfall at the Royal Observatory (mm)				
		Royal Observatory	Waglan Island	Royal Observatory	Waglan Island	Royal Observatory	Waglan Island	(i) 300 n mile	(ii) 24 hours	(iii) 48 hours	(iv) 72 hours	(i) + (iv)
T. Ruby	Jun	ENE 19	ENE 33	ENE 21	ENE 34	ENE 40	ENE 43	1.1	3.2	3.2	28.2	29.3
S.T.S. Violet	Jul	E 21	E 32	E 23	E 35	E 42	E 46	233.1	40.4	81.3	90.2	323.3
S.T.S. Clara	Aug	E 19	E 34	E 20	E 35	ENE 41	E 45	71.8	34.0	34.0	34.1	105.9
T.S. Ellen	Aug	WSW 18	SE 40	WSW 23	SE 43	SW 50	S 63	110.7	374.3	401.0	405.4	516.1
T. Iris	Sep	ENE 29	ENE 53	ENE 31	ENE 57	ENE 67	ENE 70	51.2	19.9	24.9	24.9	76.1

- N.B. (i) during the period when the tropical cyclone was centred within 300 n miles of Hong Kong
- (ii) during the 24-hour period after the tropical cyclone moved outside (or dissipated within) the 300-n mile radius
- (iii) during the 48-hour period after the tropical cyclone moved outside (or dissipated within) the 300-n mile radius
- (iv) during the 72-hour period after the tropical cyclone moved outside (or dissipated within) the 300-n mile radius

All data, other than the rainfall, refer to the period when tropical cyclone warning signals were hoisted.