ROYAL OBSERVATORY, HONG KONG
TECHNICAL NOTE NO. 68

HYDROMETEOROLOGICAL ASPECTS OF THE RAINSTORMS IN MAY 1982

By

B. Y. LEE

DECEMBER 1983

CONTENTS

FIGURES

TABLES

PLATES

(Plates 8-13 : Courtesy of the Information Services Dept.)

1. INTRODUCTION

During the four days from 28 to 31 May, 1982, a total of 653.9 mm of rain was recorded at the Royal Observatory. The daily figures, measured from midnight to midnight, are 179.0, 258.4, 11.0 and 205.5 mm respectively on these four days. A time sequence of the hourly rainfall is shown in Fig. 1.

This report presents rainfall analyses of the rainstorms. In the analysis of areal distribution of rainfall over south China, data from stations in China and Vietnam were used. Rainfall data obtained from various stations in Hong Kong were used in the derivation of rainfall intensity, spatial and temporal distributions, storm frequency estimations, mass curves and depth-area-duration relationship.

Unless otherwise specified, all times used in this report refer to Hong Kong Time, which is 8 hours ahead of the Greenwich Mean Time (GMT). Also, unless otherwise stated, the rainfall figures refer to those recorded at the Royal Observatory Headquarters.

A brief summary of the damage and losses caused by the intense rainfall is given in Appendix 1.

2. COMPARISON OF RAINFALL RECORDS AT THE ROYAL OBSERVATORY

The rainstorms did not break any of the rainfall records at the Royal Observatory over durations ranging from 15 seconds to 4 days. The 4-day total (midnight to midnight value) of 653.9 mm ranks the fifth highest since 1884, and the 24-hour total of 394.3 mm ending at 10 a.m. on 29 May ranks the sixth highest. In terms of frequency of recurrence, the 4-day total corresponds to a return period of about 30 years based on the statistical results of Peterson and Kwong (1981). Table 1 gives the rainfall amounts, their ranking and the estimated return periods of maximum rainfall depths recorded over various durations of time.

The total rainfall over the four days constitutes about 85% of the month's total of 767.4 mm which is 157% above the average for May.

3. RAINFALL OVER SOUTH CHINA

Rainfall distribution over south China during the period from 00 GMT (8 a.m.) 28 May to 00 GMT (8 a.m.) 1 June (Fig. 2) shows an area of highest rainfall near Hong Kong and Macau. As discussed by Cheng and Yerg (1972), this is considered to be partly the result of topography as Hong Kong rises abruptly from the sea and 78% of its area is above 50 metres and partly due to its shape which protrudes into the South China Sea and therefore lacks protection from possible rain-producing weather systems.

An infrared satellite picture taken at midnight, 28 May (Plate 1), shows no intense activity near Hong Kong. By 2 a.m. on 29 May, separate storm cells appeared close to the south China coast (Plate 2). These cells rapidly developed into an area of thunderstorms within three hours (Plate 3). By 8 a.m. the extent of high cloud overcast increased further (Plate 4). The brightest shade in the cloud area indicates cumulonimbus clouds with tops extending up to 14 000 m in altitude.

Satellite pictures taken at 00 a.m. and 2 a.m. on 31 May (Plates 5, 6) show convective activity a distance off the south China coast. Eventually this line of convection intensified and affected the coast (Plate 7).

4. SHORT-DURATION RAINFALL INTENSITY DURING THE RAINSTORMS

The methods of rainfall measurement in Hong Kong are described in Appendix 2.

The locations of the Jardi 'instantaneous' rate-of-rainfall recorders are : the Royal Observatory, King's Park, Airport Meteorological Office and Tate's Cairn. The maximum instantaneous rates recorded during the rainstorms are listed in Table 2 for each of the four days. Available records indicate that the extreme maximum instantaneous rate of 264 mm/h occurred at around 2.15 a.m. on 29 May, at the Royal Observatory. For the purpose of comparison, intensity values exceeding 200 mm/h over the period 1981-1982 are listed in Table 3. Comparison with the maximum instantaneous rates recorded during the May rainstorms (Table 2) shows that these values are not infrequent.

Intensities over a duration of 15 minutes or more are estimated from autographic charts. 15-, 30-, 60- and 120-minute rainfall maxima are listed in Table 4 in order of decreasing rainfall totals over the 4-day period. The maximum rainfall in 120 minutes, irrespective of the time of occurrence, is plotted (Fig. 3) using supplementary data derived from the network of telemetering tipping-bucket rain-gauges. The figure reveals maxima over Junk Bay, Tai Mo Shan and Lantau Island. Rainfall intensity minima were observed over Waglan, Cheung Chau, Sha Tin and the northern part of the New Territories. For durations of 15 and 30 minutes, another intense area was found over the southern part of Kowloon and the northern part of Hong Kong Island.

With regard to the spatial variation of rainfall intensity (Table 4), there are a few more points worth mentioning. Over a duration of 60 minutes, the maximum rainfall amounts recorded at High Island East (107.0 mm from 0230 to 0330 H, 29 May) and at Shek Pik Reservoir (100.5 mm from 0030 to 0130 H, 29 May) are 48% and 40% respectively higher than that observed at the Royal Observatory (72.3 mm from 0125 to 0225 H, 29 May). Over a duration of 120 minutes, the value at Tai Po Tau (165.0 mm from 0400 to 0600 H, 29 May) and at High Island East (154.0 mm from 0145 to 0345 H, 29 May) are 64% and 50% respectively higher than that observed at the Royal Observatory. Over durations of 15, 30, 60 and 120 minutes, the smallest of the maximum rainfall among various stations are around 50% less than the corresponding values at the Royal Observatory.

Location of local places mentioned in this section and in the following sections are shown in Fig. 4.

5. RAINFALL OVER HONG KONG

Daily rainfall amounts mentioned in this section are 24-hour values ending at 3 p.m. on each day.

The following analyses of spatial and temporal distributions of rainfall over Hong Kong were carried out using data collected by all rain-gauges.

The distribution of rainfall over Hong Kong in the month of May 1982 is presented in Fig. 5. Comparison with the mean distribution for May (Fig. 6) reveals the general resemblance in the rainfall pattern, with the exception of maxima appearing over Junk Bay, Clear Water Bay and High Island associated with the May rainstorms.

The distribution of daily rainfall in each of the four days is presented in Figs. 7 to 10. Rainfall totals over the four days (Fig. 11) show that the northeastern side of Hong Kong Island, High Island, Ma On Shan, Junk Bay, areas northwest of Tai Mo Shan (Kam Tin and Pat Heung), Hei Ling Chau and Shek Pik received more than 700 mm of rain.

The evolution of 3-hourly rainfall distribution over the four days are shown in Fig. 12(i) through Fig. 12(xxxi). Soon after 9 a.m., 28 May (Fig. 12(iv)), thunderstorms spread in from the west, affecting Lantau Island. In the afternoon, rainfall became concentrated over Tate's Cairn, Sai Kung and Hong Kong Island (Fig. 12(v), (vi)). By the evening, rain became less intense (Fig. 12(vii)). However, shortly before midnight, development occurred again in the west (Fig. 12(viii)). In the early morning of 29 May, rainfall became concentrated over Tai Mo Shan and High Island (Fig. 12(x)). The rainfall distribution between 6 a.m. and 9 a.m. (Fig. 12(xi)) shows maxima over the southeast, south of Lantau Island, Tai Mo Shan and areas to its north. Rain started to abate after 9 a.m. Only localized thunderstorms affected Sha Tin and the southeastern side of Hong Kong Island (Figs. 12(xii), (xiii)). After 6 p.m., an area of rain began to develop over Cheung Chau, Lamma Island and the south of Hong Kong Island (Fig. 12(xv)). This area of rain died out after midnight.

Rain generally subsided on 30 May. The areas which received the most rainfall were Fan Ling and Sheung Shui, where only about 20 mm fell from midnight, 29 May to midnight, 30 May (Figs. 12(xvii) to (xxiv)).

In the early morning of 31 May, rapid development occurred in the east. Rainfall was concentrated first over High Island and Waglan (Fig. 12(xxv)), then over Kowloon (Fig. 12(xxvi)), Hong Kong Island and Lantau Island (Fig. 12(xxvii)). By noon, rainfall was concentrated over Lantau and Sai Kung (Fig. 12(xxviii)). Rain continued and between 3 p.m. and 6 p.m., the rainfall maximum was over the northern part of the New Territories (Fig. 12(xxx)). Rain subsided after 6 p.m. (Fig. 12(xxxi)).

Mass curves, i.e. plots of accumulated rainfall versus time of day, for the Royal Observatory, High Island East, Shek Pik Reservoir, Ta Kwu Ling and Yuen Long are presented in Fig. 13. All autographic stations including those not shown in Fig. 13 show rapid increase in the rainfall soon after the midnight of 28 May and after the midnight of 30 May.

6. DEPTH-AREA-DURATION ANALYSIS

Depth-area-duration analysis was carried out to determine if there is any significant variation, both in time and space of the rainfall pattern, at different locations of Hong Kong. The procedure of the analysis follows recommendations in the Guide to Hydrological Practice published by the World Meteorological Organization (1974).

The pertinent automatic recording stations were first listed in a table (not shown) in order of decreasing magnitude of total storm rainfall. Accumulated values of rainfall were tabulated for each station, using 6-hour increments. This is because the subsequent analysis carried out for durations of 6, 12, 18, 24, 30, 36, 42 and 48 hours.

The next step was to examine the table and select the particular 6-hour period which had the largest of the 6-hour rainfall increments.* For this particular time increment the values from all stations were then listed. The period of maximum 12-hour rainfall was found similarly and its rainfall listed. The same operation was applied to get the maximum 18-, 24-, 30-, 36-, 42- and 48-hour increments using 6-hour rainfall totals. For periods embracing several 6-hour increments, a number of scans were required to find the period which included the maximum rainfall for a particular duration.

From the table, isohyetal maps of rainfall were prepared (not shown) for each duration. The area bounded by each 50 mm isohyet was then evaluated by the use of a planimeter. The average areal rainfall was calculated using the following expression :

$$\bar{R} = \frac{\sum_{R} A_R . R}{\sum_{R} A_R}$$

where A_R is the area bounded by two adjacent isohyets (or by the isohyet of greatest depth in the case of a rainfall maximum) with a mean rainfall R. The resulting average values were then plotted on a graph of area versus depth, with a curve for each duration (Fig. 14). The enveloping depth-area-duration values for each increment of area and duration were tabulated in Table 5.

It should be noted that the present analysis was carried over land and sea areas and for closed isohyets drawn around areas adequately covered by the rain-gauge network. A separate analysis was conducted over land area only and regardless of whether the isohyets were open or closed, as did Chen (1969) and Cheng and Yerg (1979), and it was found that for the May rainstorms the results differed by no more than 5% in general. For this reason the results were compared to those of previous rainstorms.

* In some instances, there might be more than one such period in which there were comparable rainfall values and, consequently, comparable depth-area values. It was then necessary to carry out several analysis and to draw an enveloping curve for depth-area curves of the same duration.

Fig. 14 shows that as the area increases from 100 sq. km to 1 000 sq. km, there is a general decrease in average depth of rainfall of about 100 mm for durations of 6 to 36 hours, and about 80 mm for durations of 42 and 48 hours. This is much less than the corresponding figure of 200 mm for the rainstorms in June 1972, which is calculated from the results of Cheng and Yeng (1979). It could be inferred that the spatial variation of rainfall depth during the May 1982 rainstorms was comparatively less than that of the June 1972 rainstorm.

The maximum average rainfall amounts (Table 5) do not exceed any of the corresponding values of the rainstorms in June 1966 (Chen, 1969).

7. CONCLUSIONS

The May rainstorms did not break any of the rainfall records at the Royal Observatory. The amount of 653.9 mm over the four days ranks the fifth highest in the historical records.

Satellite imagery depicts the rapid development of the intense storm cells over the sea which spread over Hong Kong during the periods between midnight, 28 May and 2 a.m., 29 May (Plates 1 and 2) and between 2 and 5 a.m., 31 May (Plates 6 and 7).

Short-duration rainfall intensities recorded at the Royal Observatory are found to be not infrequent (Table 1). The extent to which short-duration rainfall varied over Hong Kong is illustrated by the fact that, among various stations, the smallest of the maximum depths for durations from 15 to 120 minutes were about 50% less than those recorded at the Royal Observatory, and that the largest of these maximum rainfall values for durations of 60 and 120 minutes were 48% and 64% repectively higher than those recorded at the Royal Observatory.

Results of a depth-area-duration analysis show that the maximum areal rainfall depths did not exceed any of the corresponding values for the rainstorms in June 1966. When compared to the rainstorms in June 1972, there was less spatial variation in the maximum average rainfall values.

ACKNOWLEDGEMENT

Thanks are due to Mr. C.Y. Lam for his many valuable suggestions.

REFERENCES

1.	Chen, T.Y.	1969	The Severe Rainstorms in Hong Kong during June 1966, Royal Observatory Supplement to Meteorological Results 1966.
2.	Cheng, T.T.	1971	Response of a Jardi Rate-of-Rainfall Recorder, Royal Observatory Technical Note (Local) No. 13.
3.	Cheng, T.T. and Yerg, M.C. Jr.	1979	The Severe Rainfall Occasion, 16-18 June 1972, Royal Observatory Technical Note No. 51.
4.	Peterson, P.	1964	The Rainfall of Hong Kong, Royal Observatory Technical Note No. 17.
5.	Peterson, P. and Kwong, H.	1981	A Design Rain Storm Profile for Hong Kong, Royal Observatory Technical Note No. 58.
6.	World Meteorological Organization	1974	Guide to Hydrological Practices, WMO Report No. 168.

APPENDIX 1

A BRIEF SUMMARY OF DAMAGE AND LOSSES CAUSED BY THE RAINSTORMS IN MAY 1982

This summary has been compiled from information supplied by various Government Departments and public utility companies. Damage reports in the local press were also examined and collected. Plates 8-13 illustrate some of the damage caused by the rainstorms.

During the rainstorms, 25 people were killed, 20 of which by landslips. About 115 people were injured and more than 2 800 made homeless. There were about 296 cases of landslip, probably the worst since 1976.

Severe flooding occurred in various parts of Hong Kong. Rivers in the northwestern New Territories overflowed their banks and vast areas were inundated. Parts of the New Territories were under flood water two metres deep. The floods killed 700 000 heads of poultry and 10 000 pigs and destroyed about 1 000 hectares of farmland. About 400 fish ponds were destroyed, with 570 tonnes of pond fish and 2.3 million fish fry lost. Emergency grants paid by the Government to farmers amounted to HK$2.9 million.

The cost of damage to public works amounted to HK$56 million.

APPENDIX 2

RAINFALL MEASUREMENT IN HONG KONG

Four types of rainfall measuring instruments are used in Hong Kong :-

Type	No.*	Mode of Measurement	Location
Ordinary rain-gauge	81	Daily amount by manual method	All over Hong Kong
Autographic tilting-siphon rain-gauge	29	Continuous recording automatically on chart	All over Hong Kong
Autographic tipping-bucket rain-gauge	2	Continuous recording automatically on chart in quantities of 0.5 mm	Airport Meteorological Office, Waglan Island
Automatic telemetering tipping-bucket rain-gauge	22	Reporting by telemetry in quantities of 0.5 mm every 15 minutes	13 in Hong Kong Island 5 in Kowloon and 4 in the New Territories
Jardi rate-of-rainfall recorder	4	'Instantaneous' intensity recorded on chart	Royal Observatory, King's Park, Airport Meteorological Office, Tate's Cairn

* as in May 1982.

Daily rainfall collected by an ordinary rain-gauge is measured at 3 p.m. each day at all rainfall stations. The rainfall amount is reported to the nearest 0.1 mm.

The recording chart on an autographic rain-gauge is mounted on a drum which is driven by clockwork and moves around a vertical axis a distance of about 11.5 mm in an hour.

For a tilting-siphon rain-gauge, the rainwater in a collector displaces a float so that a marking pen attached to the float moves on the recording paper a vertical distance of 50 mm for every 25 mm of rain. A tilting mechanism will empty the collector after 25 mm of rain has fallen. Rainfall can be read from the chart to the nearest 0.1 m..

Possible causes of inaccuracy in the rainfall readings have been discussed by Peterson (1964). The only difference at present is that the siphoning error in siphon gauges has been reduced to only 2% by the replacement of natural siphon gauges by tilting-siphon gauges in the 1970's. In view of the relative insignificance of the siphoning corrections, they have not been applied to any rainfall value. Rainfall data are routinely checked for inconsistency and the procedure of adjusting rainfall data, when necessary, is described by Peterson (1964). At some stations where there are two rain-gauges, normally one ordinary and the other autographic, the daily rainfall normally refers to that taken with the ordinary rain-gauge.

The two buckets in a tipping-bucket rain-gauge rest on a pivot so that when the bucket has received 0.5 mm of rain it tips and allows the other to start collecting rainwater. During the tip, an electrical switch is operated and a pulse is passed to a nearby autographic recorder or to a remote central station by telemetry.

For the telemetering tipping-bucket rain-gauges, rainfall amount was reported every 15 minutes (changed to 5 minutes in June 1983), i.e. 4 times every hour. The error resulting from the use of 15-minute rainfall from all these gauges in evaluating running maxima over durations of 60 and 120 minutes, for the heavy rain occasion of interest, amounts to :

Duration	Mean Possible Error	Maximum Possible Error
60 min.	16.0%	26.0%
120 min.	4.8%	7.1%

The error is found to be even greater for durations less than 60 minutes. For this reason, data collected by these rain-gauges are not used in deriving rainfall intensity over durations of 60 minutes or less.

The operation of a Jardi rate-of-rainfall recorder has been explained and investigated by Cheng (1971). It records the 'instantaneous' intensity with a response time of 15 seconds. In other words, rainfall of any intensity will have to persist for at least 15 seconds before it can be fully registered by the recorder.

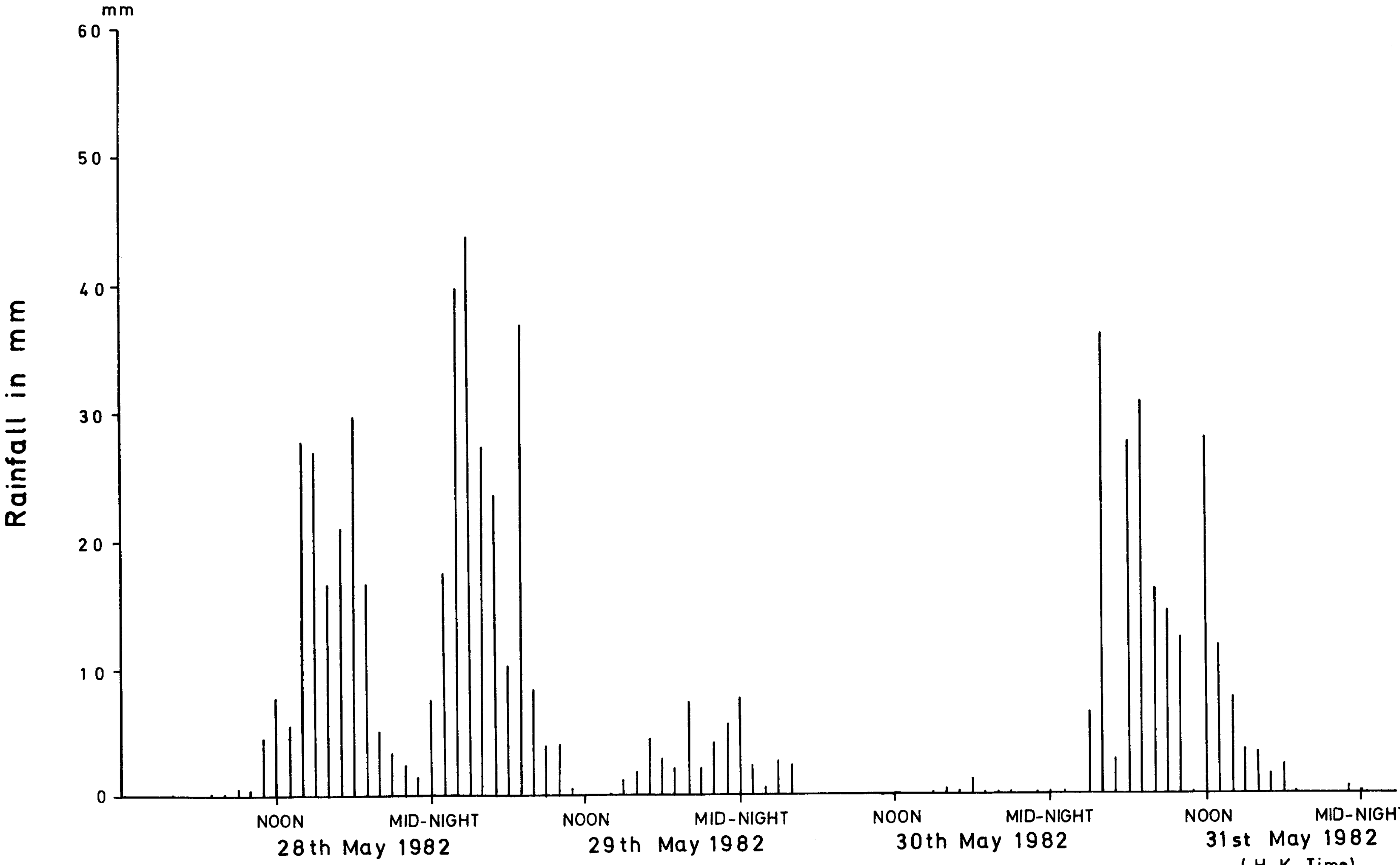


Fig. 1 Time sequence of rainfall for the May rainstorms

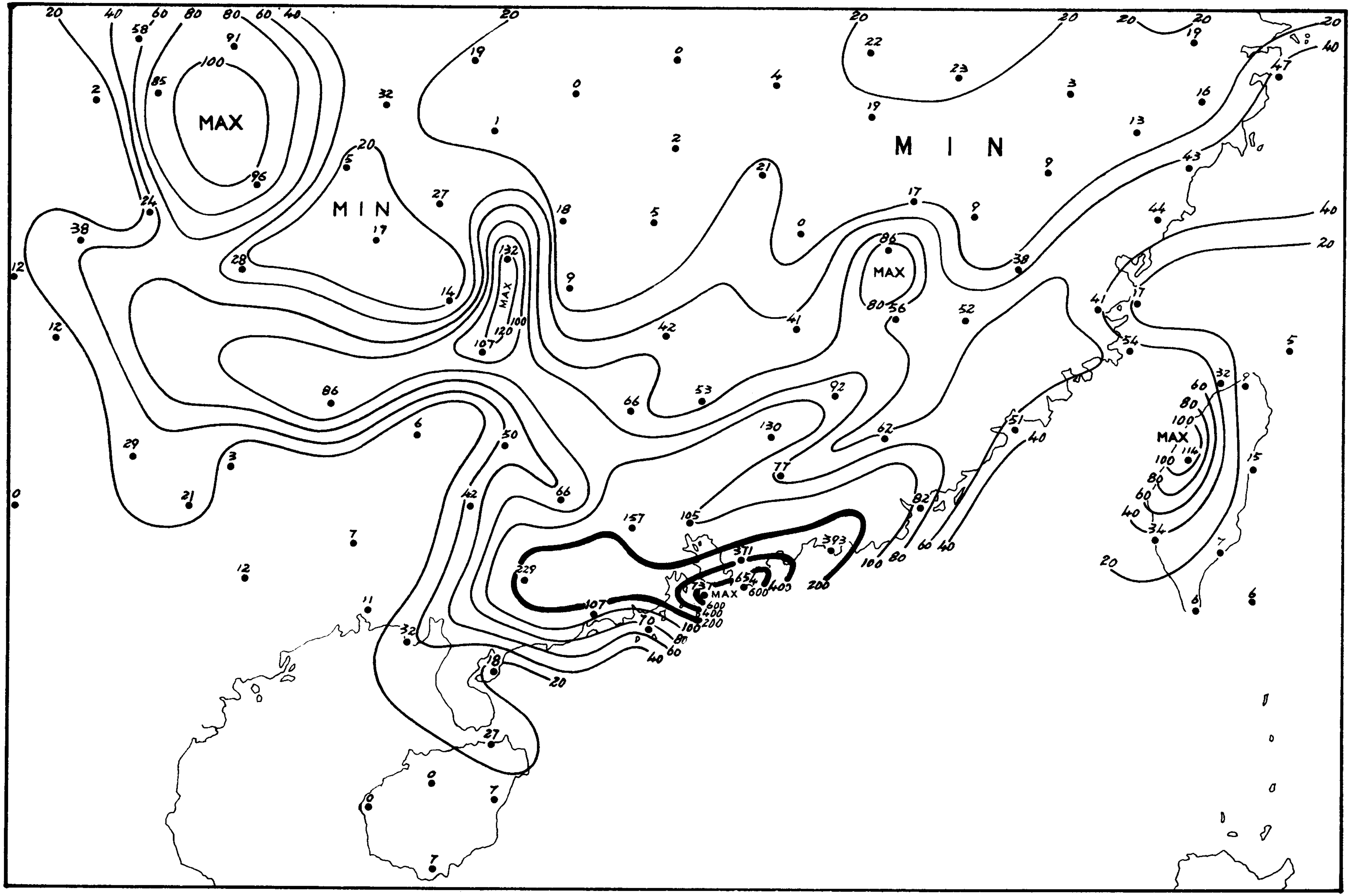
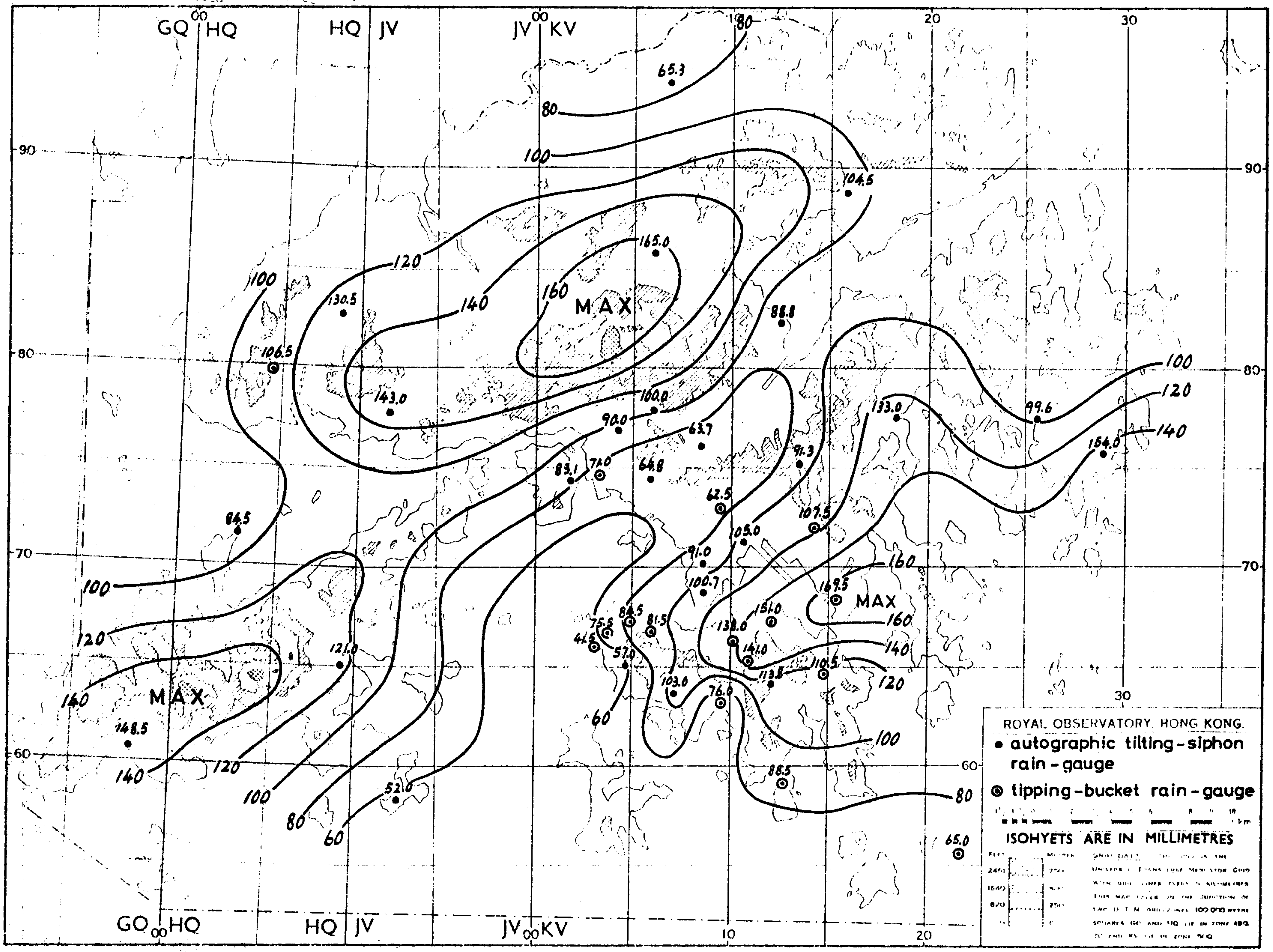
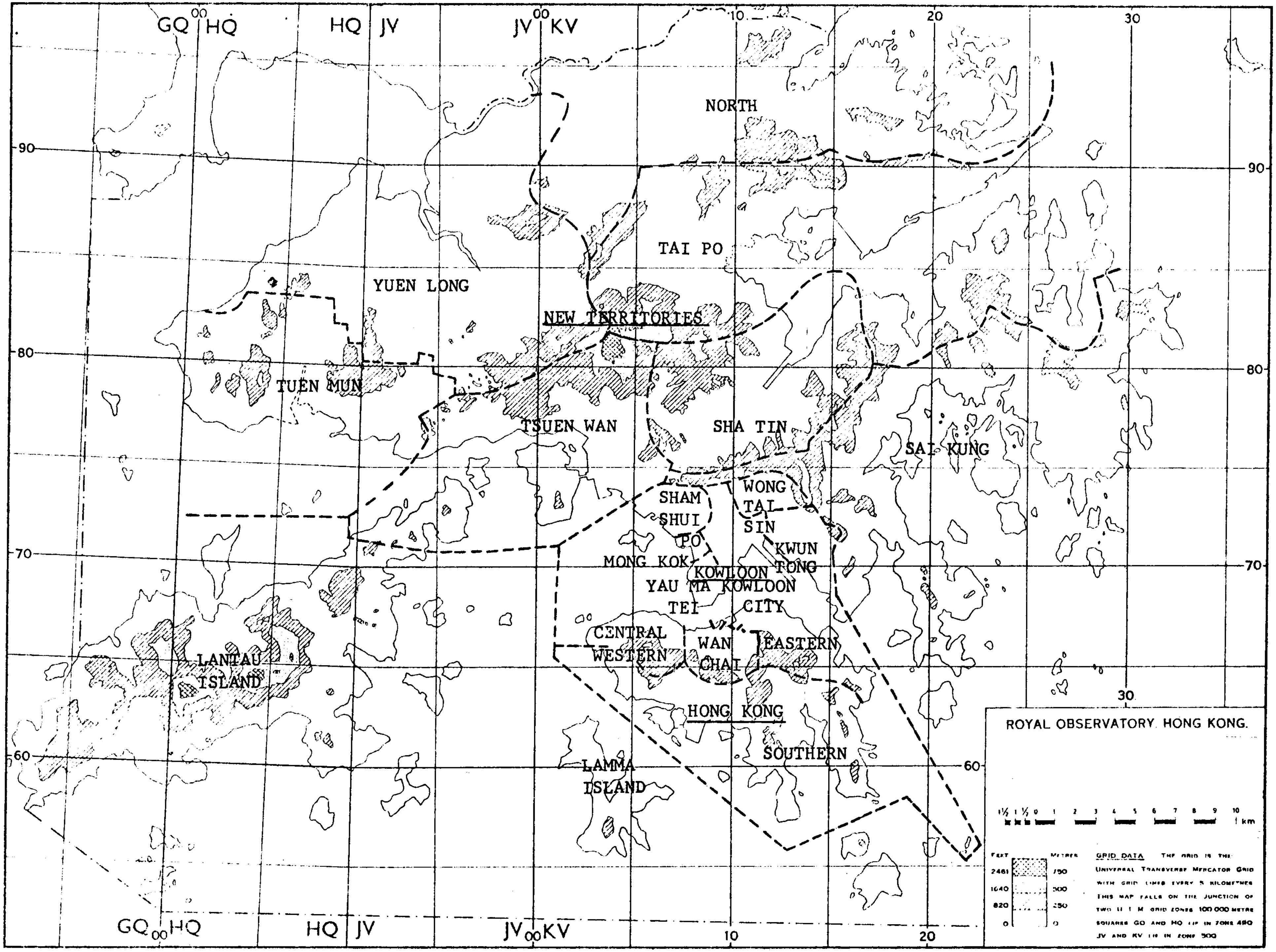


Fig. 2 Rainfall distribution over south China from 0000 GMT, 28 May to 0000 GMT, 1 June 1982.



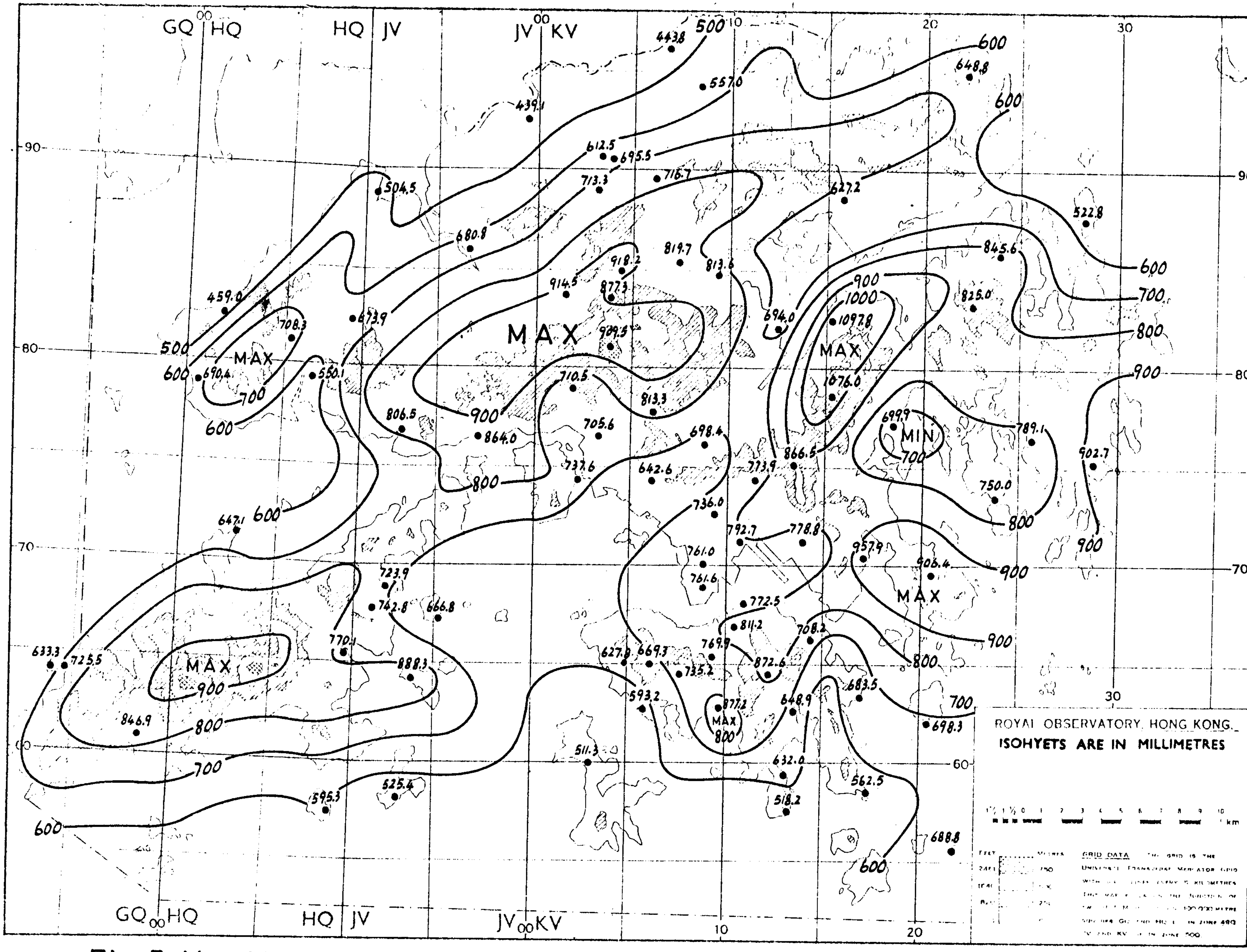
RC 128

Fig. 3 Maximum 120-minute rainfall during the May rainstorms.



R.O. 126

Fig. 4 Map of Hong Kong showing the city districts



R.O. 128

Fig. 5 Monthly rainfall map for May 1982 ending at 3 p.m. on 31 May

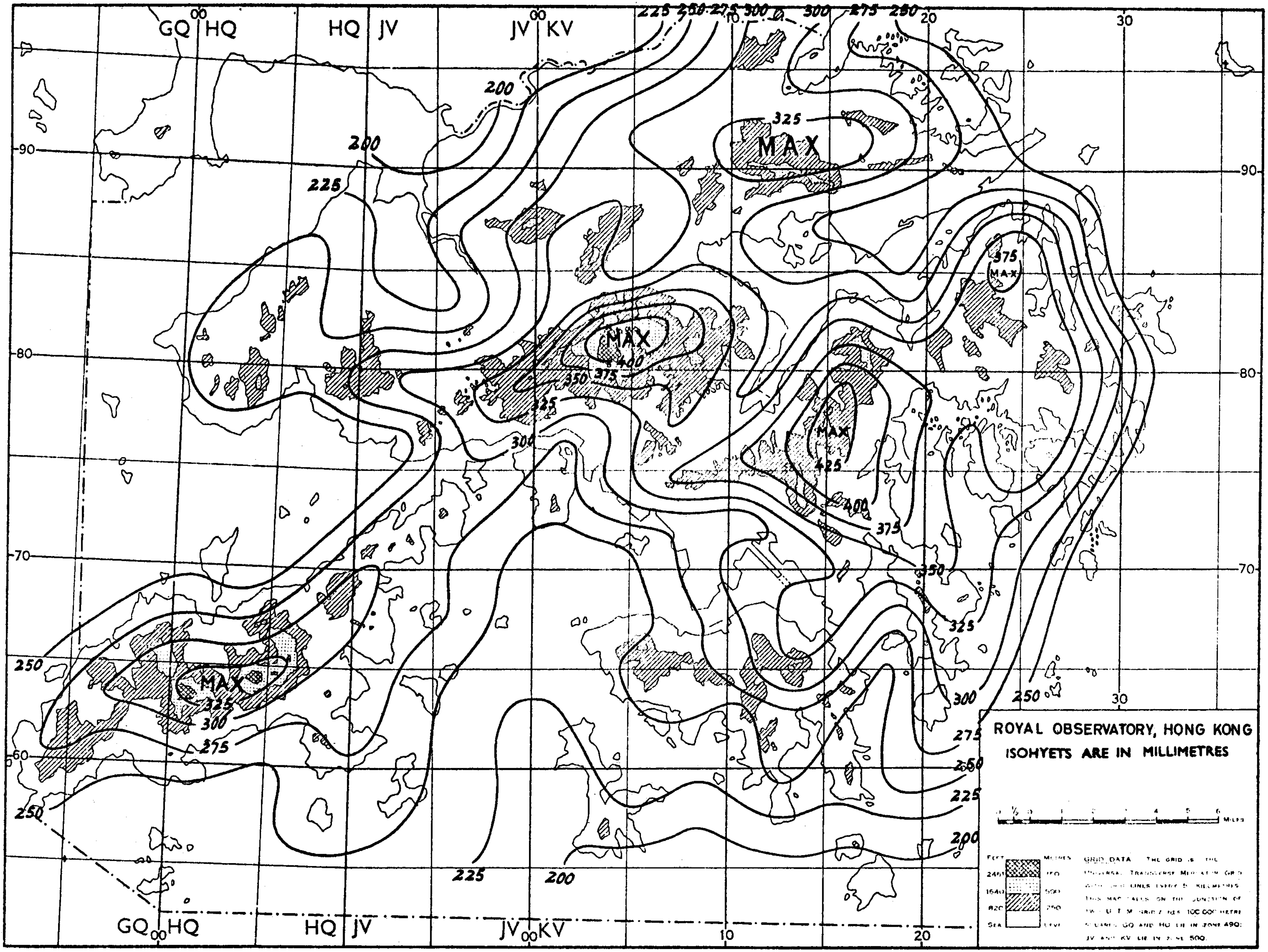


Fig 6 Mean rainfall chart for May 1952 - 1976

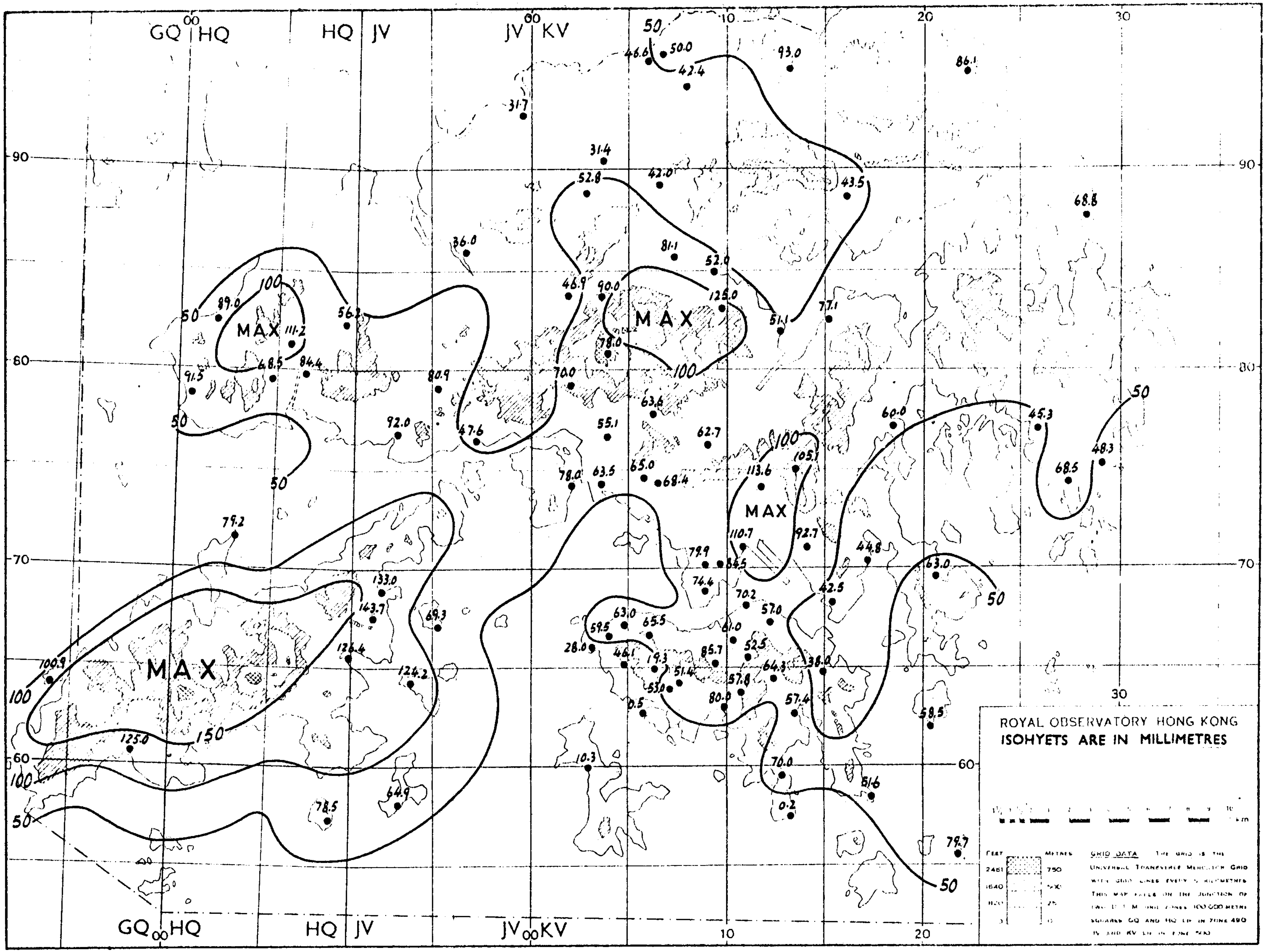
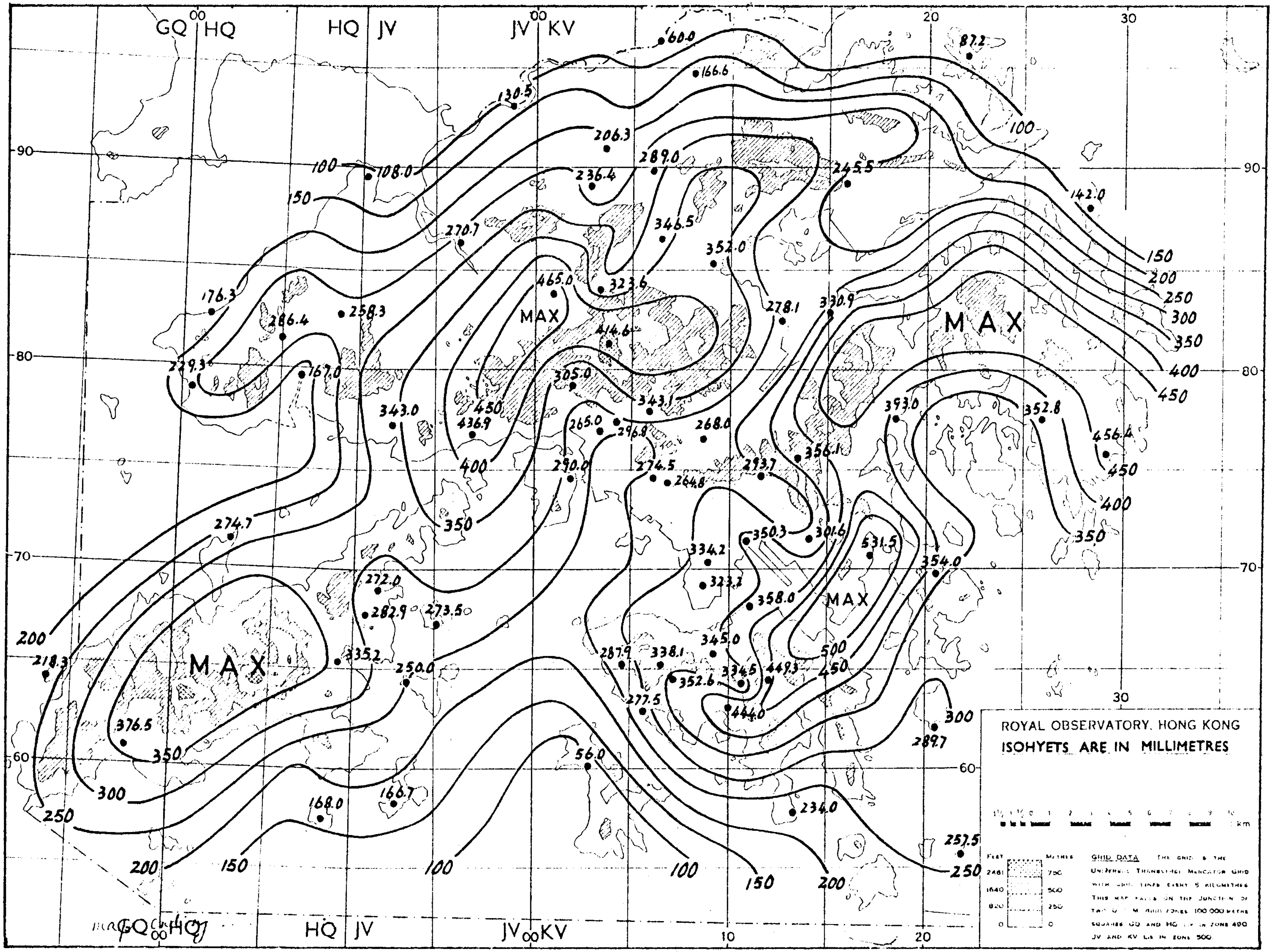


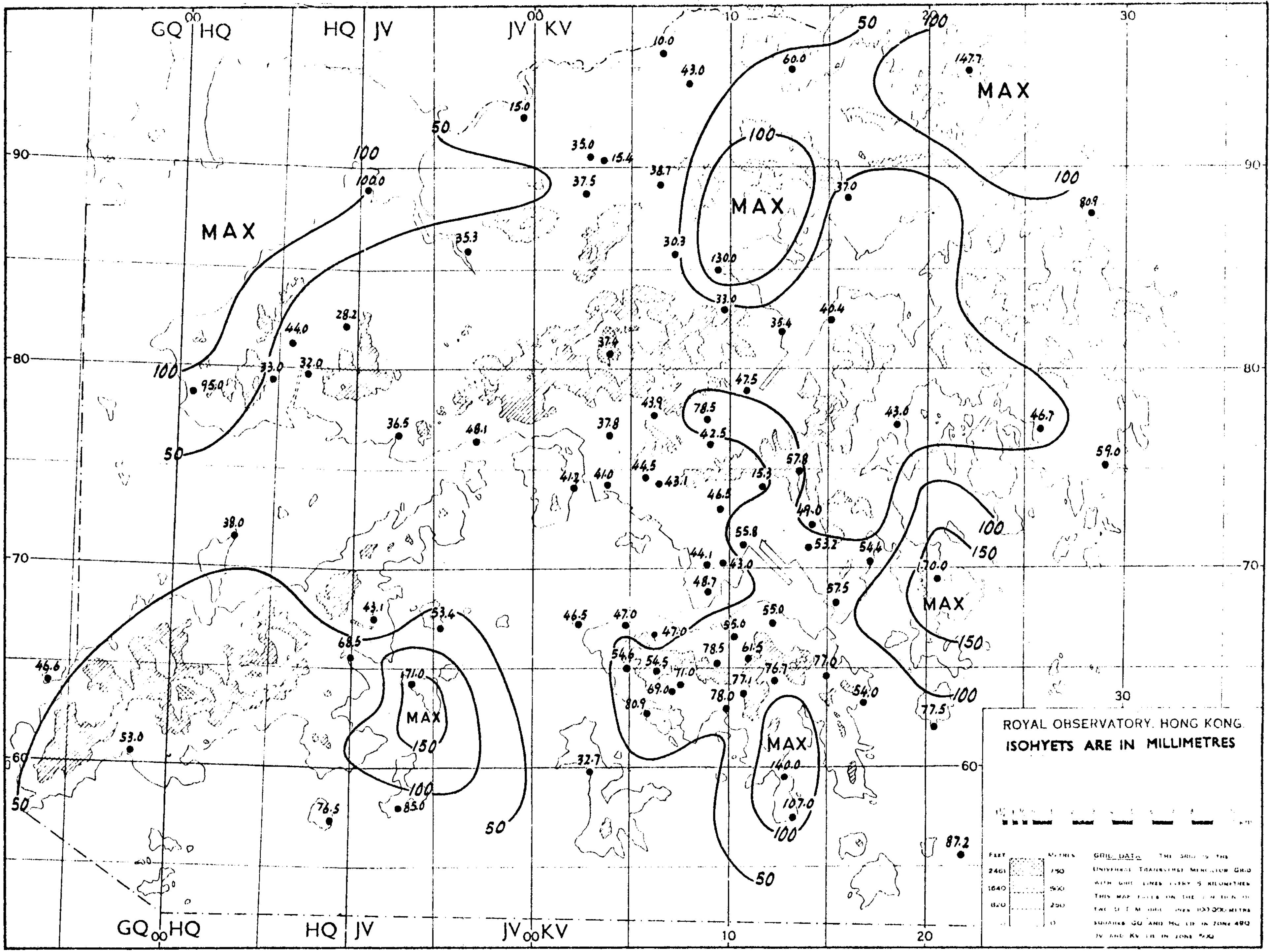
Fig. 7 24-hour rainfall map ending at 3 p.m. 28 May 1982

R.O. 128



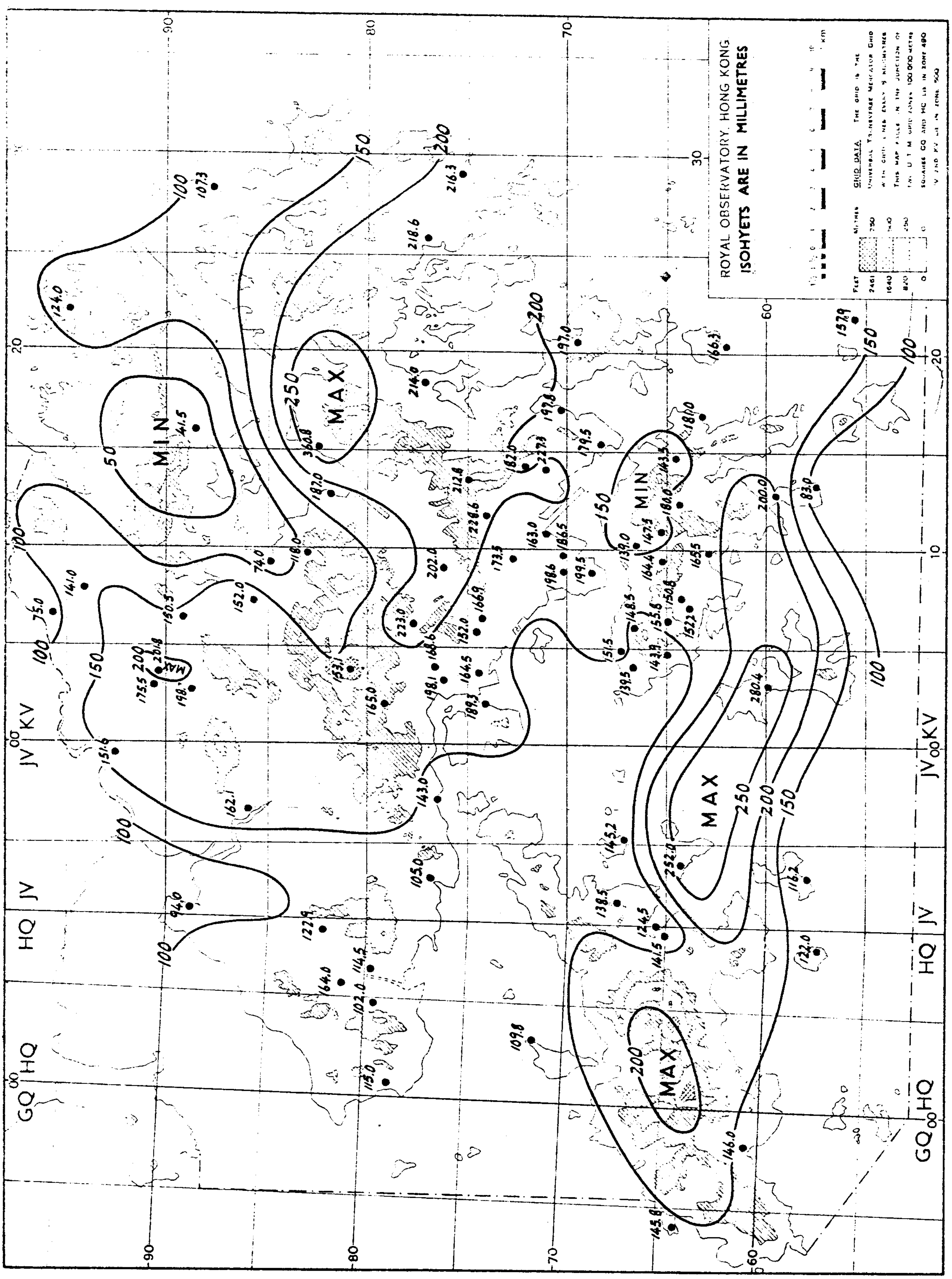
R.O. 128

Fig 8 24-hour rainfall map ending at 3 p.m. 29 May 1982



R.O. 128

Fig. 9 24-hour rainfall map ending at 3 p.m. 30 May 1982



R.O. 128

Fig. 10 24 - hour rainfall map ending at 3 p.m. 31 May 1982

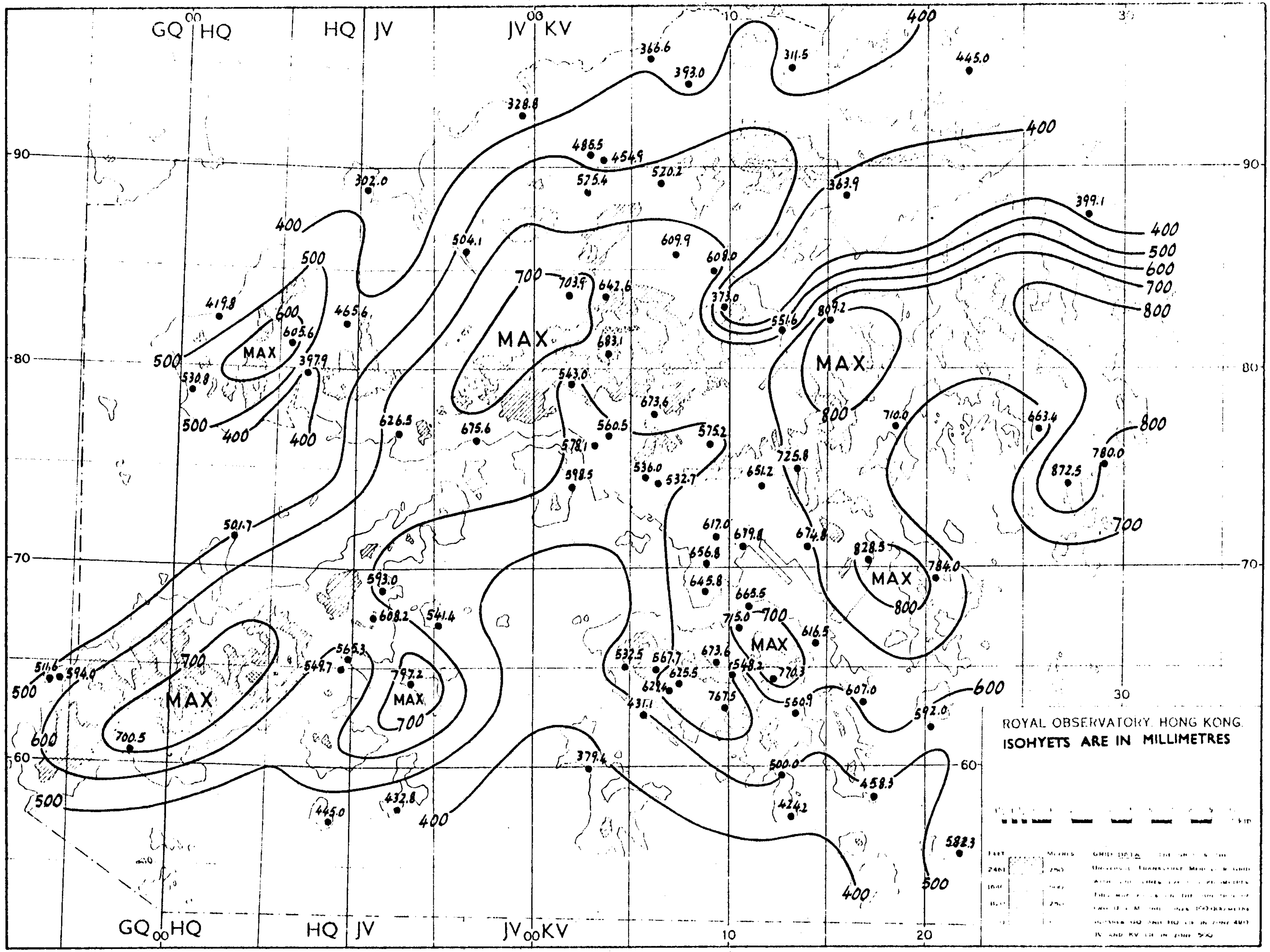
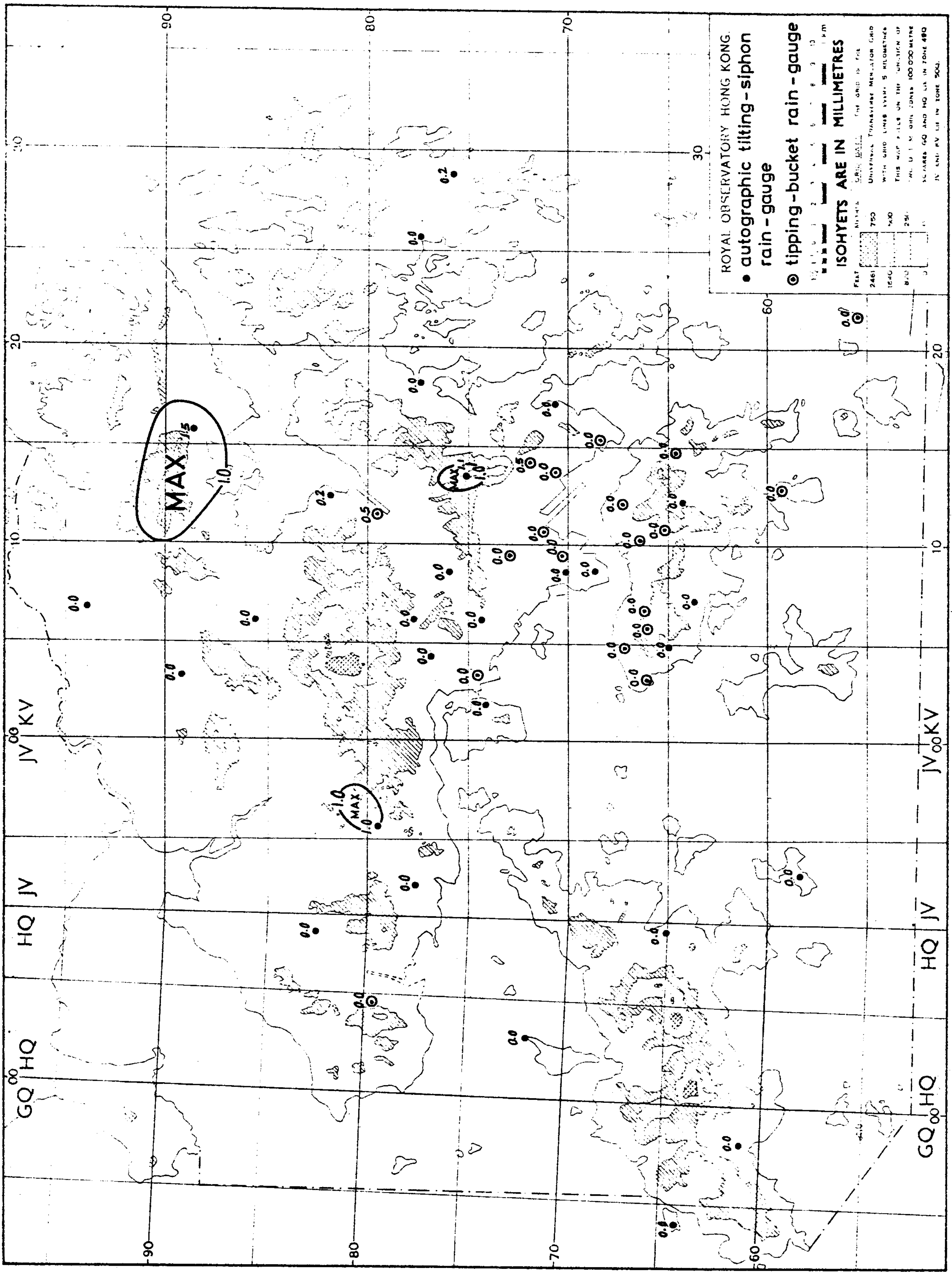


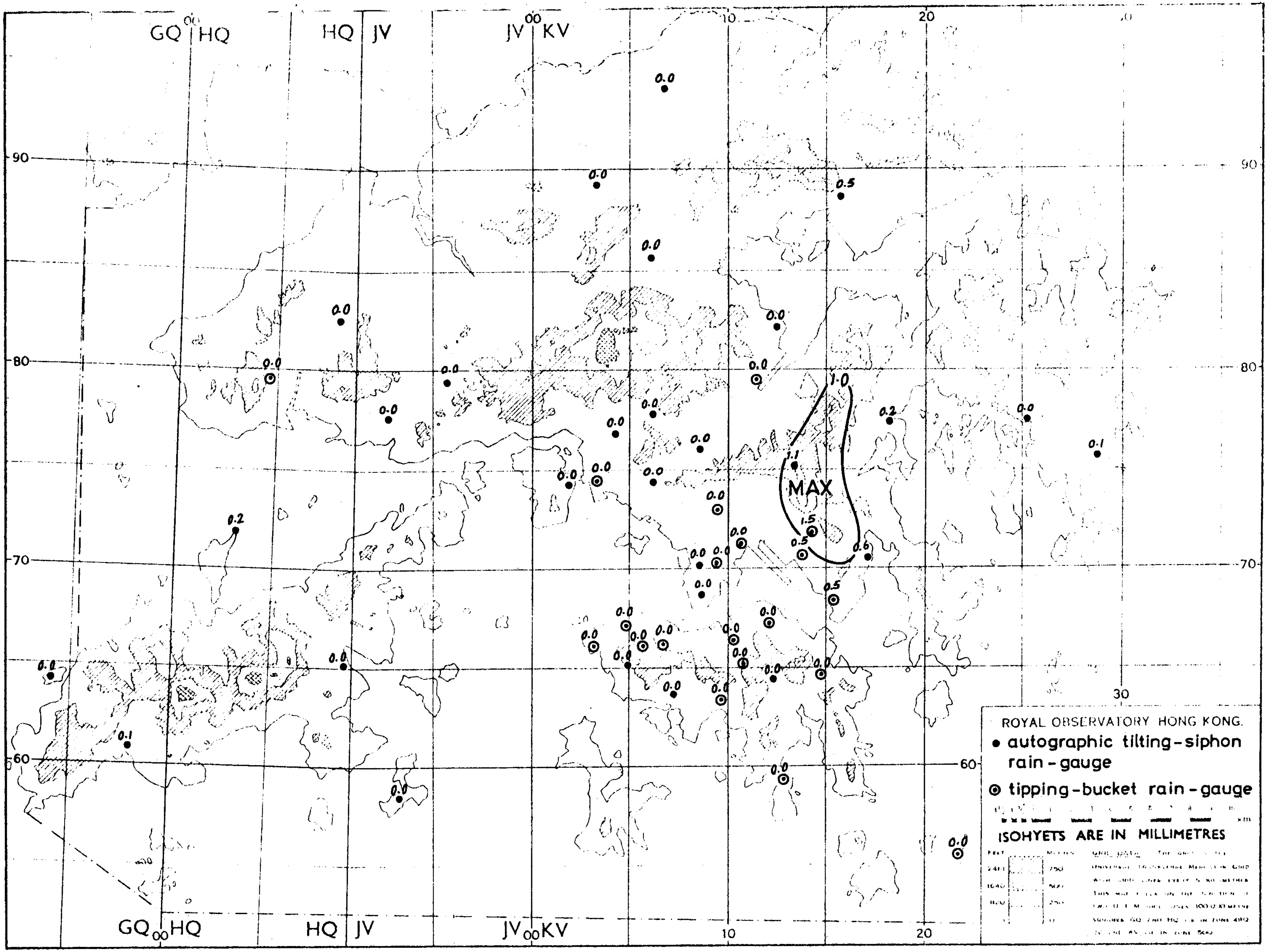
Fig.11 4-Day rainfall total ending at 3 p.m. 31 May 1982

R.O. 128

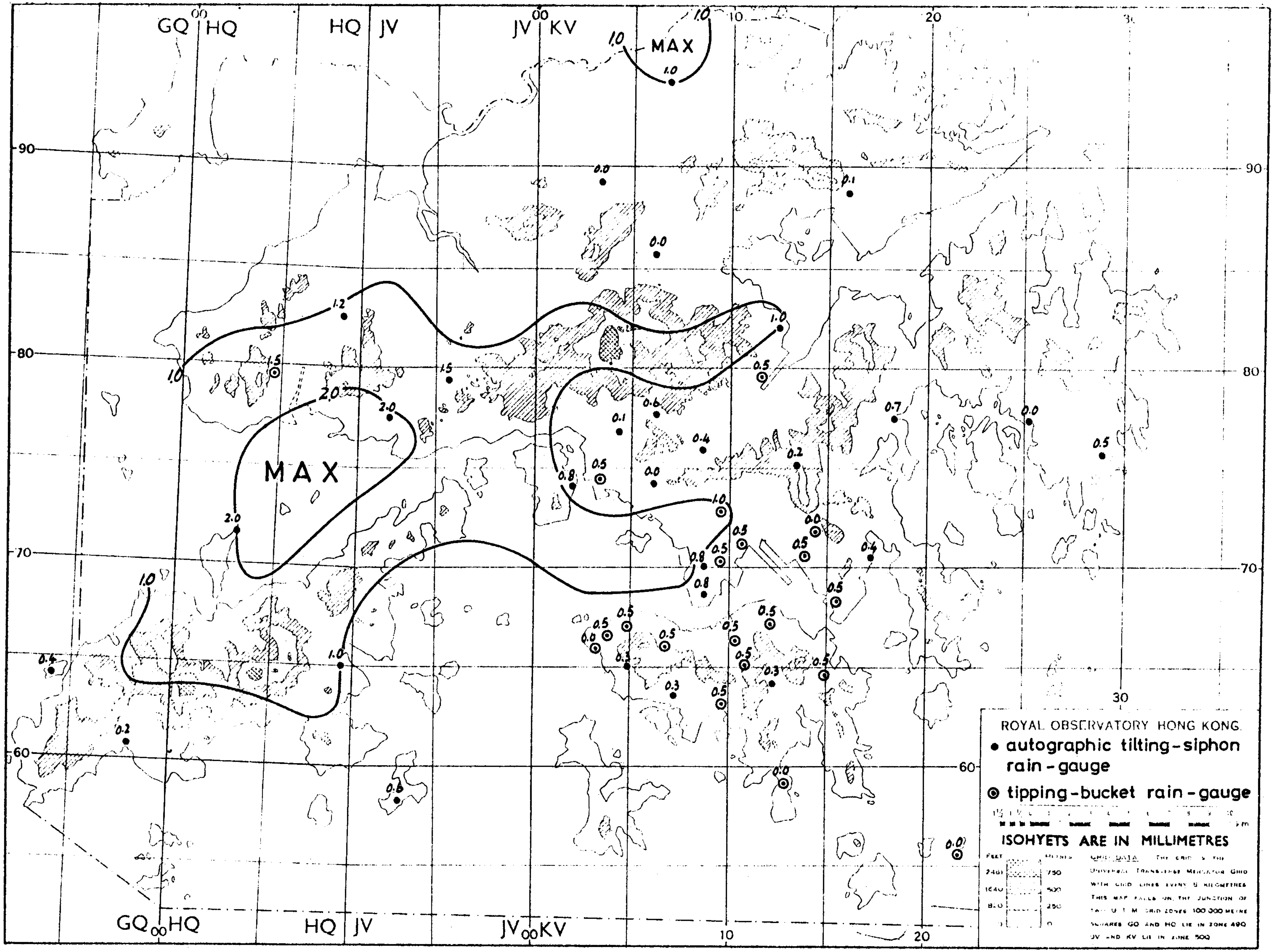


R.O. 128

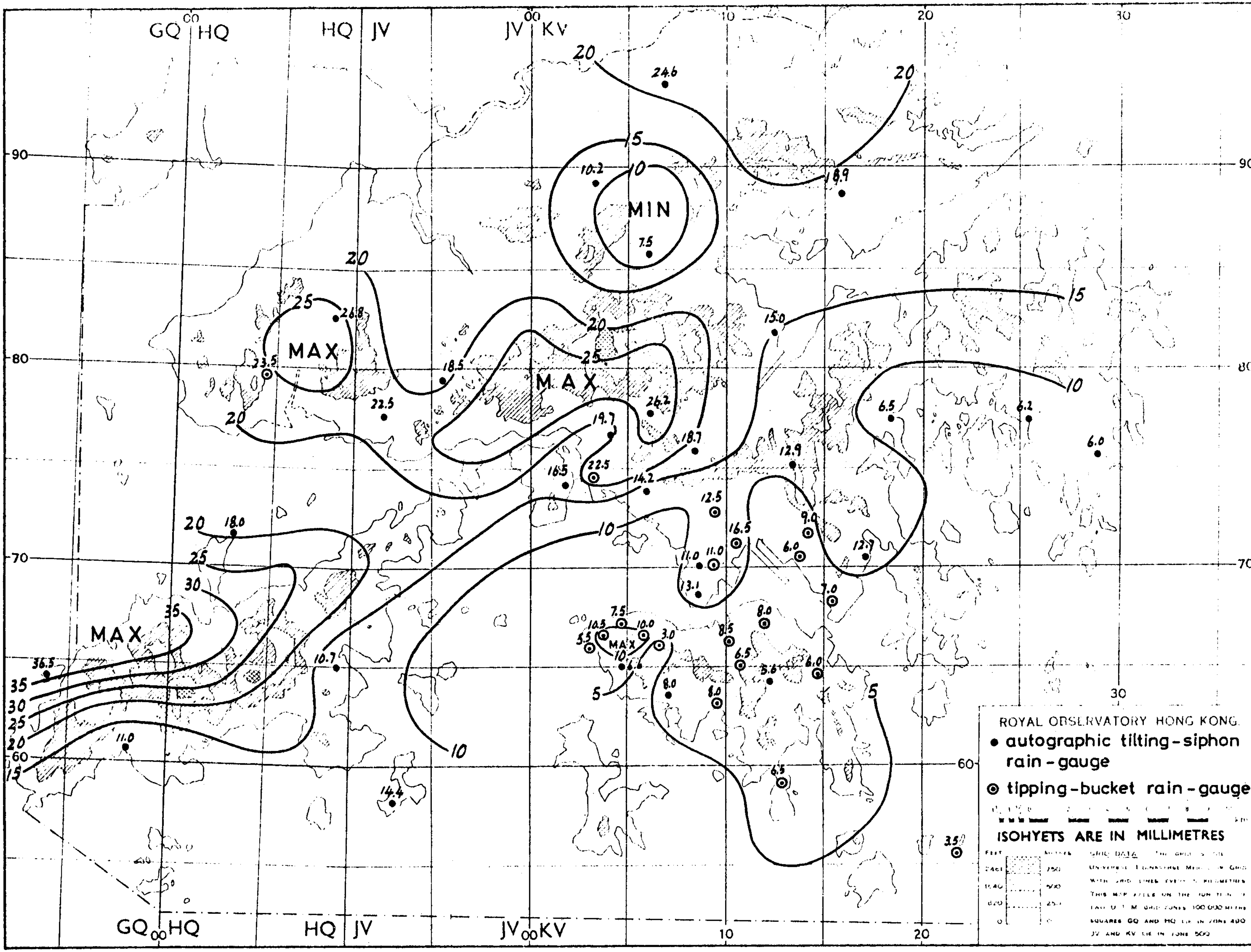
Fig 12 (i) 3 - hour rainfall map ending at 0300 H.K. Time, 28 May 1982



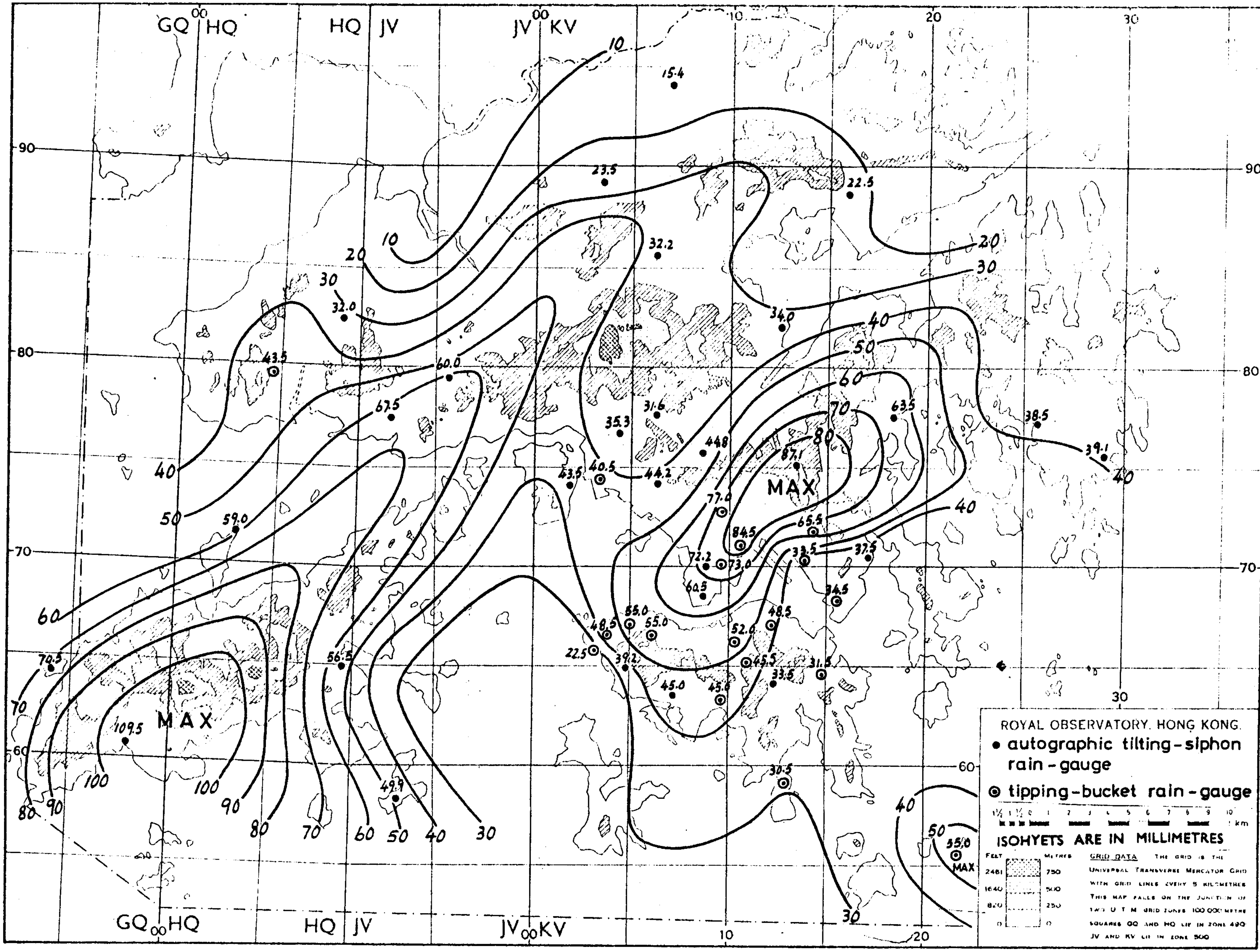
R.O. 128 Fig. 12 (ii) 3-hour rainfall map ending at 0600 H.K. Time, 28 May 1982



R.O. 128 Fig. 12 (iii) 3-hour rainfall map ending at 0900 H.K. Time, 28 May 1982

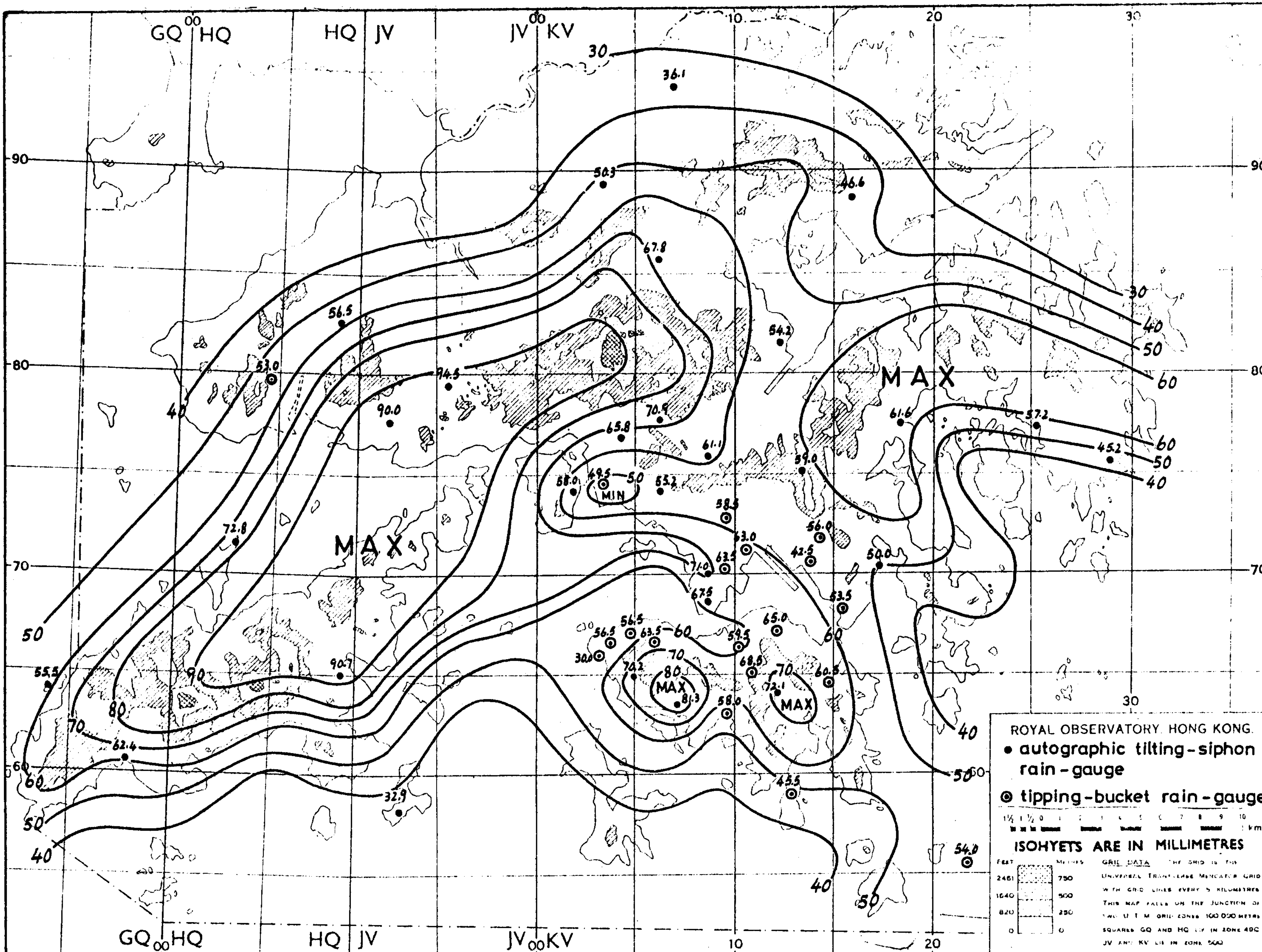


R.O. 128 Fig. 12 (iv) 3-hour rainfall map ending at 1200 H.K. Time, 28 May, 1982

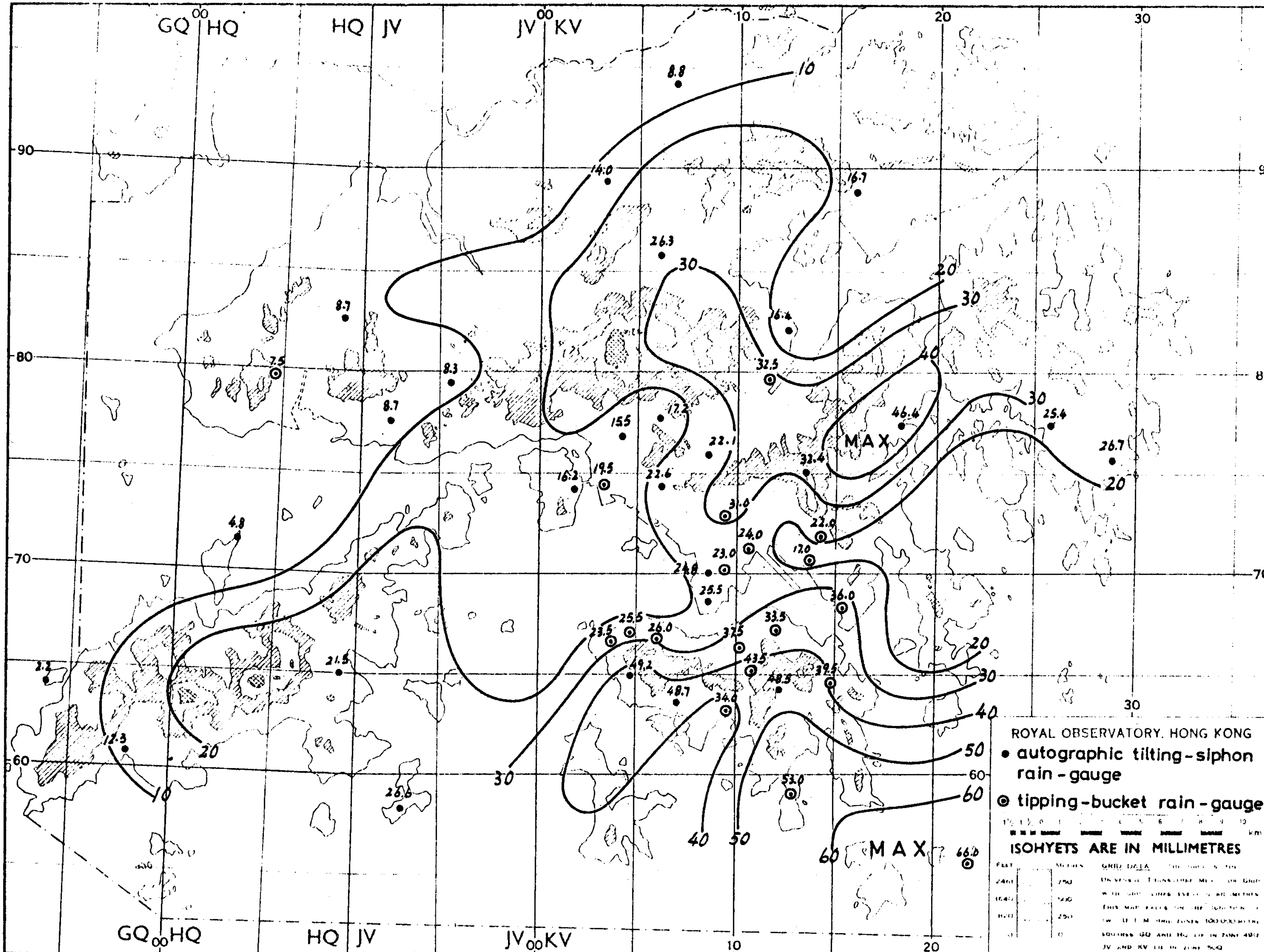


R.O. 128

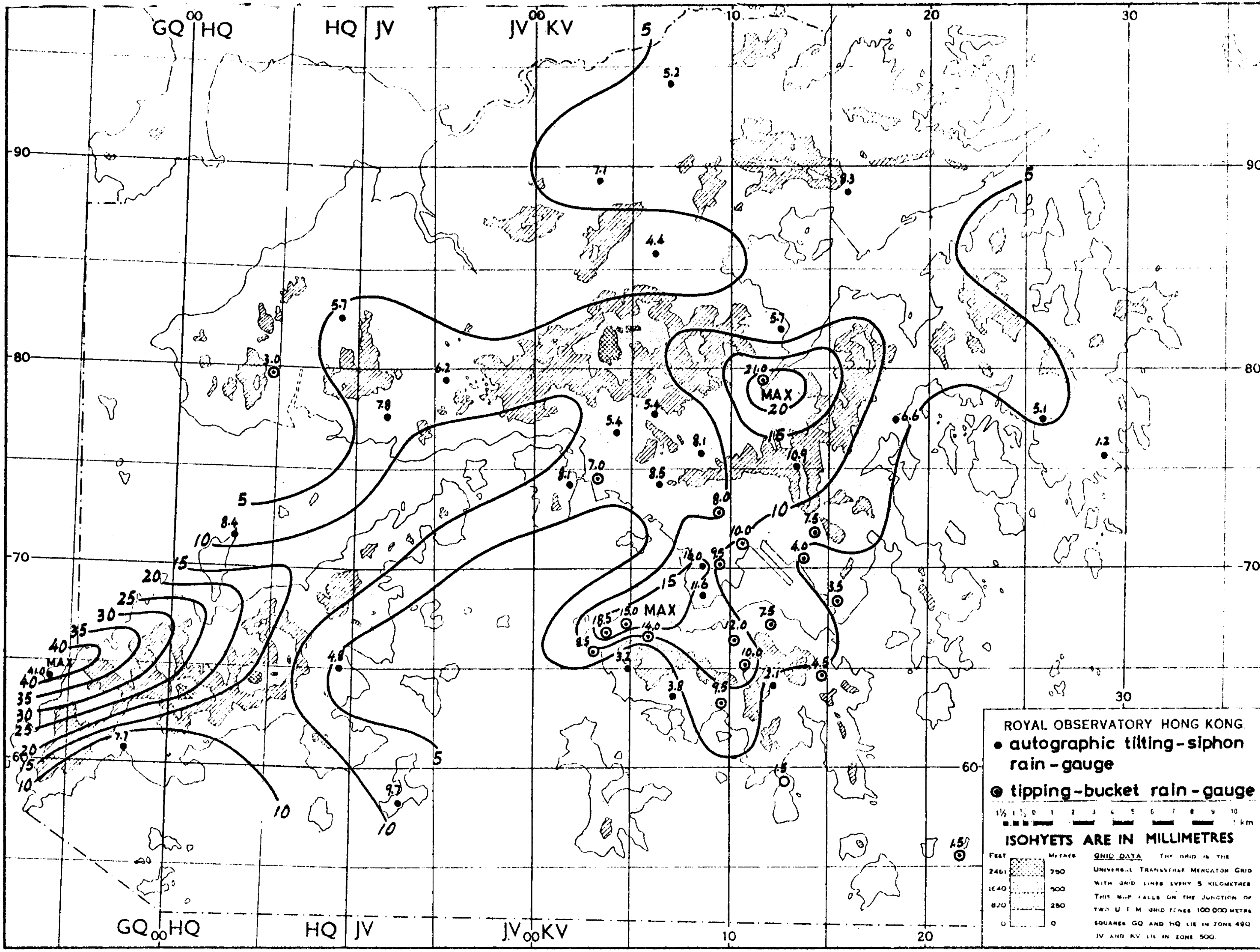
Fig.12 (v) 3-hour rainfall map ending at 1500 H.K. Time, 28 May 1982



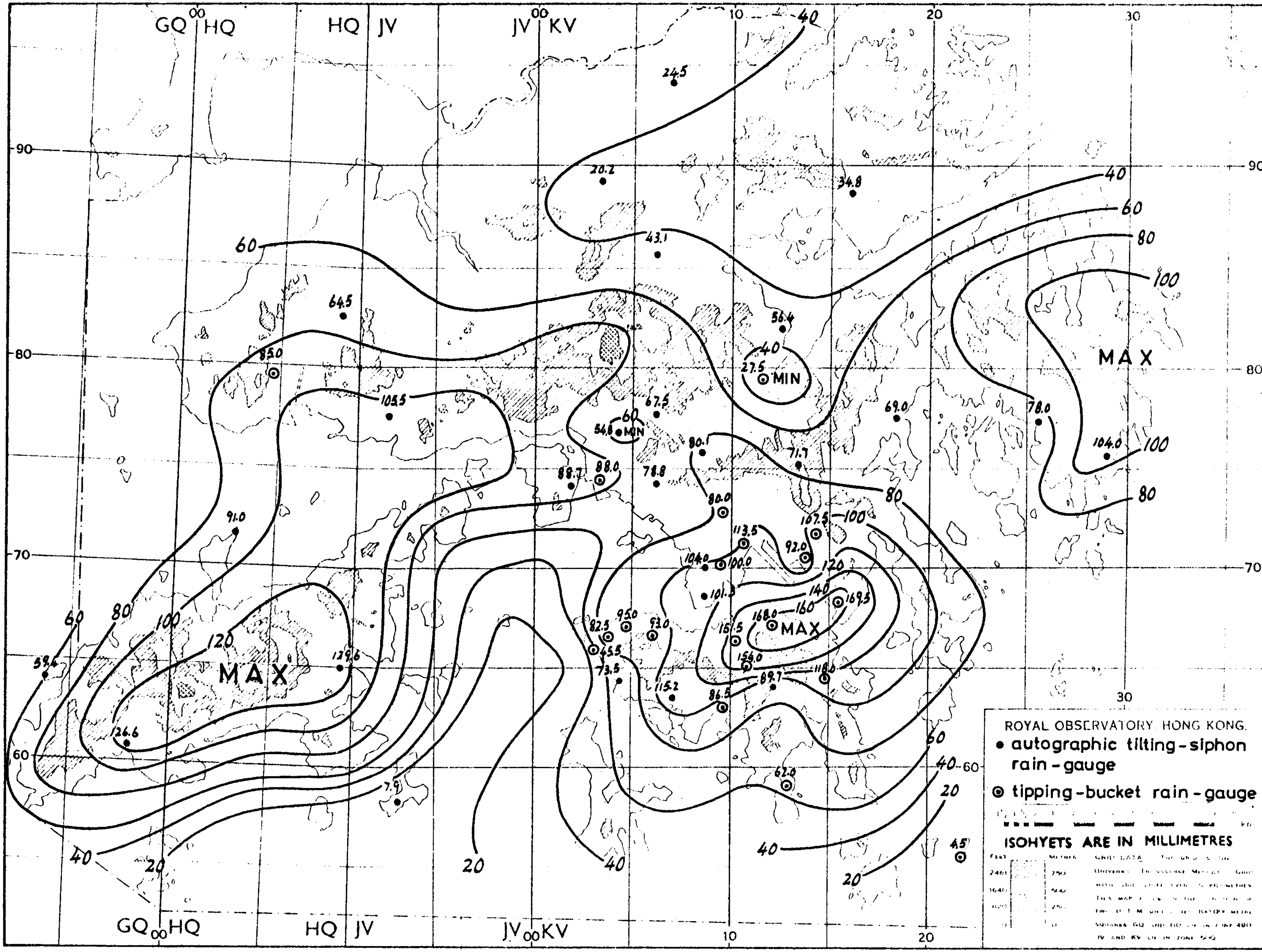
R.O. 128 Fig. 12 (vi) 3-hour rainfall map ending at 1800 H.K. Time, 28 May 1982



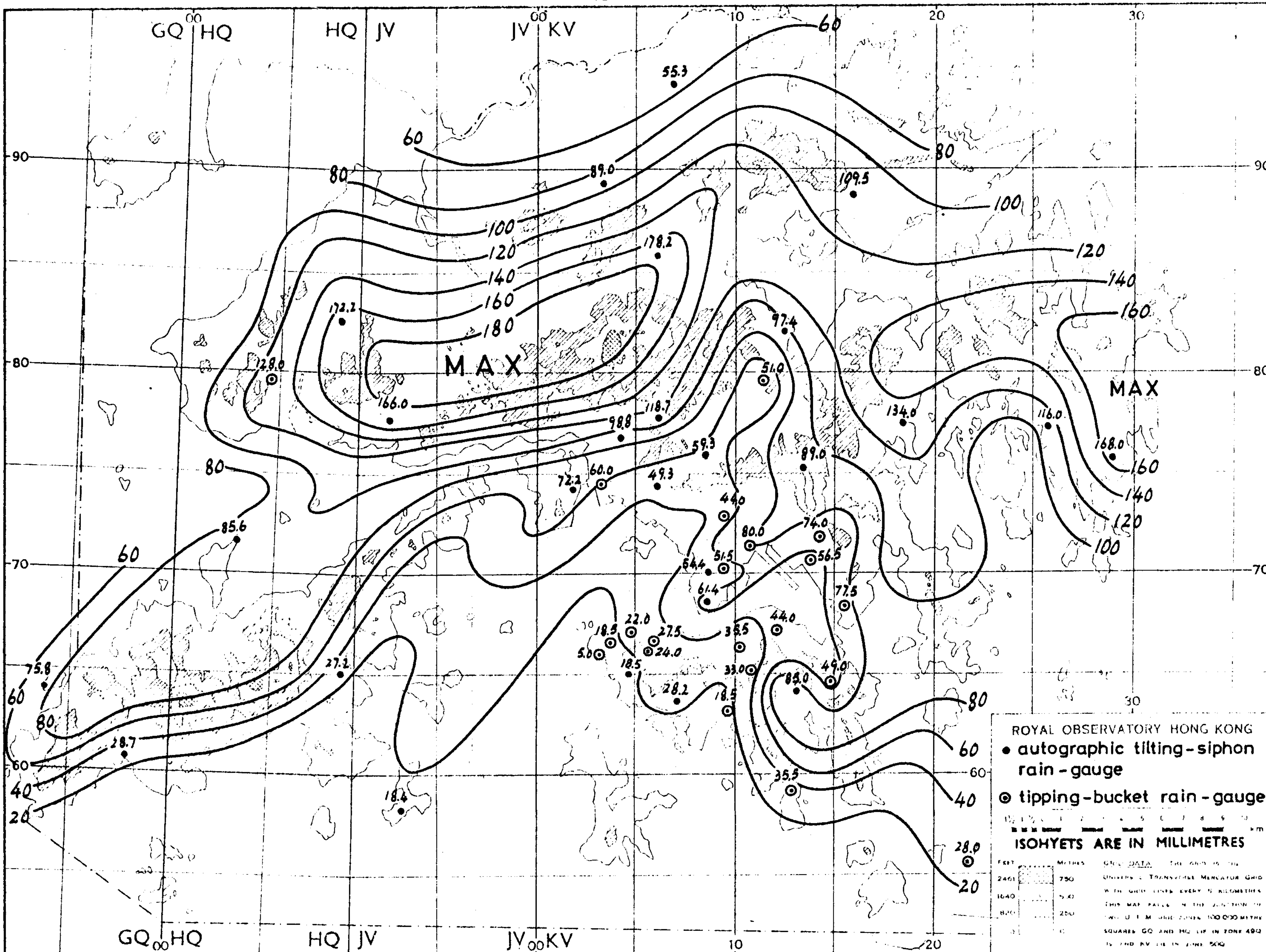
R.O. 128 Fig. 12 (vii) 3-hour rainfall map ending at 2100 H.K. Time, 28 May 1982



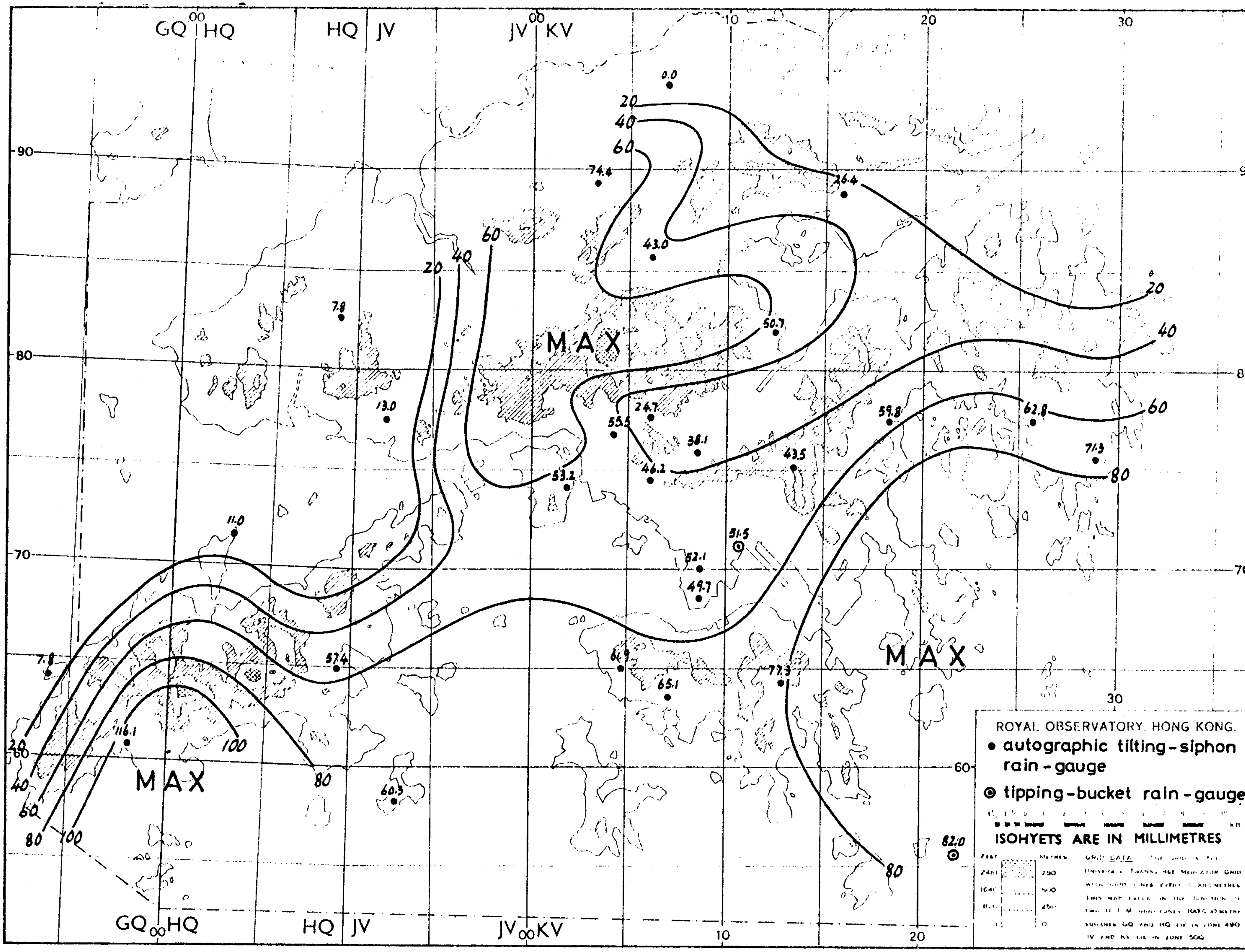
R.O. 128 Fig. 12 (viii) 3-hour rainfall map ending at 0000 H.K. Time, 29 May 1982



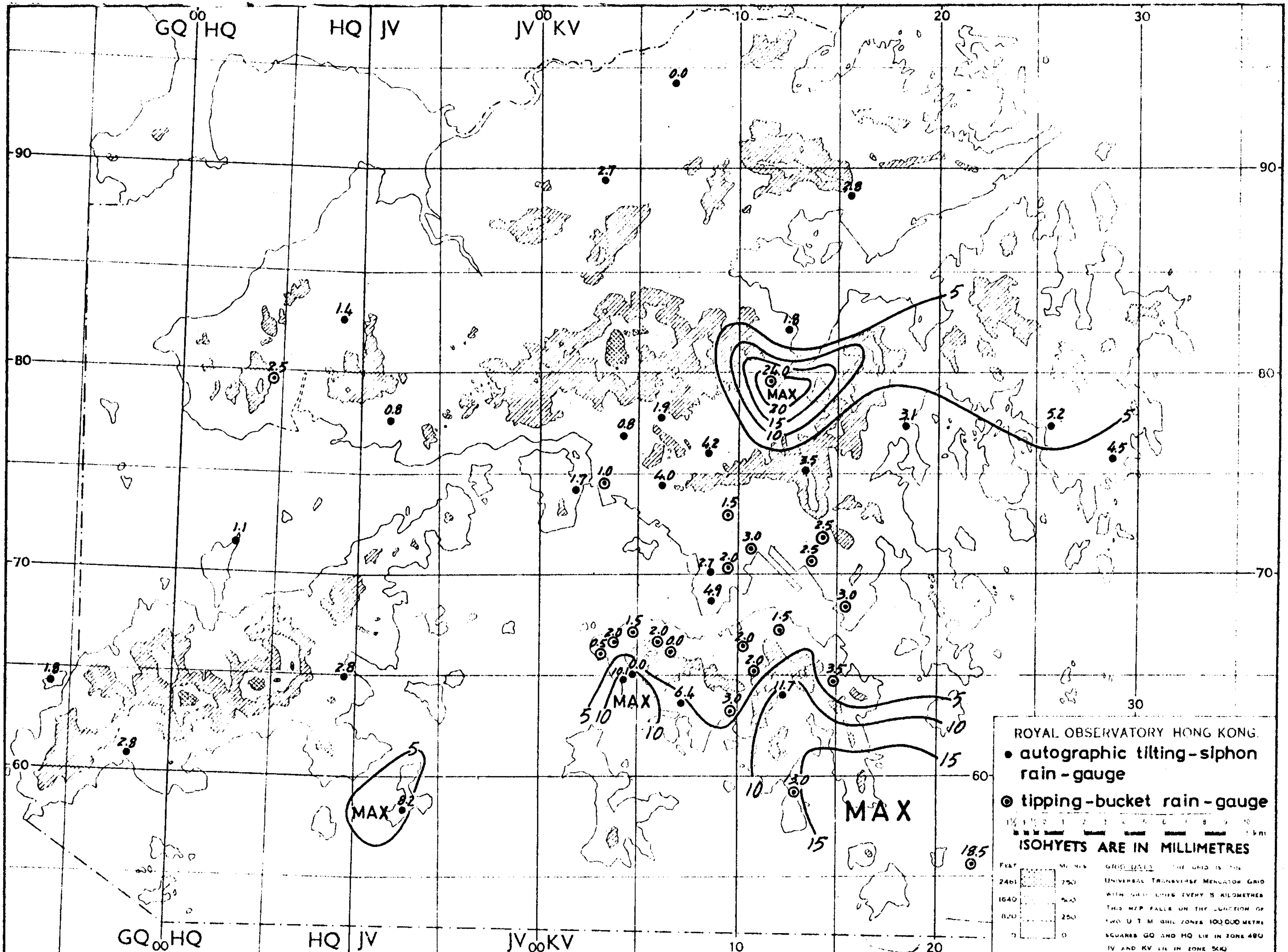
R.O. 128 Fig. 12 (ix) 3-hour rainfall map ending at 0300 H.K. Time, 29 May 1982



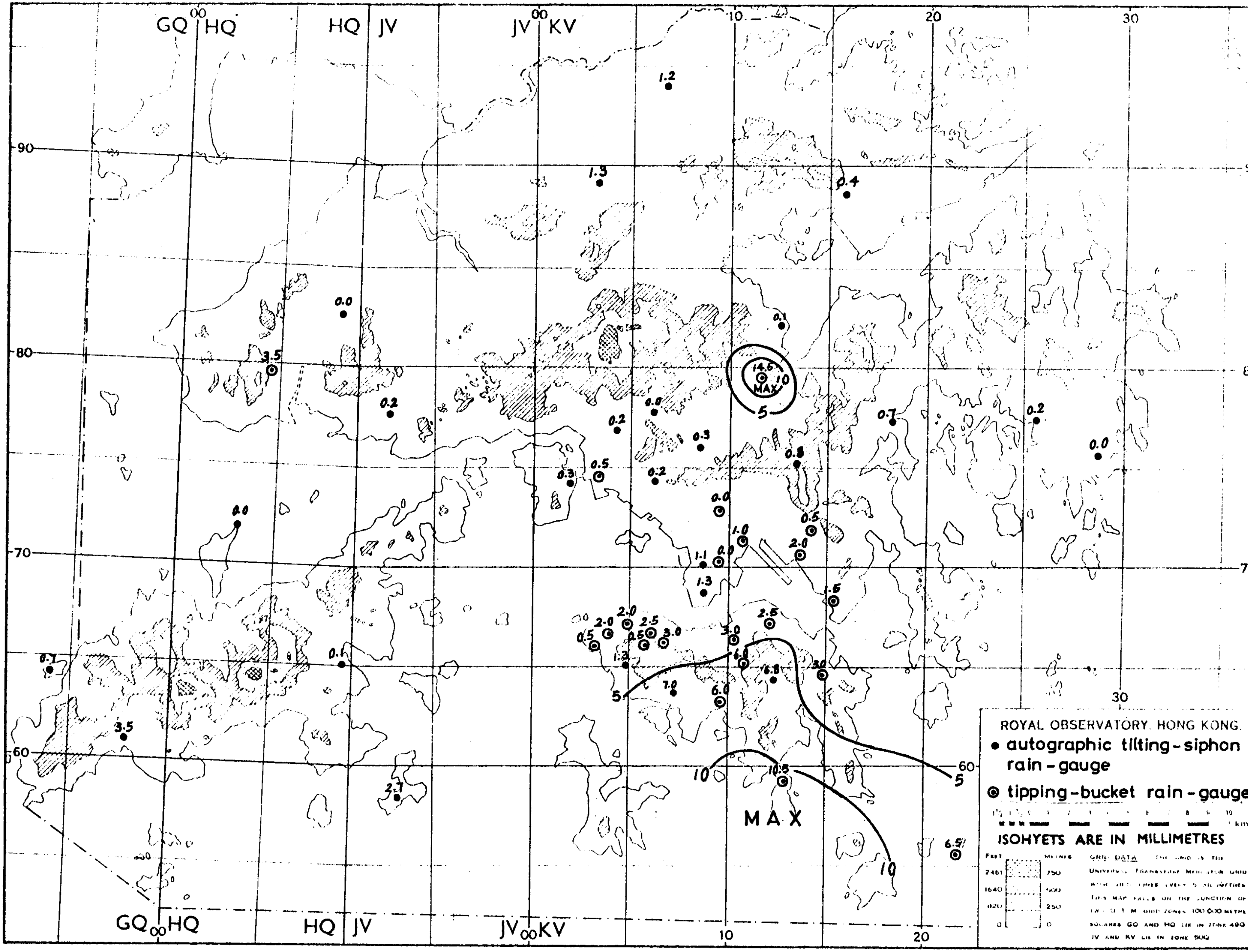
R.O. 128 Fig. 12 (x) 3-hour rainfall map ending at 0600 H.K. Time, 29 May 1982



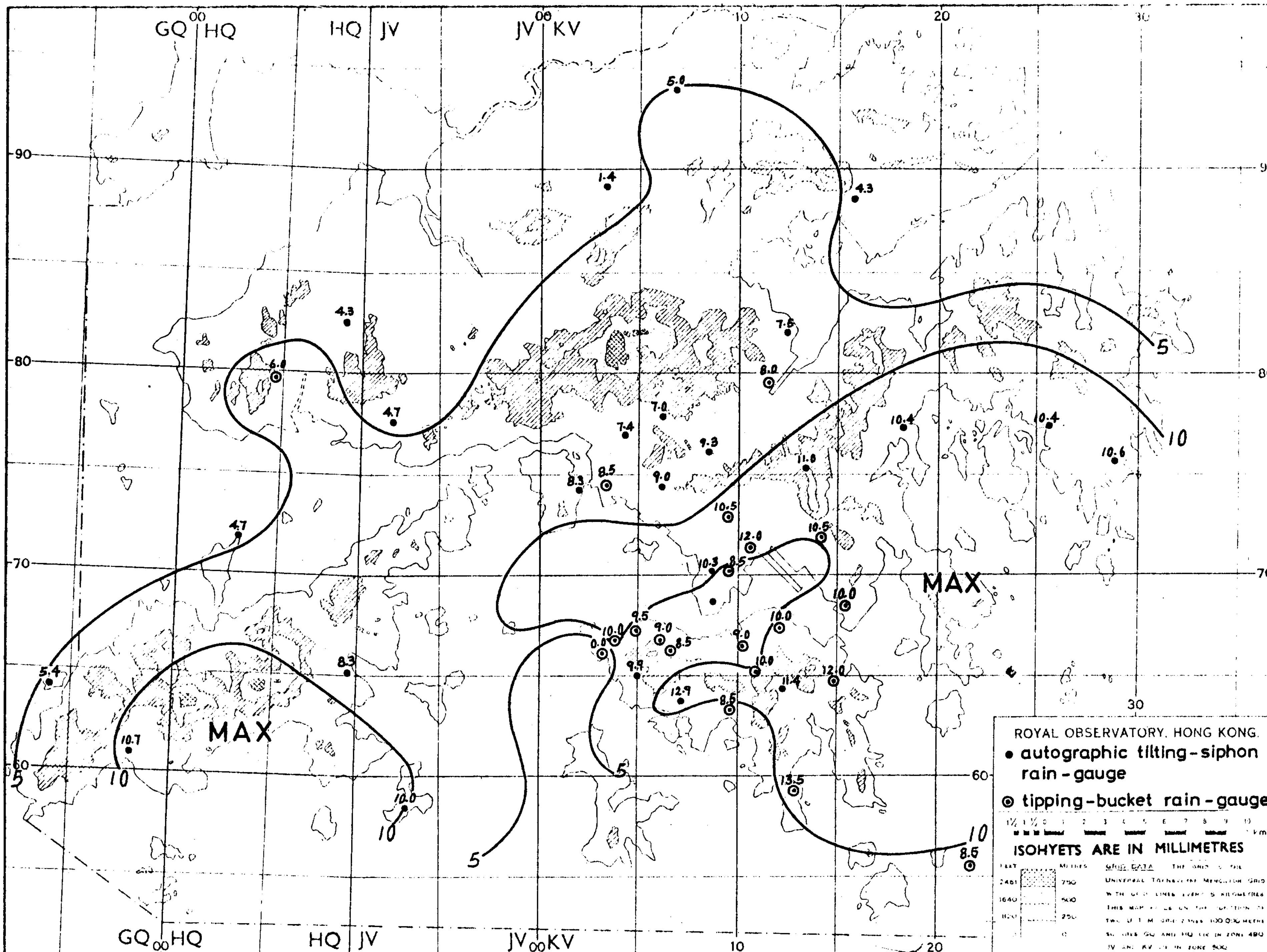
R.O. 128 Fig. 12 (xi) 3-hour rainfall map ending at 0900 H.K. Time, 29 May 1982



R.O. 128 Fig. 12 (xii) 3-hour rainfall map ending at 1200 H.K. Time, 29 May 1982



R.O. 128 Fig. 12 (xiii) 3-hour rainfall map ending at 1500 H.K. Time, 29 May 1982



R.O. 128 Fig. 12 (xiv) 3-hour rainfall map ending at 1800 H.K. Time, 29 May 1982

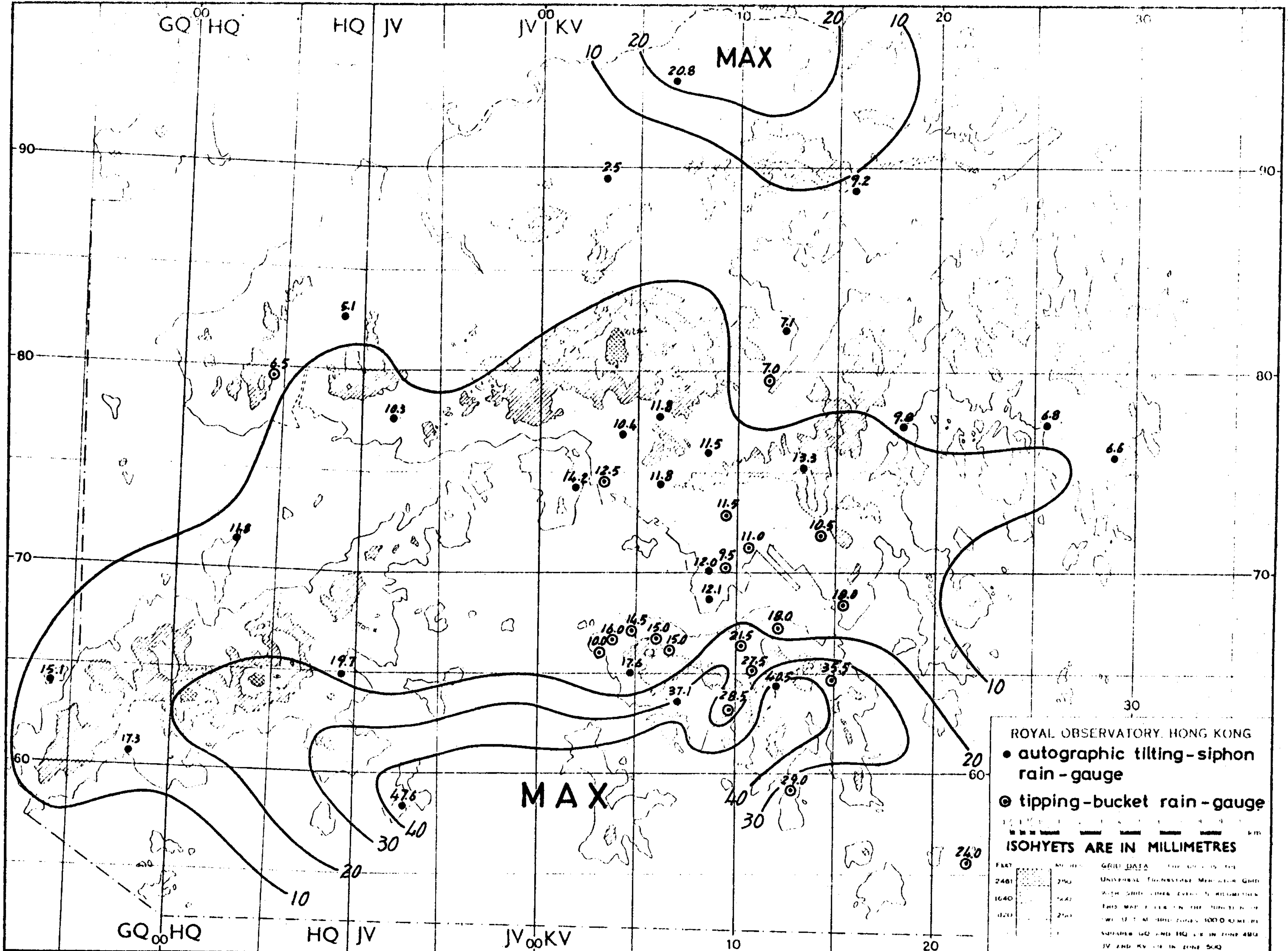
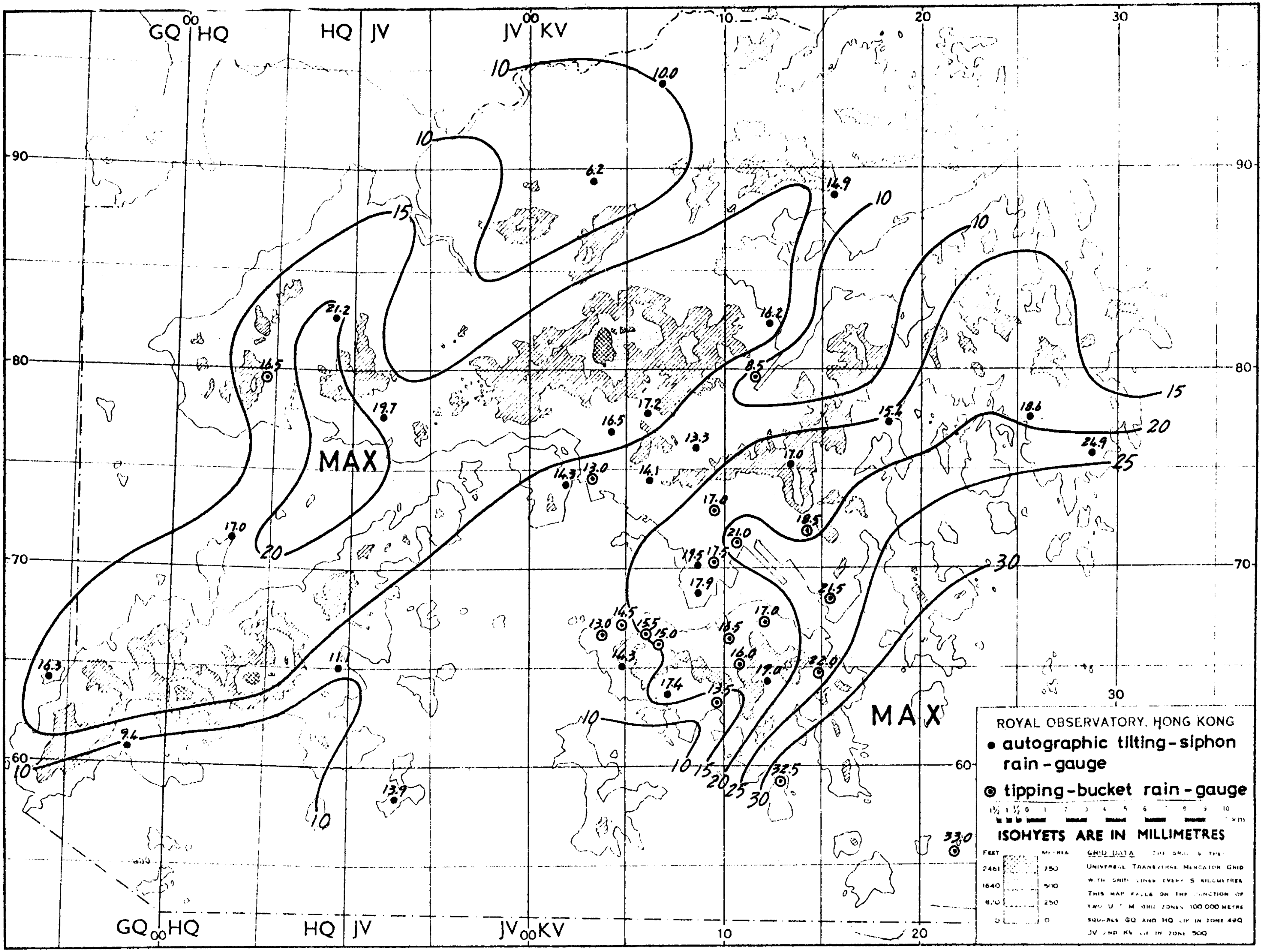
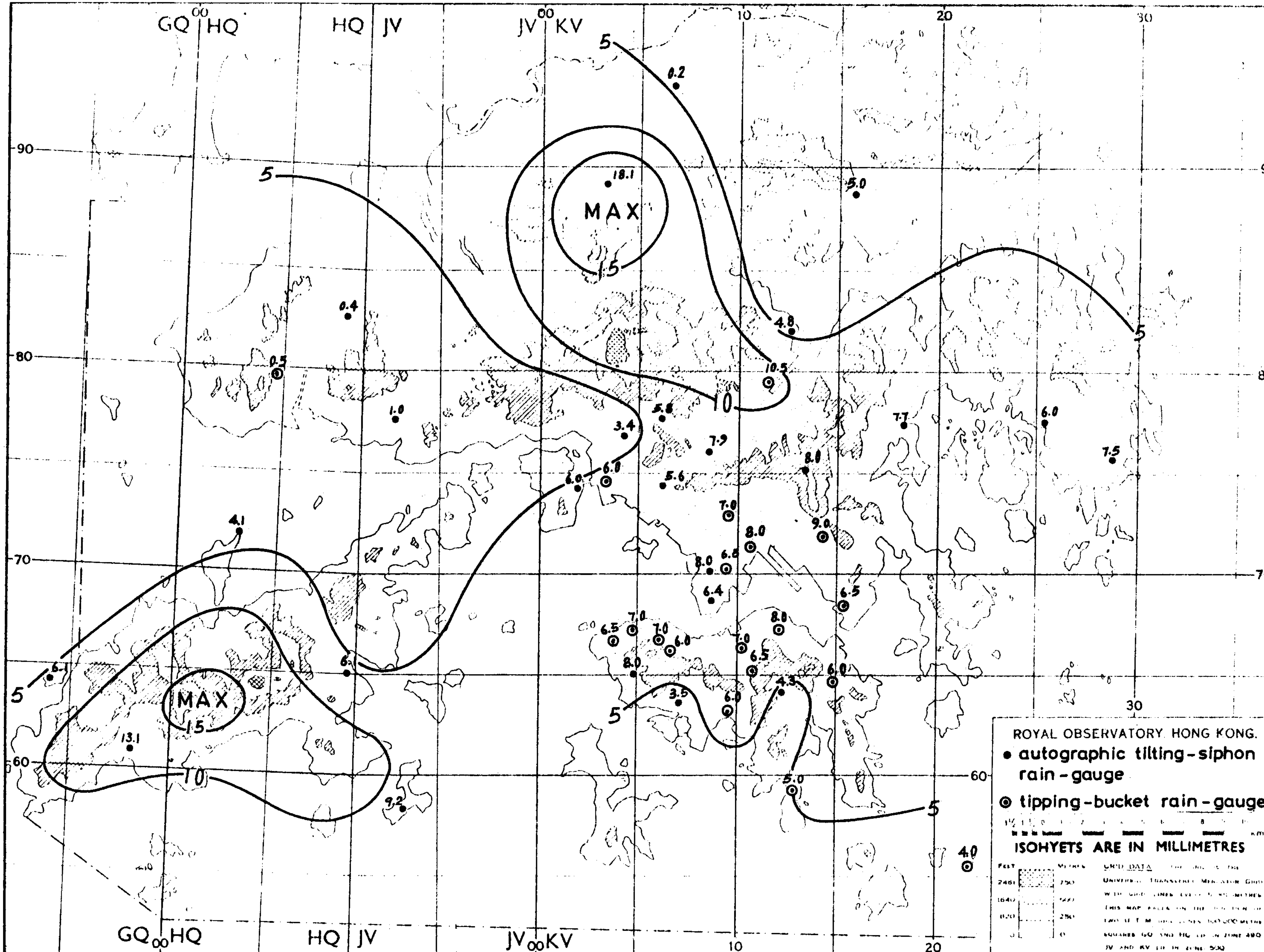


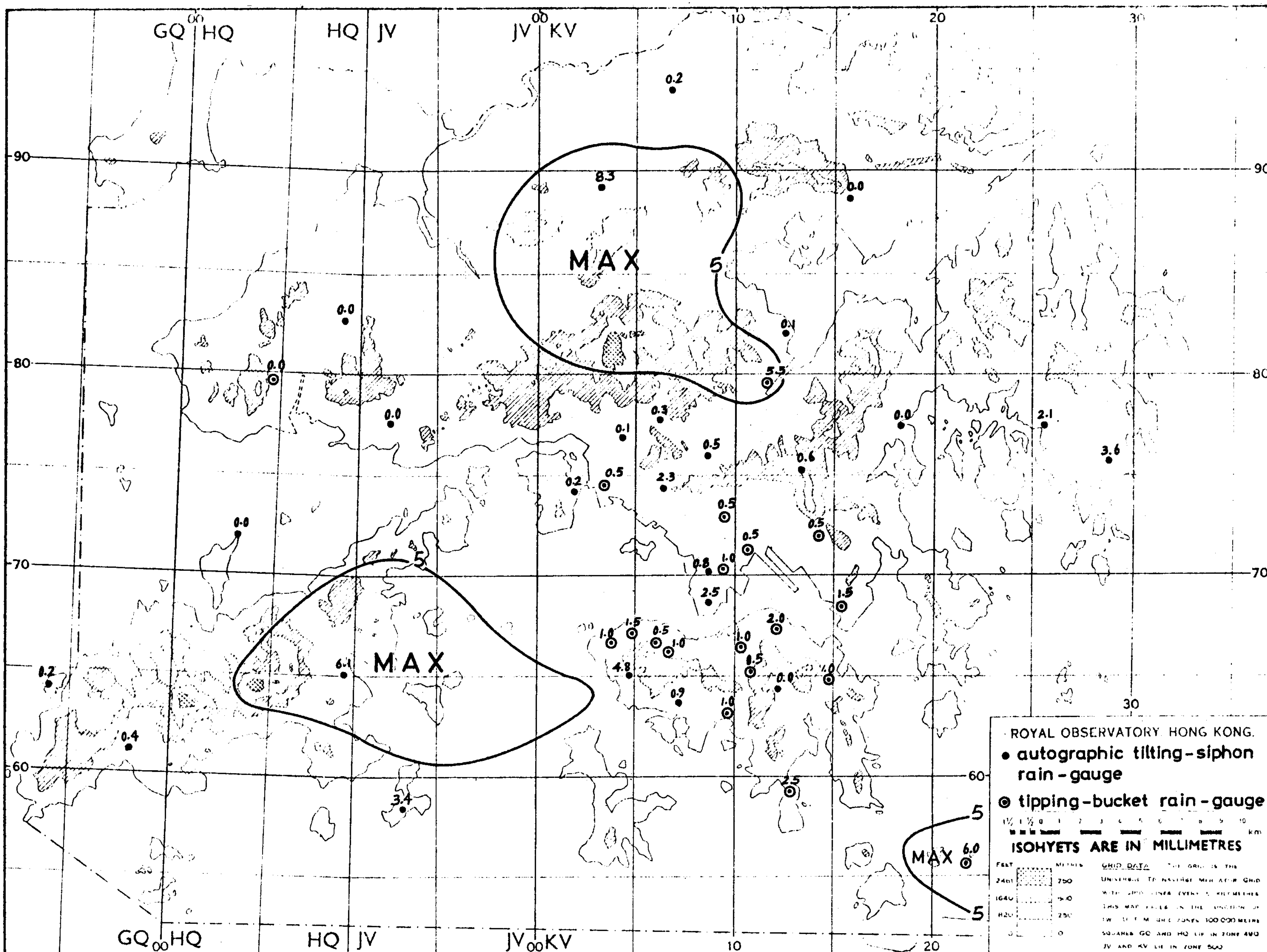
Fig. 12 (xv) 3-hour rainfall map ending at 2100 H.K. Time, 29 May 1982



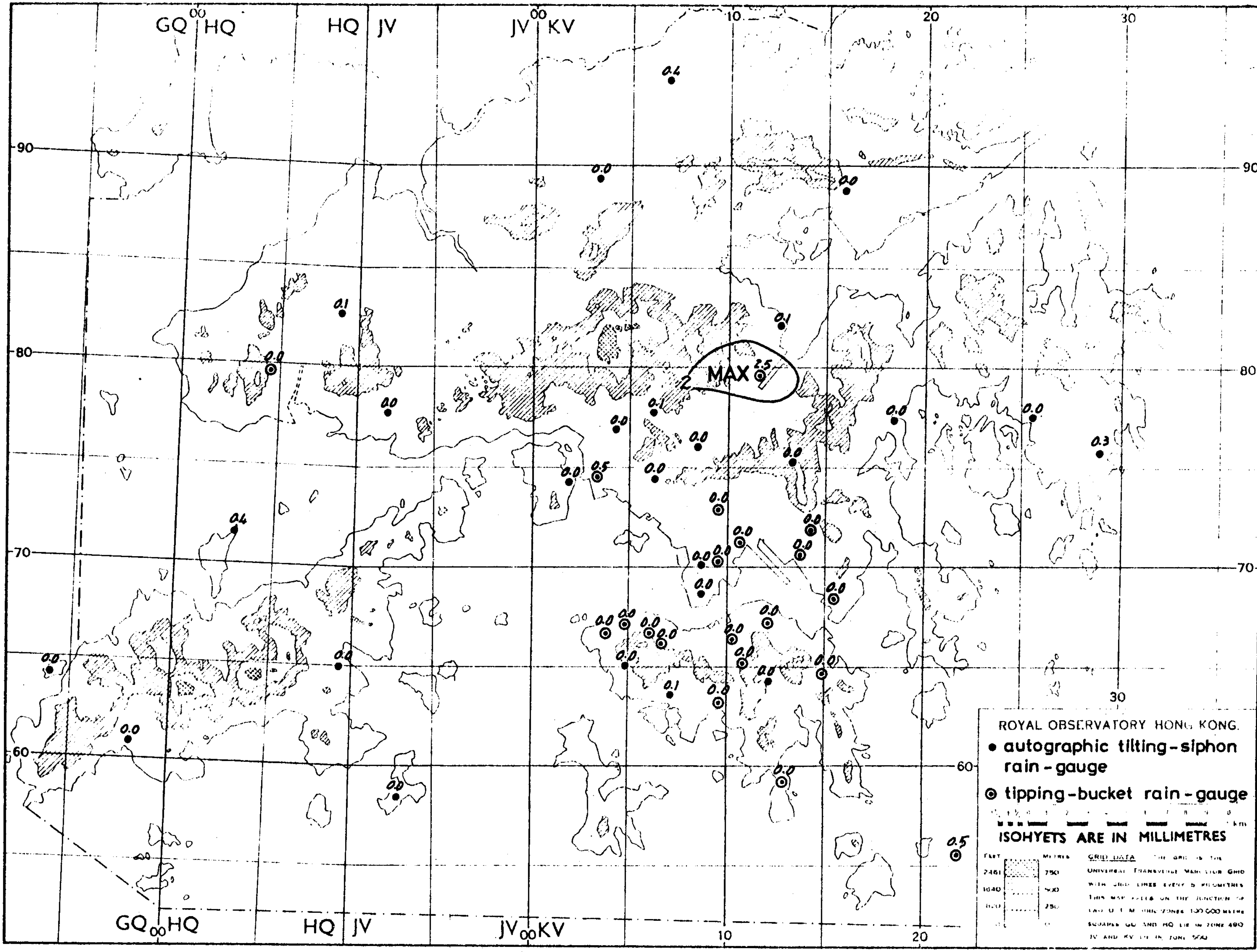
R.O. 128 Fig. 12 (xvi) 3-hour rainfall map ending at 0000 H.K. Time, 30 May 1982



R.O. 128 Fig. 12 (xvii) 3-hour rainfall map ending at 0300 H.K. Time, 30 May 1982

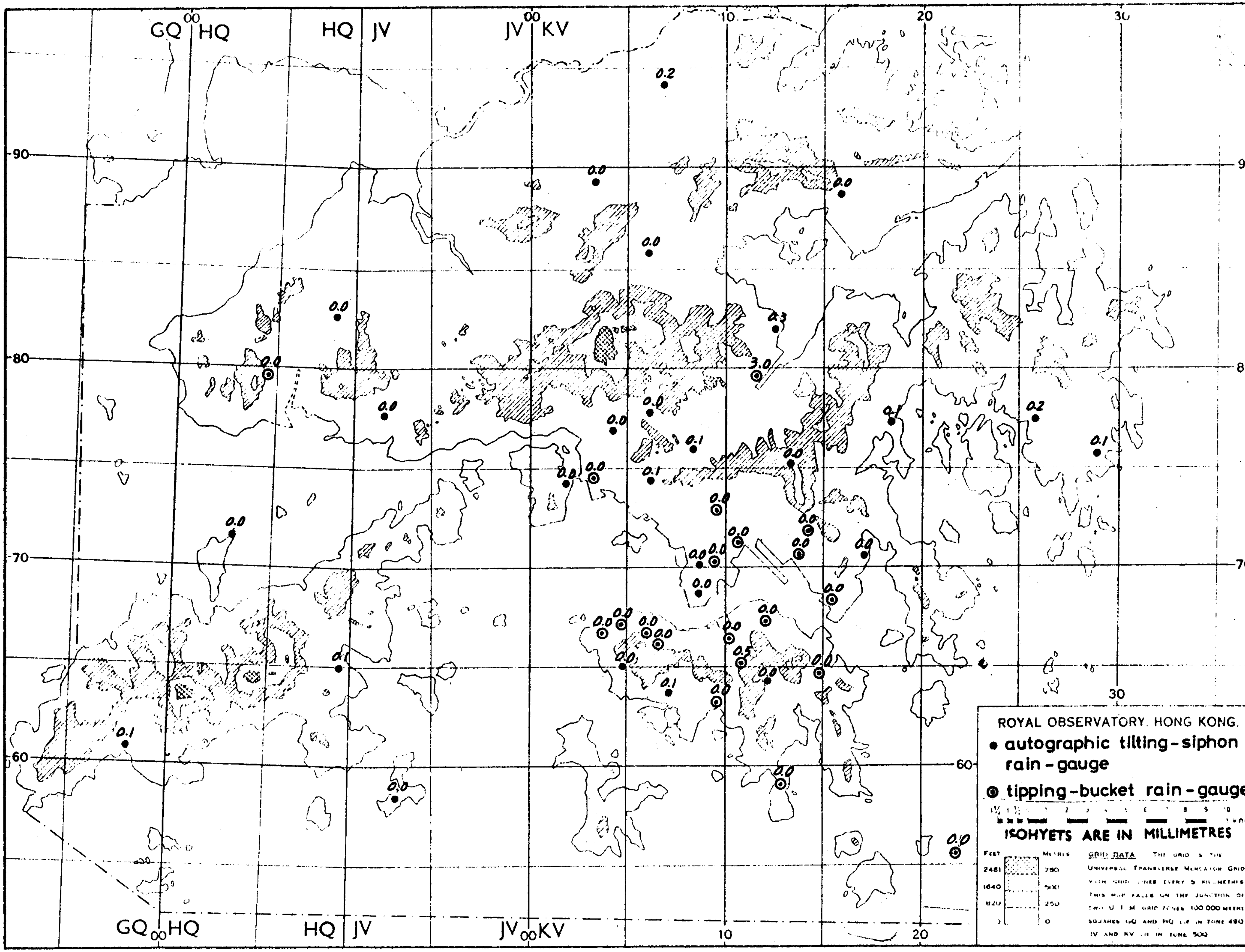


R.O. 128 Fig. 12 (xviii) 3-hour rainfall map ending at 0600 H.K. Time, 30 May 1982

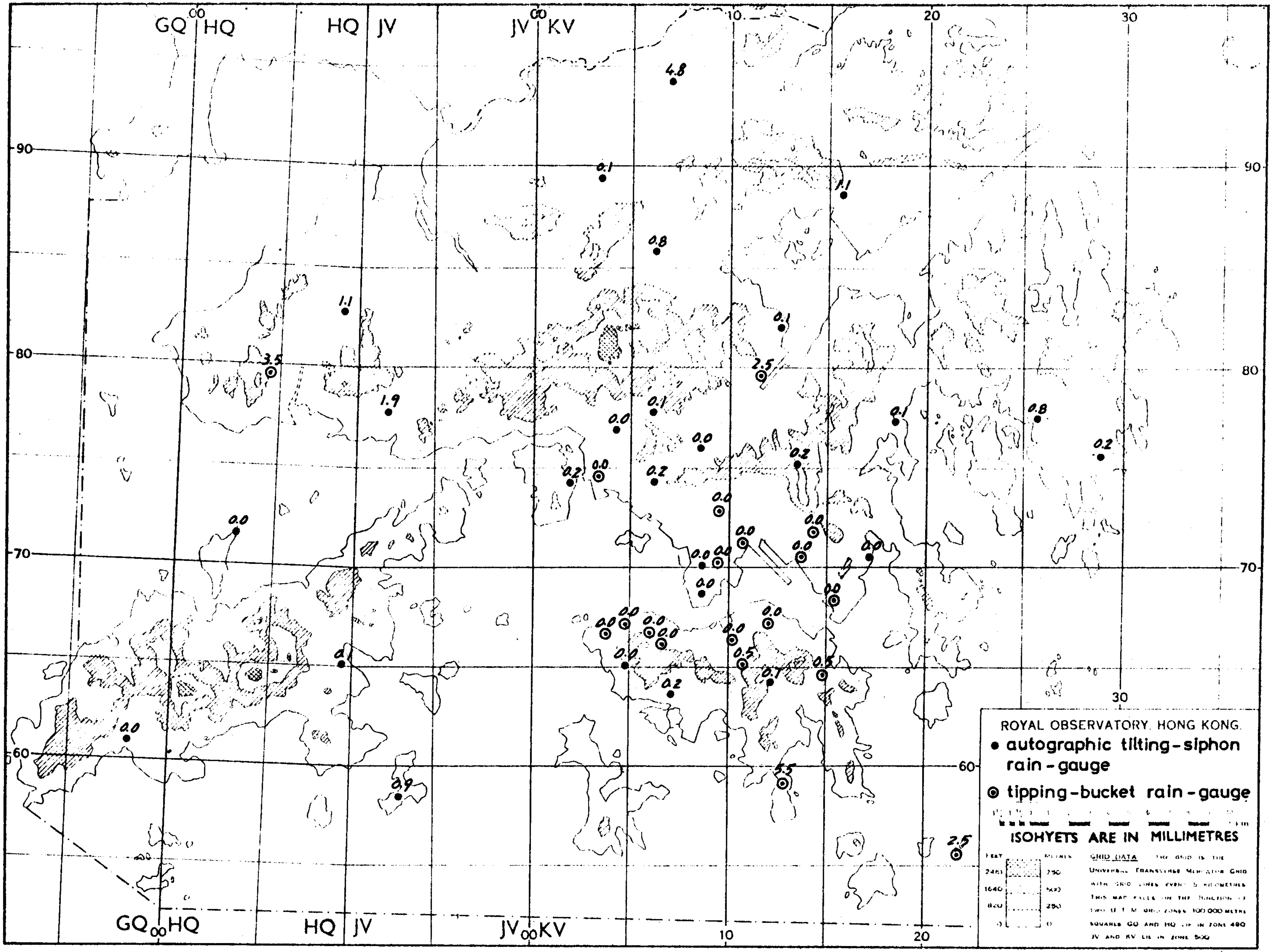


R.O. 128

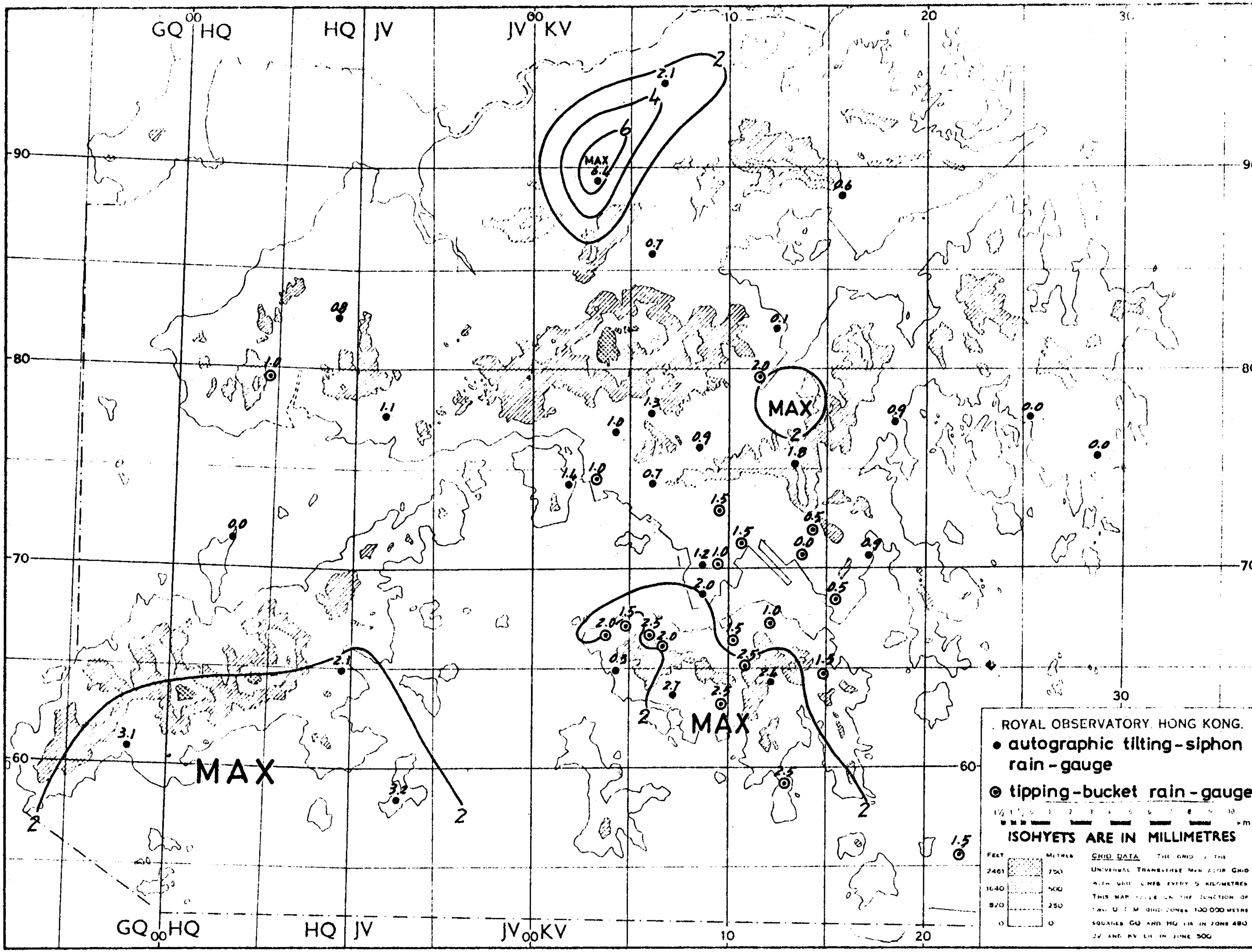
Fig. 12 (xix) 3-hour rainfall map ending at 0900 H.K. Time, 30 May 1982



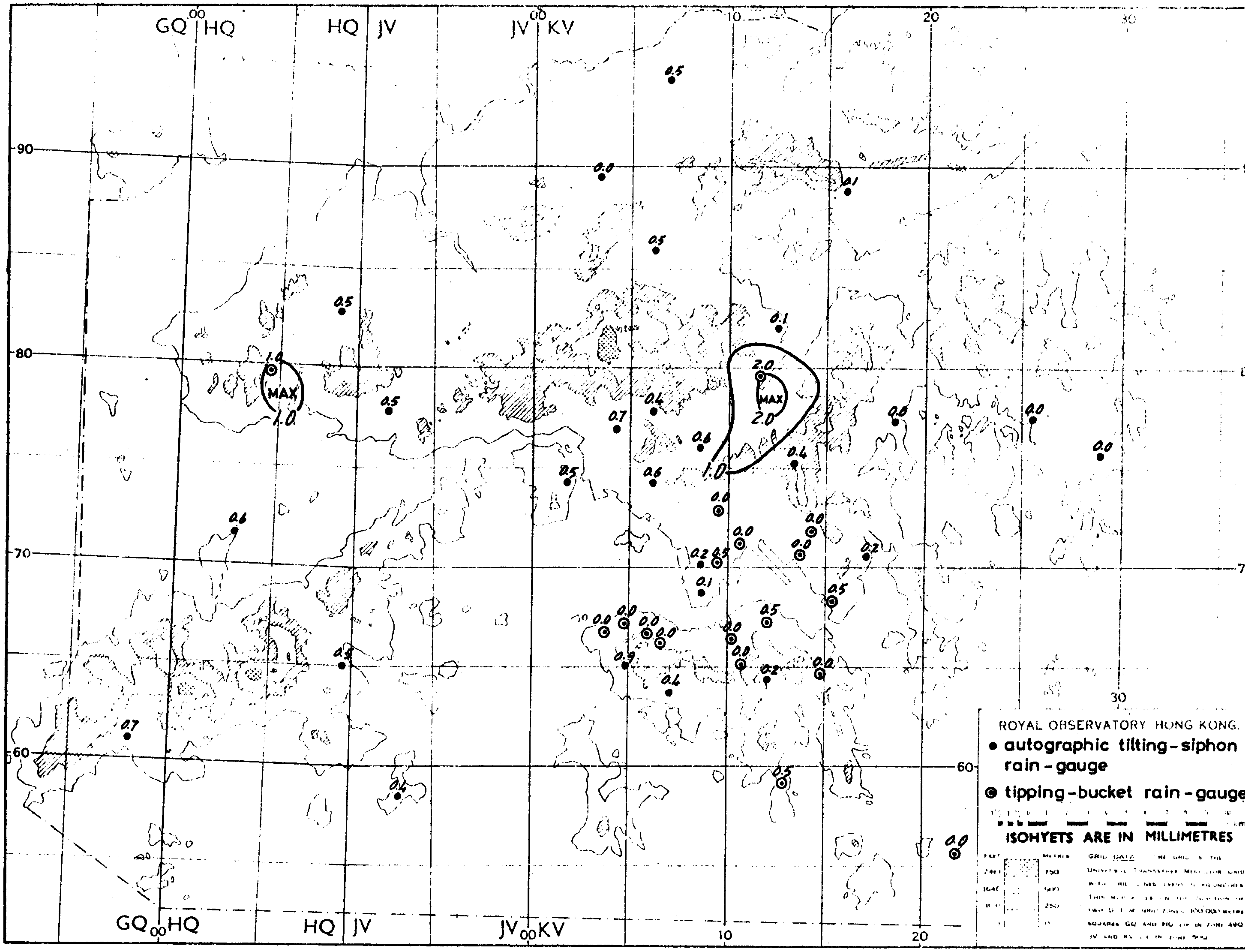
R.O. 128 Fig. 12 (xx) 3-hour rainfall map ending at 1200 H.K. Time, 30 May 1982



R.O. 128 Fig. 12 (xxi) 3-hour rainfall map ending at 1500 H.K. Time, 30 May 1982

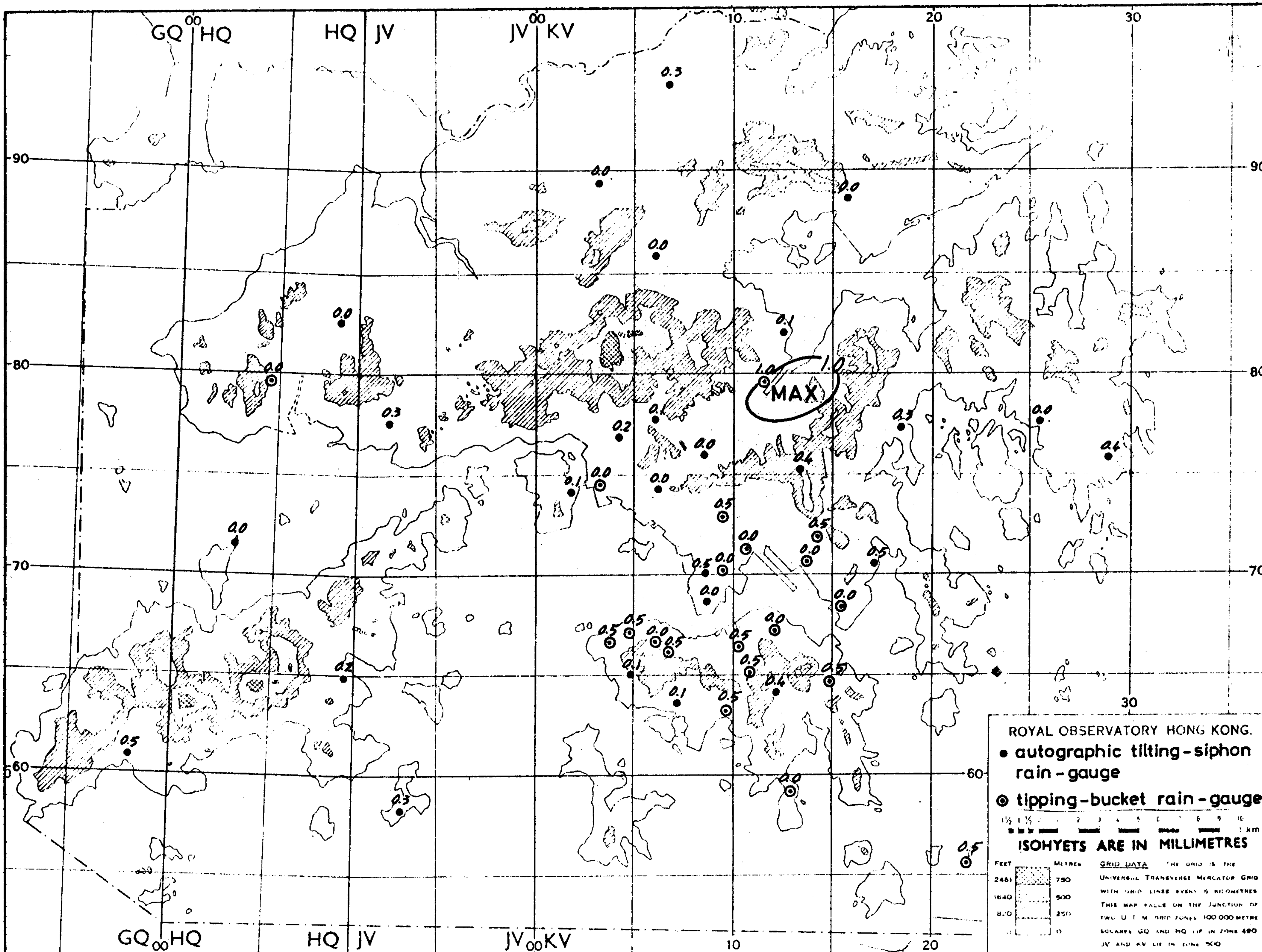


R.O. 128 Fig. 12 (xxii) 3-hour rainfall map ending at 1800 H.K. Time, 30 May 1982

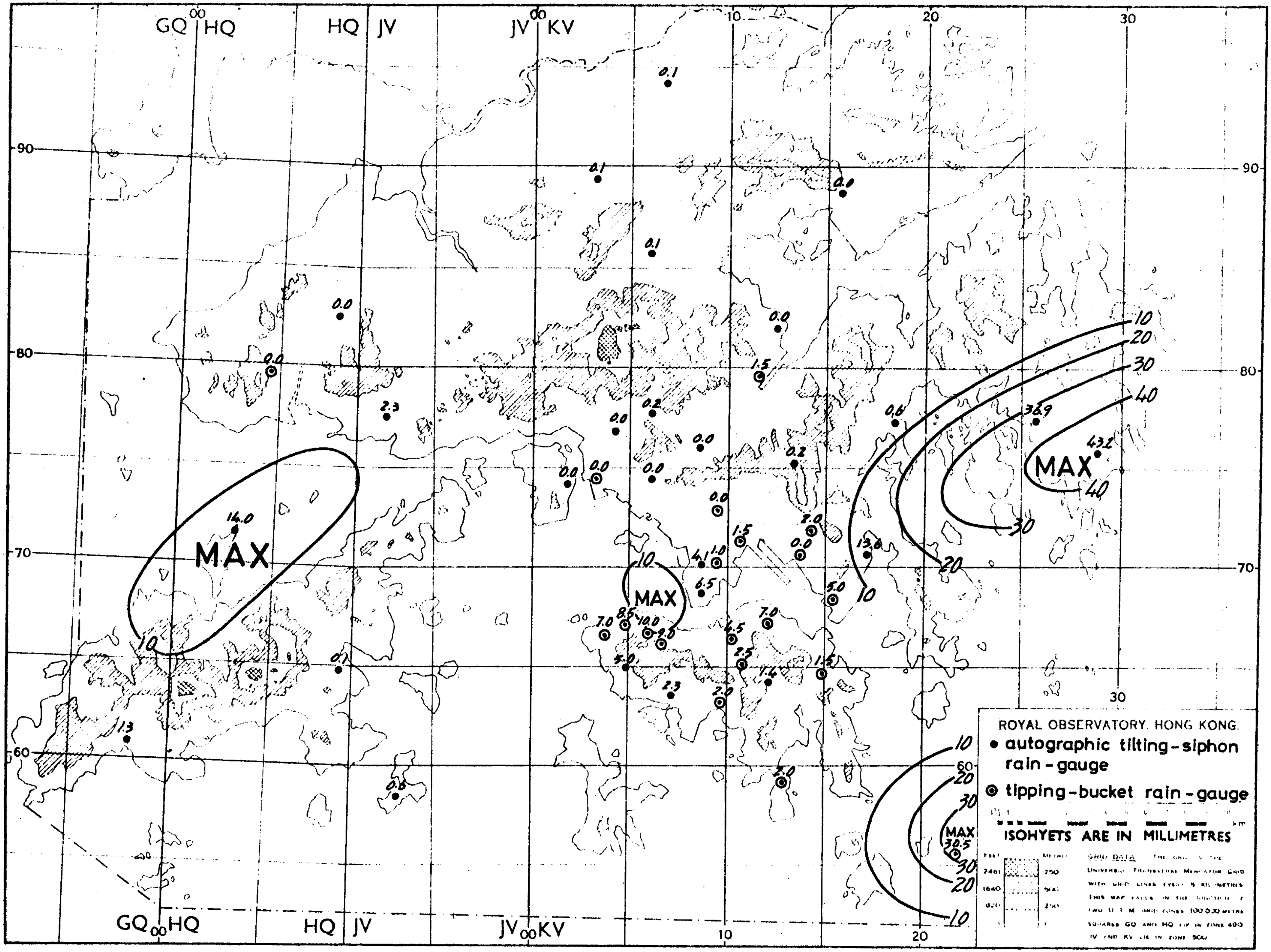


R.O. 128

Fig. 12 (xxiii) 3-hour rainfall map ending at 2100 H. K. Time, 30 May 1982

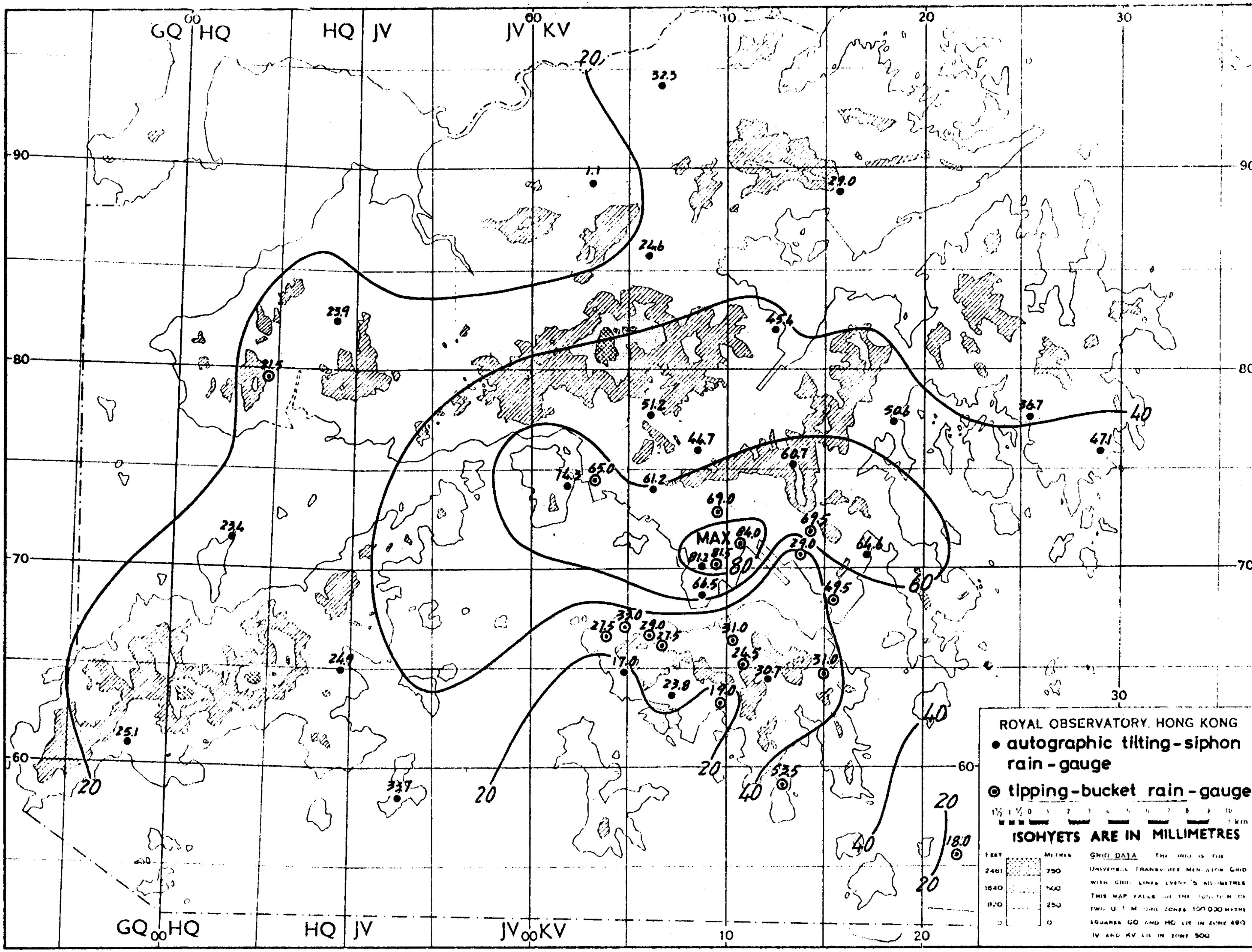


R.O. 128 Fig. 12 (xxiv) 3-hour rainfall map ending at 0000 H.K. Time, 31 May 1982

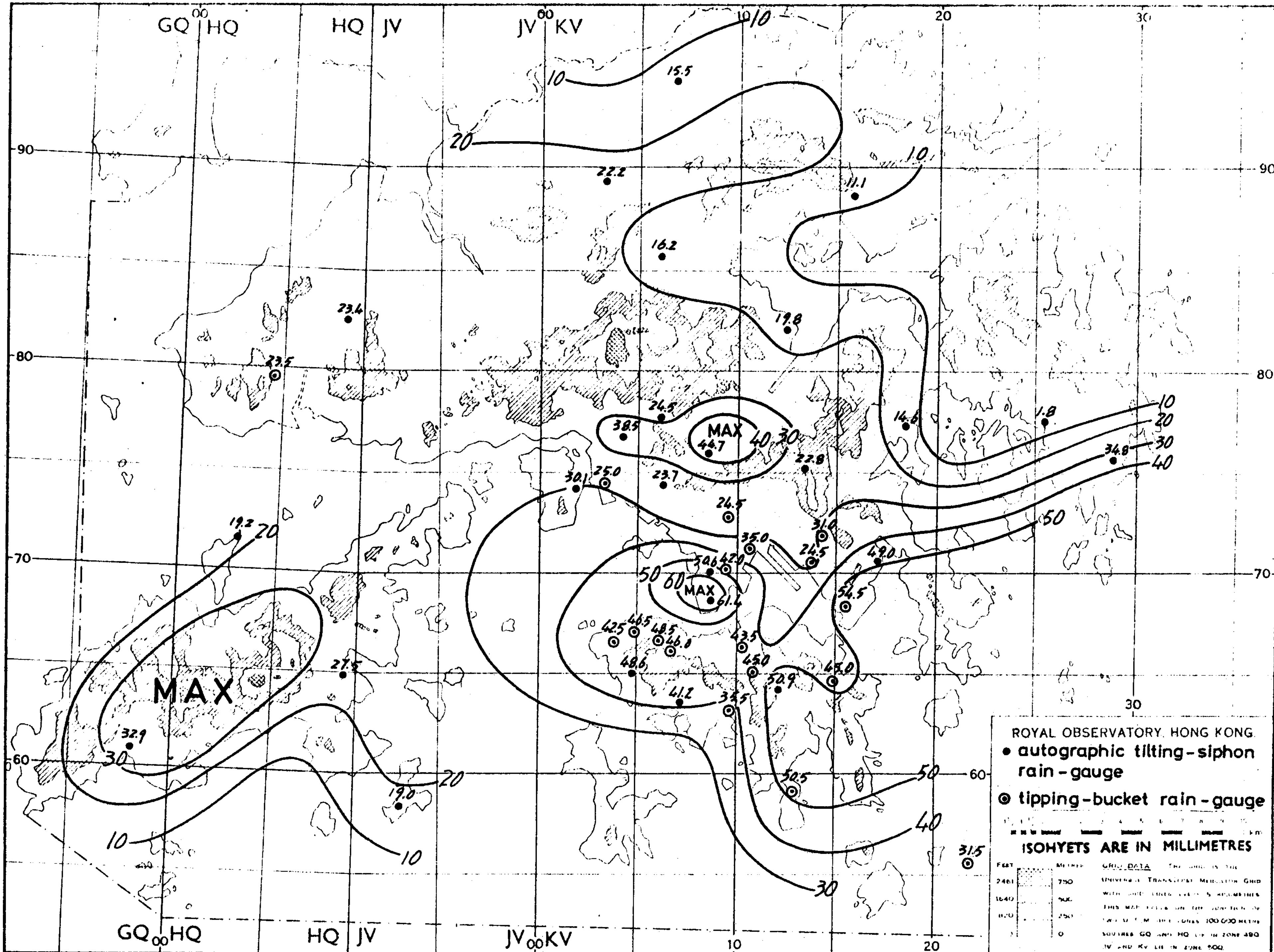


R.O. 128

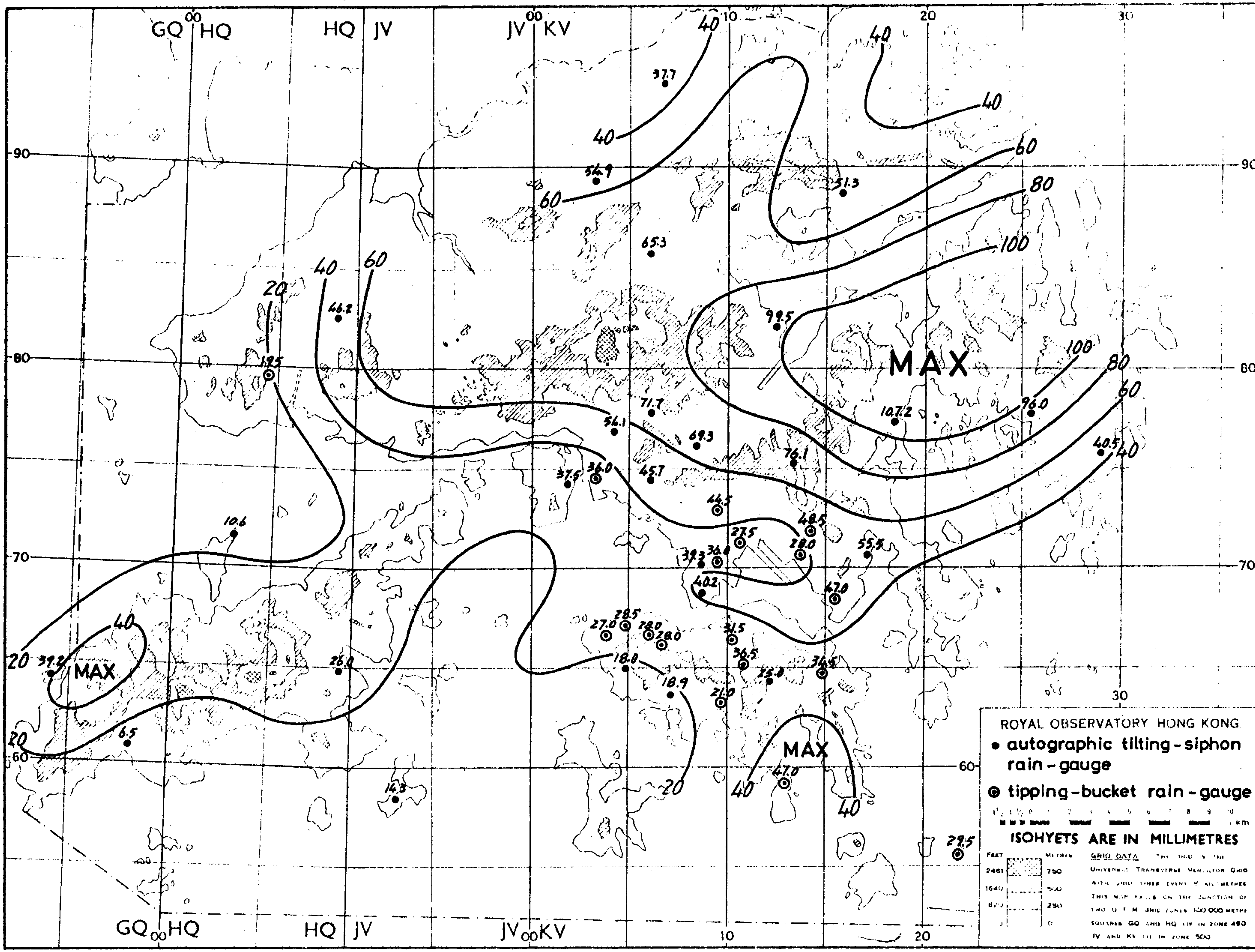
Fig. 12 (xxv) 3-hour rainfall map ending at 0300 H. K. Time, 31 May 1982



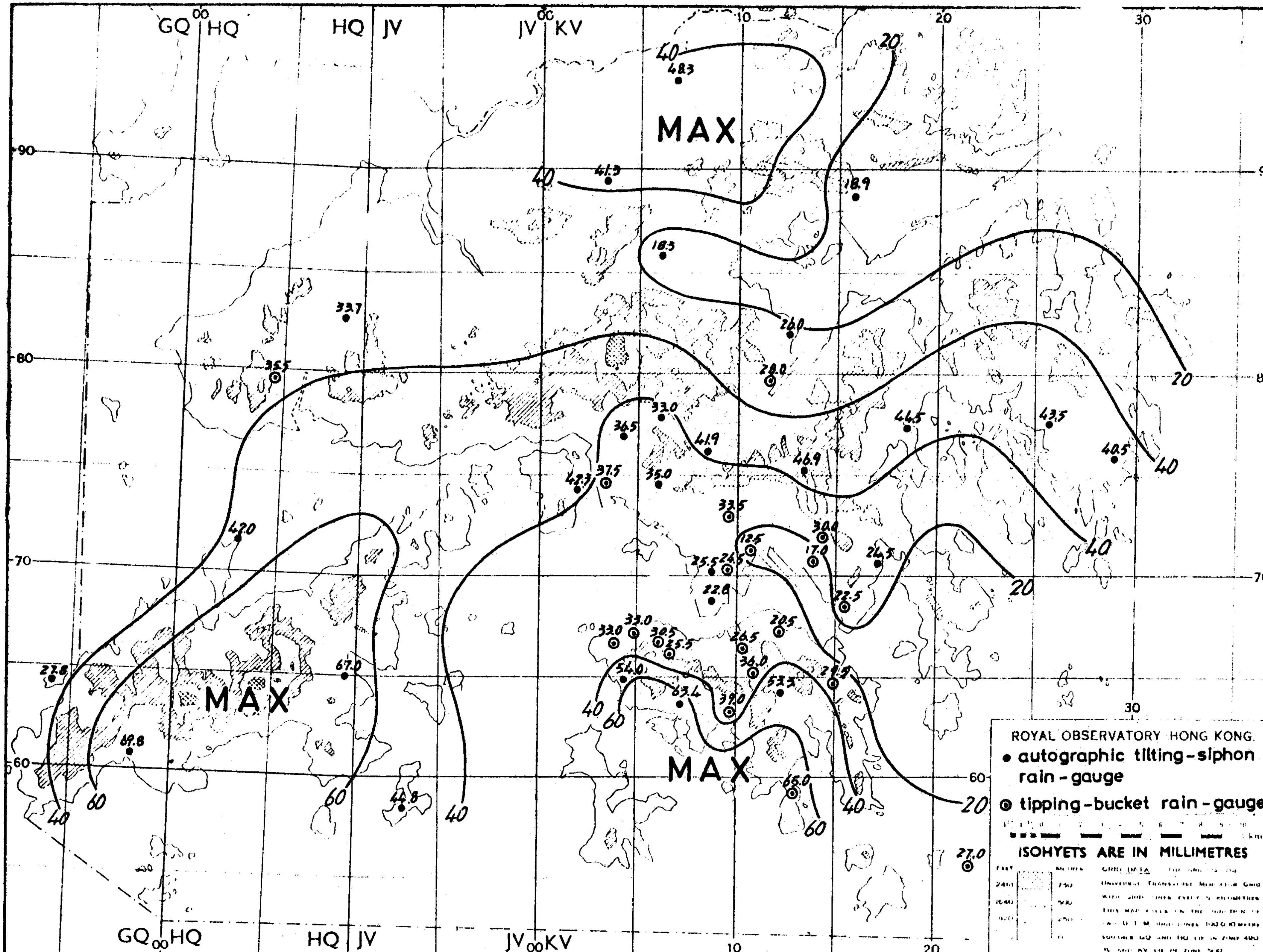
R.O. 128 Fig. 12 (xxvi) 3-hour rainfall map ending at 0600 H.K. Time, 31 May 1982



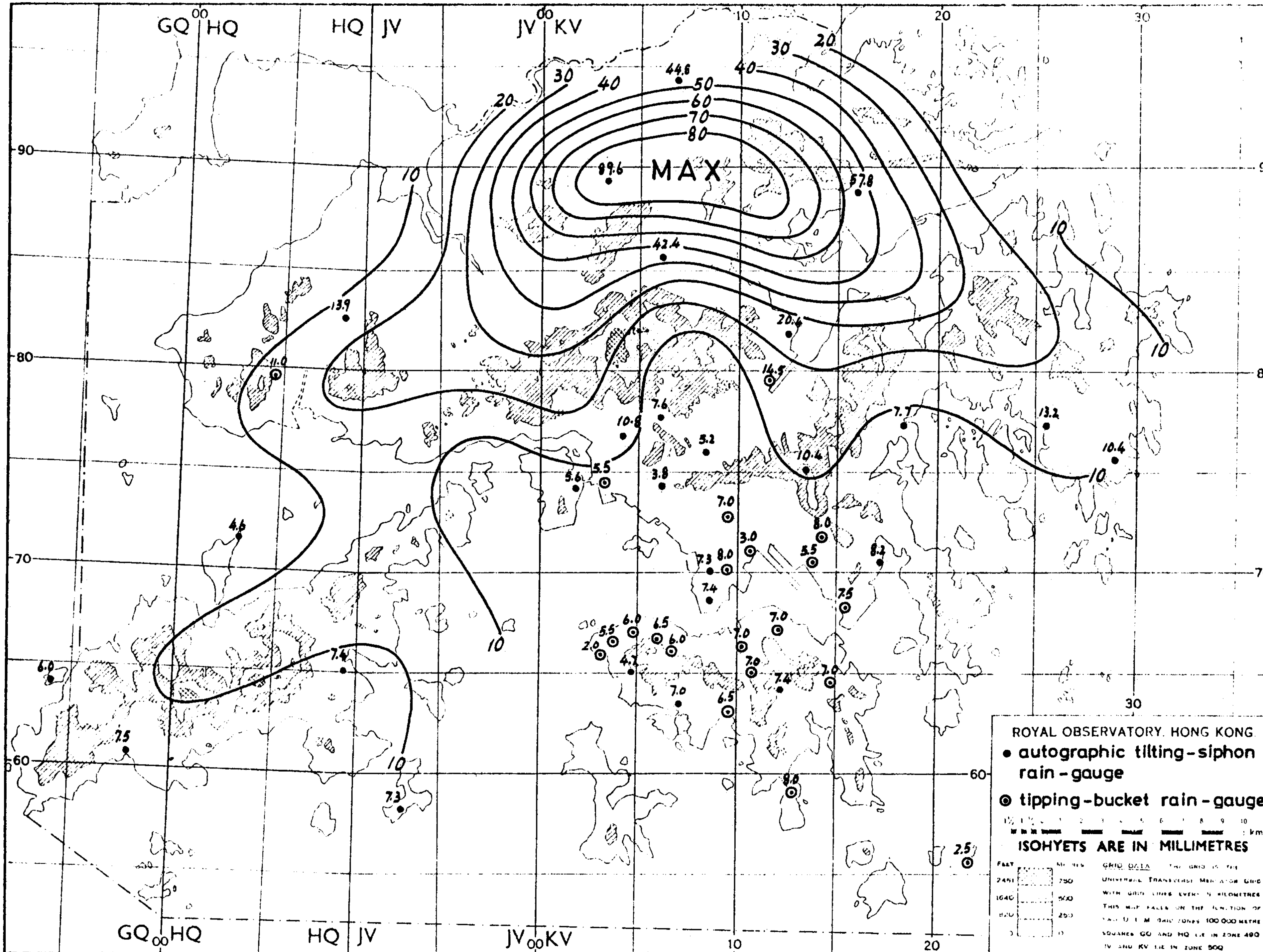
R.O. 128 Fig. 12 (xxvii) 3-hour rainfall map ending at 0900 H.K. Time, 31 May 1982



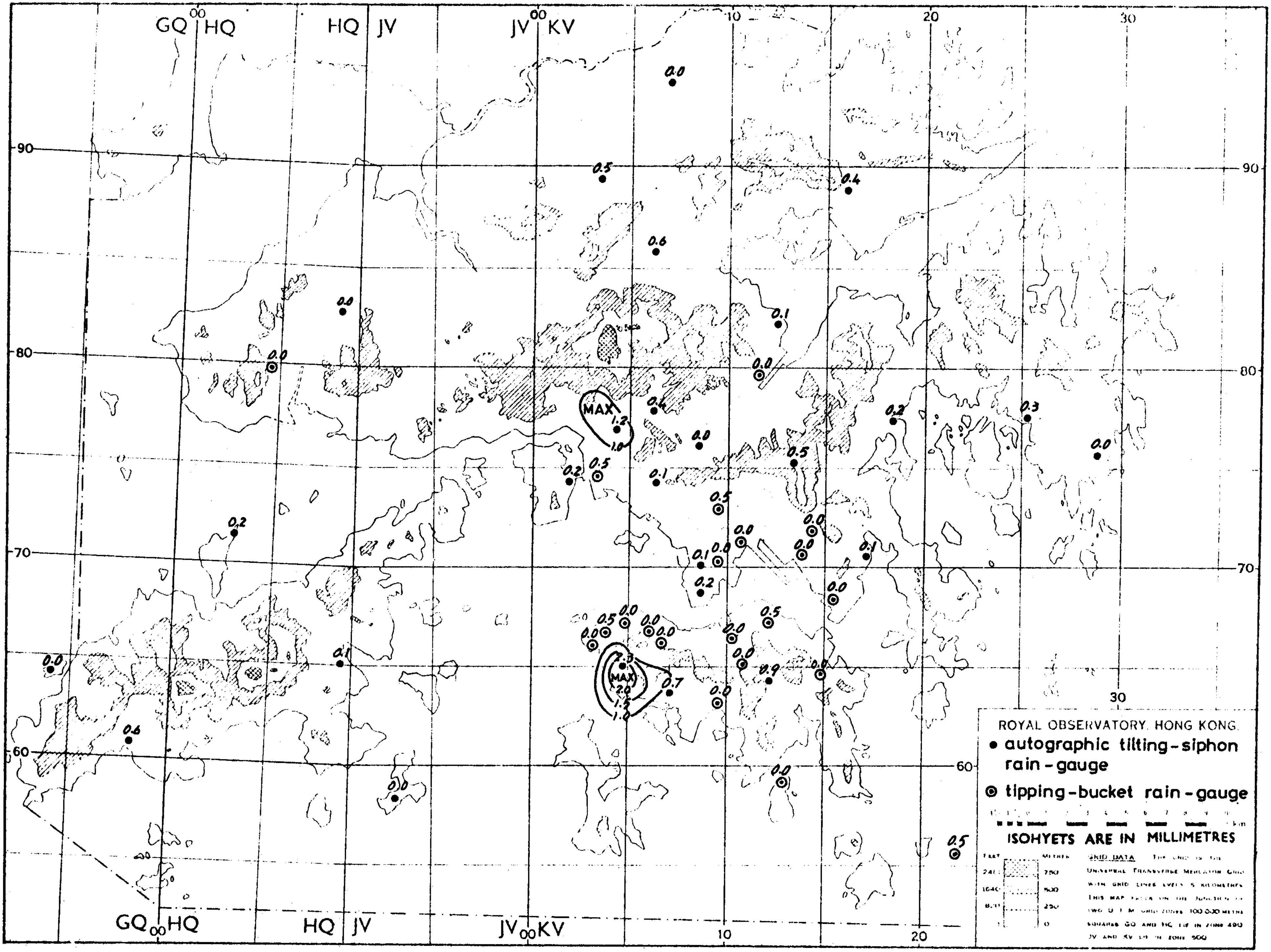
R.O. 128 Fig. 12 (xxviii) 3-hour rainfall map ending at 1200 H.K. Time, 31 May 1982



R.O. 128 Fig. 12 (xxix) 3-hour rainfall map ending at 1500 H.K. Time, 31 May 1982



R.O. 128 Fig. 12 (xxx) 3-hour rainfall map ending at 1800 H. K. Time, 31 May 1982



R.O. 128 Fig. 12 (xxxi) 3-hour rainfall map ending at 2100 H.K. Time, 31 May 1982

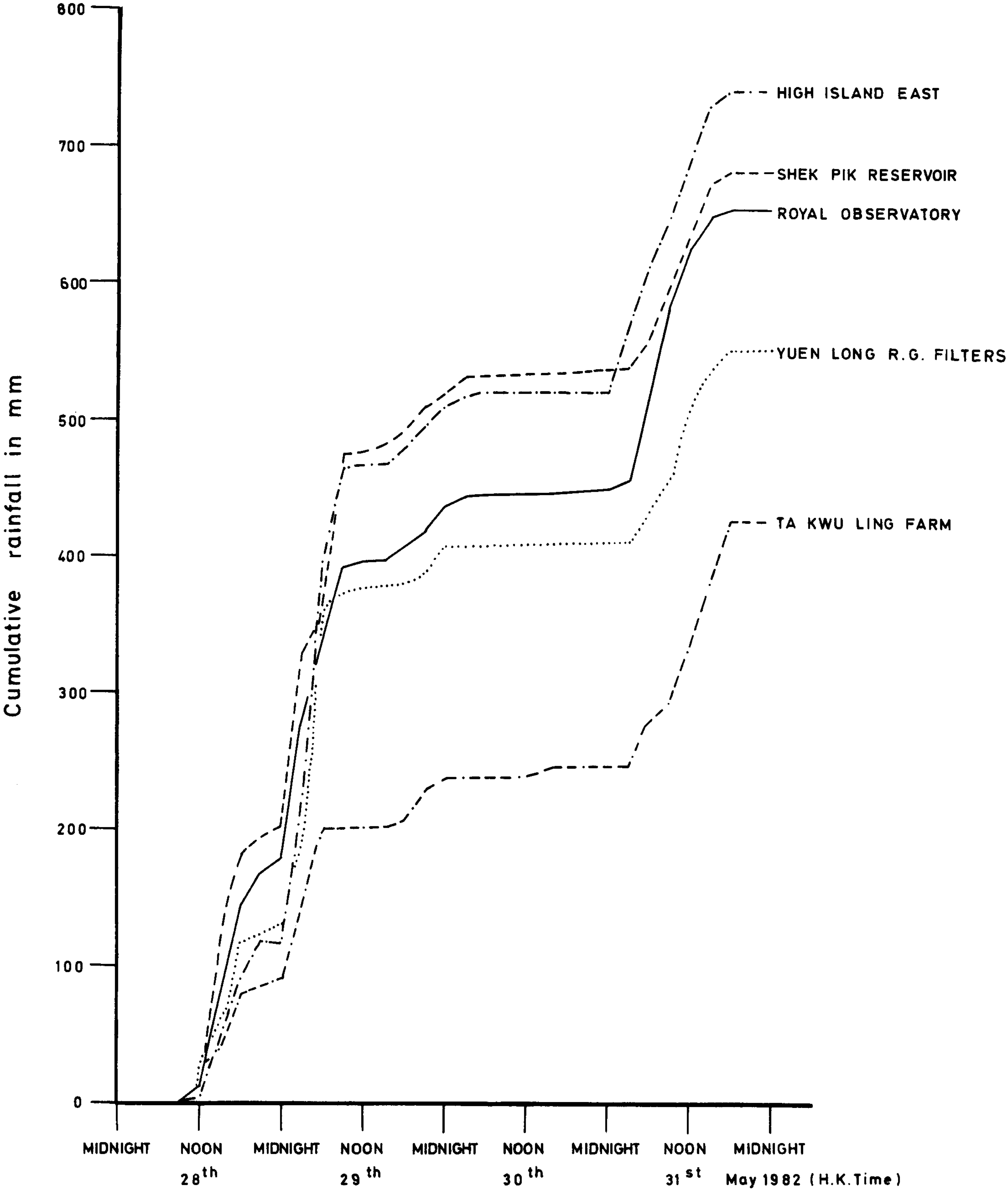


Fig. 13 Mass curves for various rainfall stations

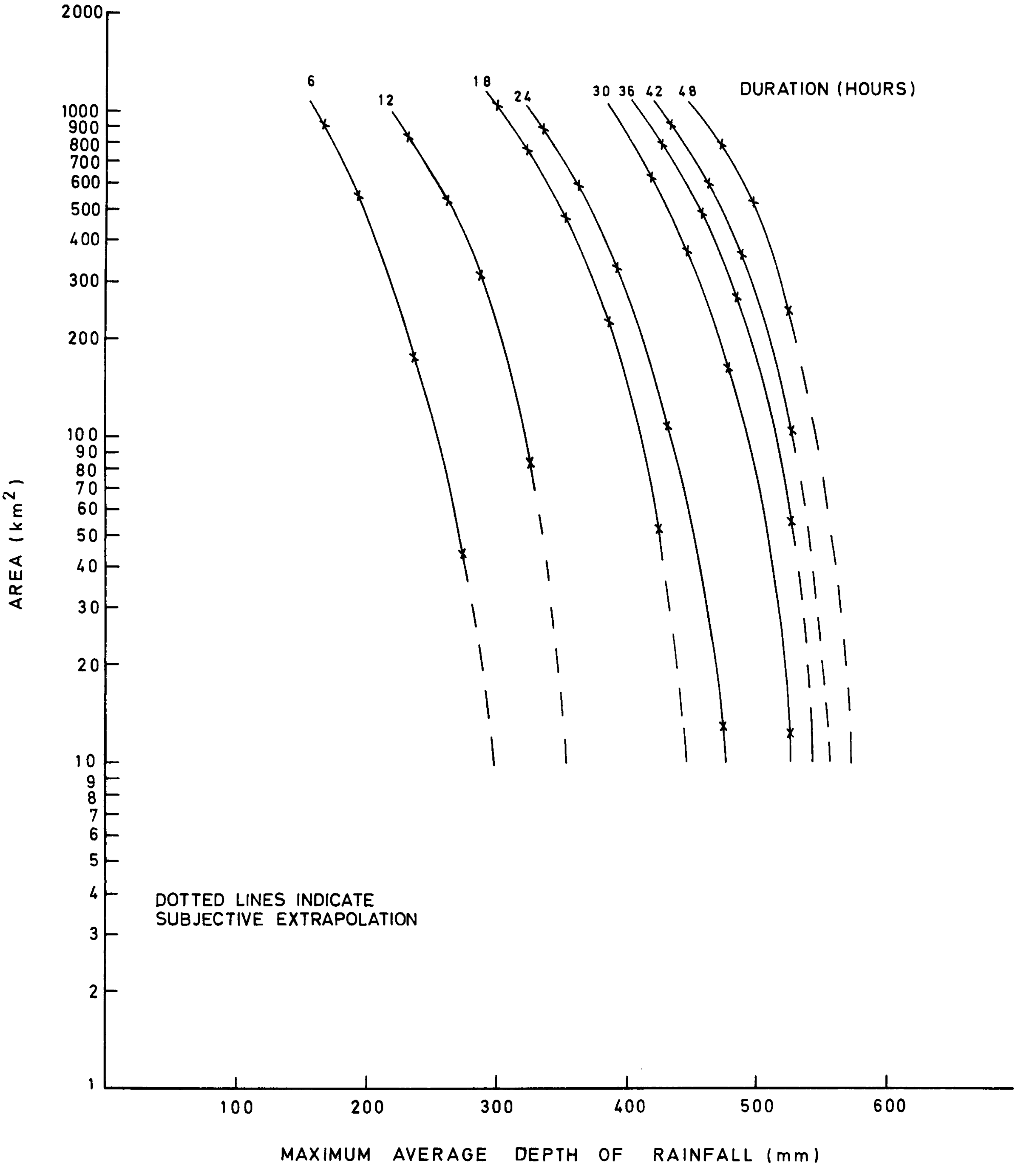


Fig. 14 Depth-area-duration curves of the May rainstorms

TABLE 1. MAXIMUM RAINFALL INTENSITY VALUES DURING 28–31 MAY 1982 COMPARED WITH PREVIOUS ANNUAL MAXIMA

Duration	Date & Time of Occurrence	Rainfall amount (mm)	Intensity (mm/h)	Rank 1884–1939 1947–1982	Return Period (1) (yr)	Remarks
15 seconds	29th 0225H	–	197	–	5	Recorded at King's Park. Exceeded by the 238 mm/h recorded on August 16, 1982.
15 minutes	29th 0210H–0225H	33.0	132.0	8(1947–82)	5	
30 "	29th 0155H–0225H	56.3	112.6	5(1947–82)	5	
60 "	29th 0125H–0225H	72.3	72.3	–	5	Less than the 82.5 mm/h on August 16, 1982.
120 "	29th 0130H–0330H	100.7	50.4	17(1947–82)	5	
240 "	28th 2340H–29th 0340H	139.1	34.8	13(1947–82)	5	
1 hour (2)	29th 0200H–0300H	43.9	43.9	60	5	
2 hours	29th 0100H–0300H	83.8	41.9	40	5	
4 "	29th 0100H–0500H	135.0	33.8	20	5	
6 "	29th 0100H–0700H	182.2	30.4	17	5	
8 "	29th 0000H–0800H	208.2	26.0	11	5	
12 "	28th 2200H–29th 1000H	225.7	18.8	20	5	
24 "	28th 1000H–29th 1000H	394.3	16.4	6	13	
36 "	29th 1200H–30th 0000H	431.4	12.0	6	10	
1 day (3)	29th	258.4	10.8	–	10	Exceeded by the 334.2 mm recorded on August 16, 1982
2 days	28th–29th	437.4	9.1	9	10	
3 "	29th–31st	474.9	6.6	9	10	
4 "	28th–31st	653.9	6.8	5	30	
5 "	28th May–1st June	655.2	5.5	5	23	

Note : (1) Return periods are estimated from values obtained by Peterson and Kwong (1981)

(2) Clock hour

(3) Civil day

TABLE 2. MAXIMUM RATE OF RAINFALL RECORDED BY JARDI RECORDERS, 28-31 MAY 1982

	28 May		29 May		30 May		31 May	
	Rate (mm/h)	Time	Rate (mm/h)	Time	Rate (mm/h)	Time	Rate (mm/h)	Time
Royal Observatory	182	1333H	264	0215H	72	0302H	228	0338H
King's Park Meteorological Station	149	1422H	197	0225H	8	0142H	139	0549H
Airport Meteorological Office	160	1340H	239	0215H	60	0242H	204	0328H
Tate's Cairn Radar Station	171	1349H	232	0621H	unserviceable		unserviceable	

TABLE 3. INTENSITY VALUES EXCEEDING 200 mm/h AS RECORDED BY JARDI RATE-OF-RAINFALL RECORDERS IN 1981-1982

	Royal Observatory		King's Park		Airport Meteorological Office		Tate's Cairn	
Year	Date*	Intensity (mm/h)	Date*	Intensity (mm/h)	Date*	Intensity (mm/h)	Date*	Intensity (mm/h)
1981	15 Mar	223	6 Jul	244	15 Mar	227	31 May	222
	23 Jul	201	29 Sep	314	6 Jul	450	7 Jul	218
	27 Jul	204			4 Sep	214	23 Jul	265
					29 Sep	330	27 Jul	234
1982	29 May	264	16 Aug	238	7 May	222	29 May	232
	31 May	228			29 May	239	7 Jul	304
	31 Jul	242			31 May	204	3 Aug	204
	1 Aug	270			1 Aug	204	16 Aug	278
	16 Sep	213			16 Aug	204	16 Sep	250

* Civil day

TABLE 4. MAXIMUM SHORT-DURATION INTENSITY VALUES DERIVED FROM THE NETWORK OF AUTOGRAPHIC RAINGAUGES, 28 - 31 MAY, 1982
(arranged in decreasing order of 4-day rainfall total)

Station	Station No.	Height above M.S.L. (m)	Four-day Total (mm)	15-min (mm)	Ending Time DDGGgg	30-min (mm)	Ending Time DDGGgg	60-min (mm)	Ending Time DDGGgg	120-min (mm)	Ending Time DDGGgg
High Island East	352	125	739.3	34.0	290315	65.0	290325	107.0	290330	154.0	290345
Sai Kung Farm	282	45	723.2	21.0	290310	34.0	290345	67.0	290400	133.0	290460
Tate's Carin	277	575	685.6	23.0	281345	37.4	290350	64.5	281430	91.3	290345
Tai Tam Byewash	205	155	682.0	24.4	290240	46.4	290305	73.2	290305	113.9	290320
Shek Pik Reservoir	268	5	680.0	26.5	290110	52.5	290115	100.5	290130	148.5	310155
King's Park	228	65	671.4	34.0	290210	46.5	290215	69.0	290230	91.0	290240
High Island Wewt	350	85	668.2	24.9	290315	36.9	290620	69.7	290630	99.6	290710
Airport Meteorological Office	202	5	665.0	31.0	290215	55.0	290230	73.0	290225	105.0	290345
Royal Observatory	201	30	653.9	33.0	290225	56.3	290225	72.3	290225	100.7	290330
Aberdeen Lower Reservoir	10	85	641.7	26.0	290210	50.2	290225	67.5	290230	103.0	290310
Tai Lam Chung Reservoir	220	45	626.5*	25.0	290540	42.5	290555	75.0	290540	143.0	290600
Silver Mine Bay T/W	326	60	610.2	25.5	290205	51.0	290220	86.0	290225	121.0	290230
Tai Po Tau T/W	302	105	609.9*	29.0	290535	55.0	290445	95.0	290600	165.0	290600
Jubilee Reservoir	212	200	597.5	25.0	290430	46.0	290630	64.8	290515	100.0	290615
Tsing Yi Development	305	25	594.5	29.5	290625	40.8	311000	47.8	290700	83.1	290630
Sha Tin T/W	355	30	587.3	20.0	290620	25.0	290655	41.5	290210	63.7	290230
Chinese University	351	120	580.8	19.5	311035	33.5	290635	61.5	311030	88.8	311130
Tsuen Wan R/G Filters	159	120	570.7	25.0	290640	34.5	290840	50.0	290635	90.0	290640
Yuen Long R/G Filters	217	20	551.4	29.5	290550	52.0	290245	81.0	290555	130.5	290555
Waglan Island	203	50	539.5	22.0	290840	31.0	290735	47.0	281930	65.0	290845
Kowloon Byewash	16	120	537.2	17.5	290645	30.0	290550	47.5	290255	64.8	290315
Pokfulam Reservoir	211	175	532.5	21.0	290720	27.5	290545	52.5	290730	57.0	290830
Chek Lap Kok	362	55	506.5	27.0	290530	34.0	290630	60.0	290145	84.5	290150
Tai Mei Tuk Pumping Station	341	10	492.7	18.0	290535	35.5	290525	61.5	290530	104.5	290630
Cheung Chau	234	70	440.1	18.0	311230	26.0	311245	44.2	290650	52.0	290750
Ta Kwu Ling Farm	283	5	425.5	18.0	311435	28.4	311440	37.7	300330	65.3	311620

* Data derived from ordinary raingauge, because of temporary malfunction of the autographic raingauge. However, the down-time of the gauge was considered not to have affected the estimation of intensity.

TABLE 5. MAXIMUM AVERAGE DEPTH OF RAINFALL DURING THE RAINSTORMS IN MAY 1982

Area in sq. km	(Duration in hours)							
	6	12	18	24	30	36	42	48
10	300	355	445	475	525	545	555	575
20	290	345	440	470	520	540	550	570
50	275	335	425	455	505	525	540	555
100	255	320	410	435	495	515	525	545
200	235	305	390	410	470	495	510	530
500	200	265	350	370	430	455	475	500
1 000	160	220	305	325	390	410	425	455

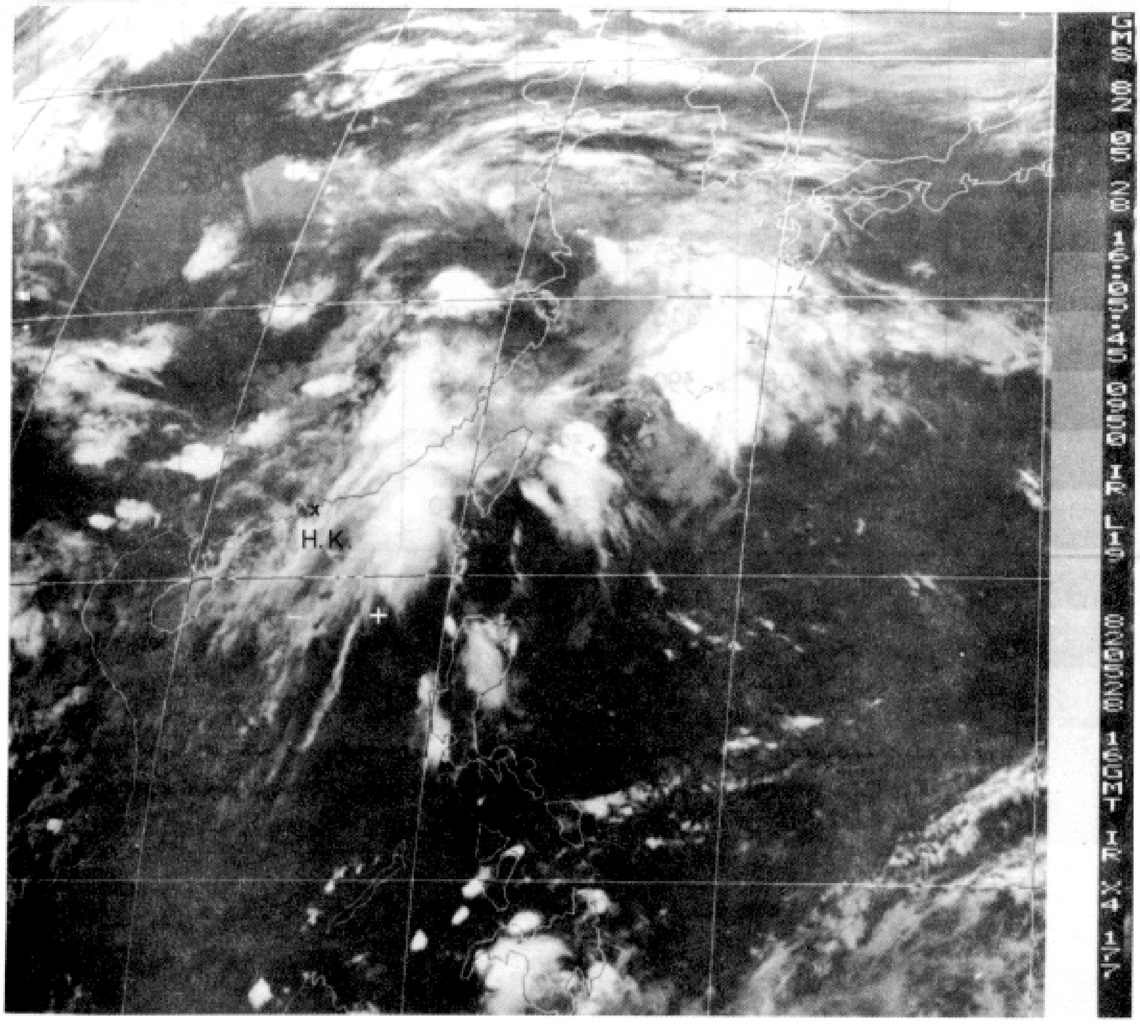


Plate 1. Infrared imagery taken at midnight, 28 May 1982

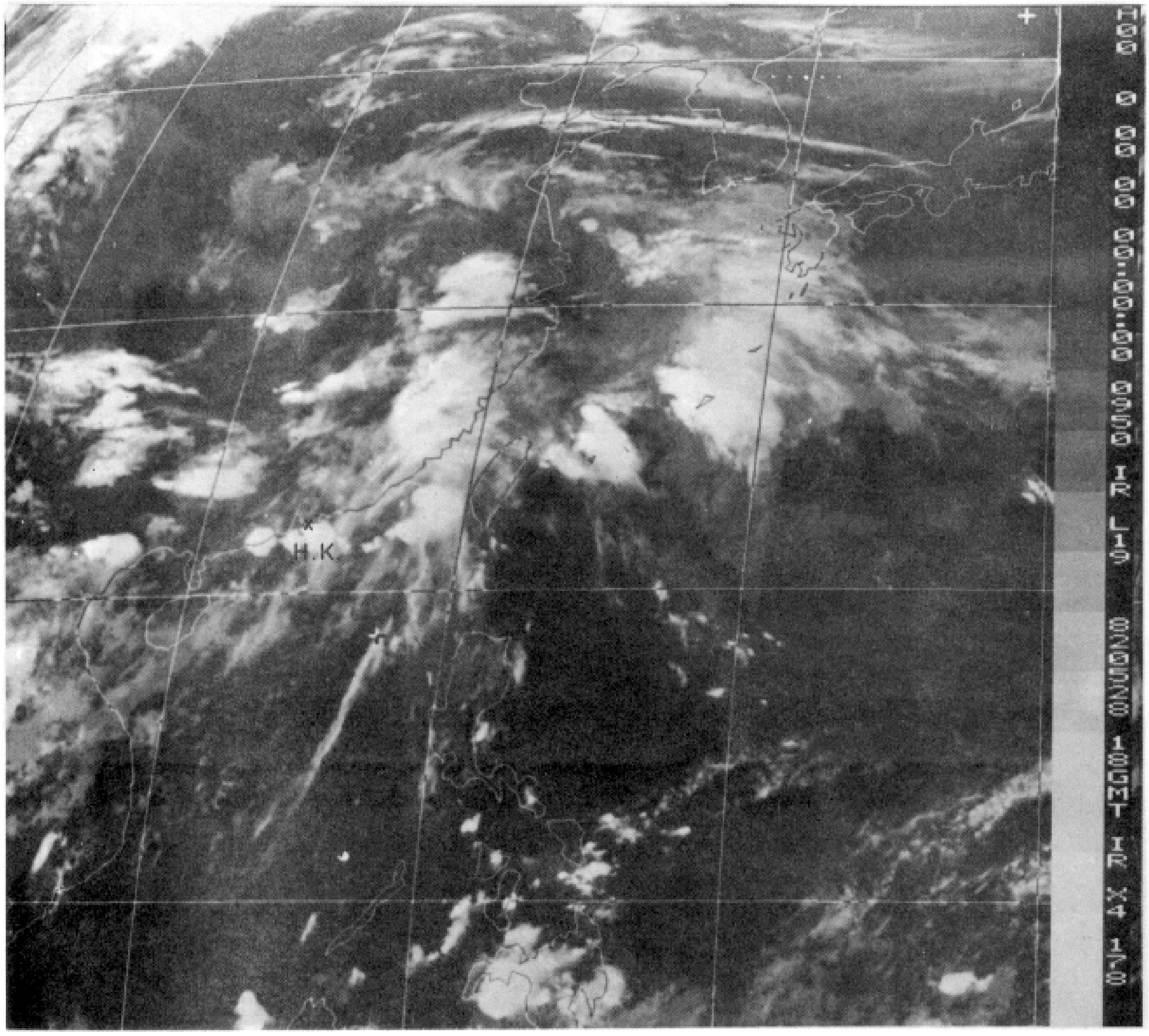


Plate 2. Infrared imagery taken at 2 a.m., 29 May 1982

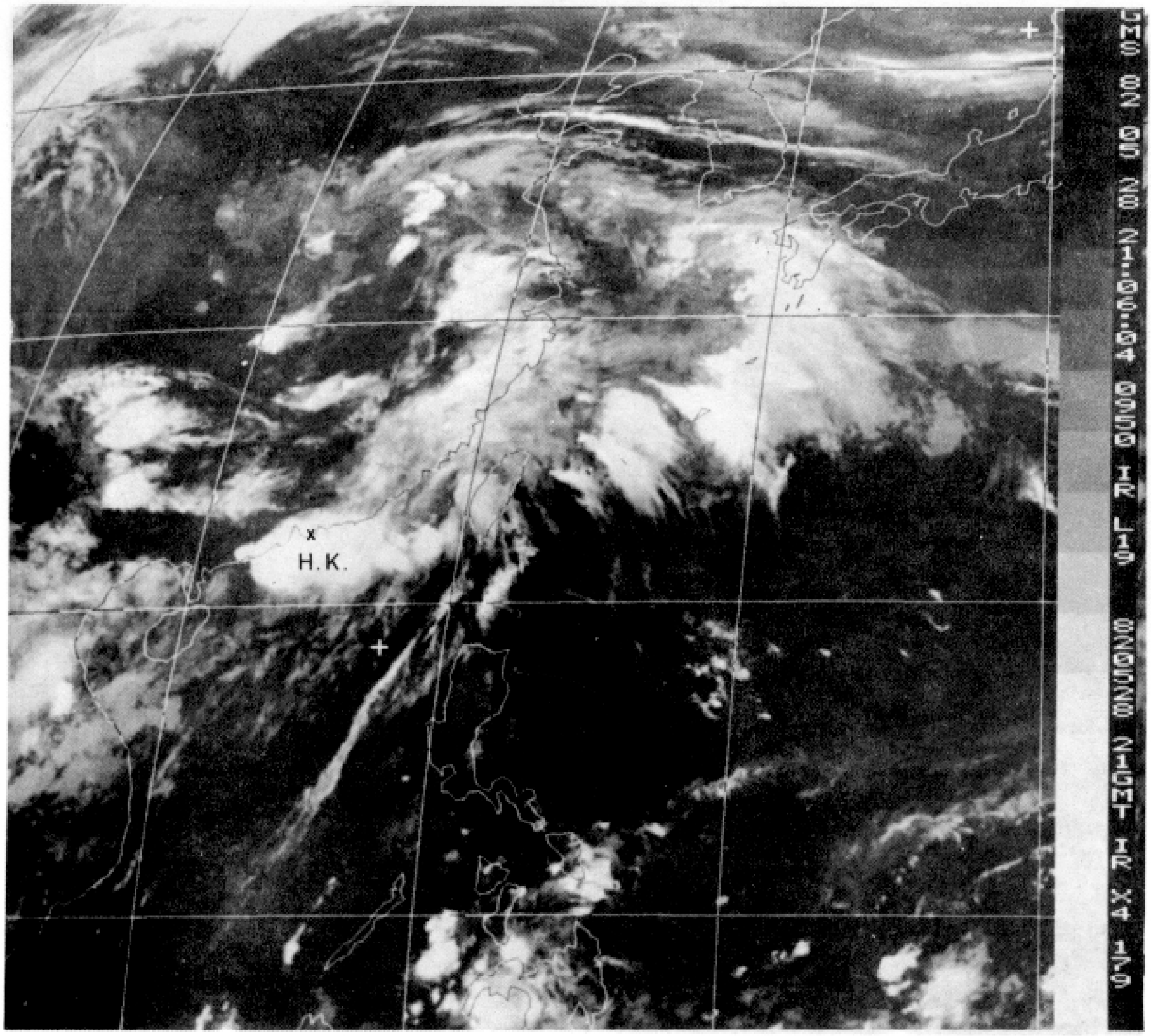


Plate 3. Infrared imagery taken at 5 a.m., 29 May 1982

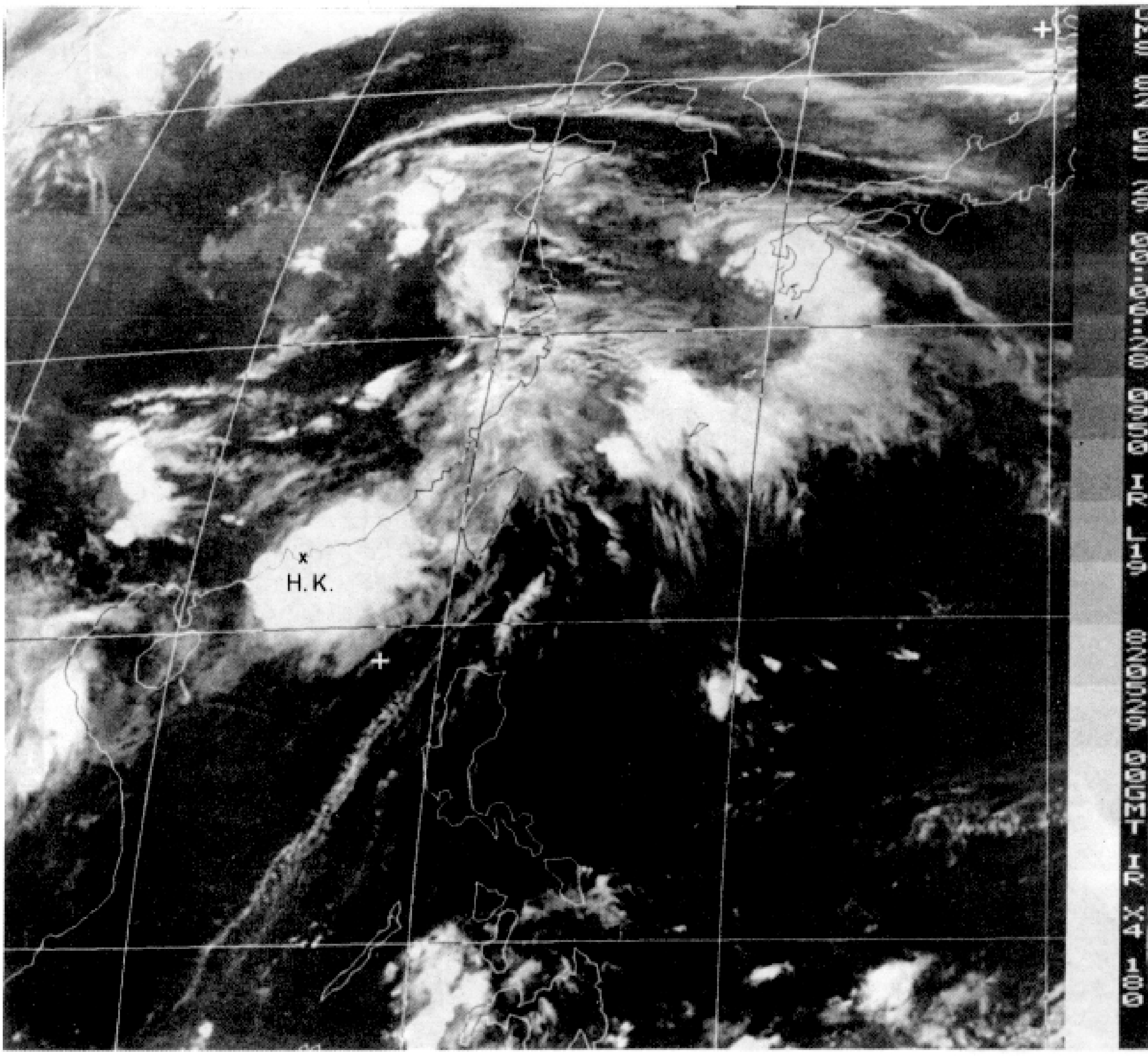


Plate 4. Infrared imagery taken at 8 a.m., 29 May 1982

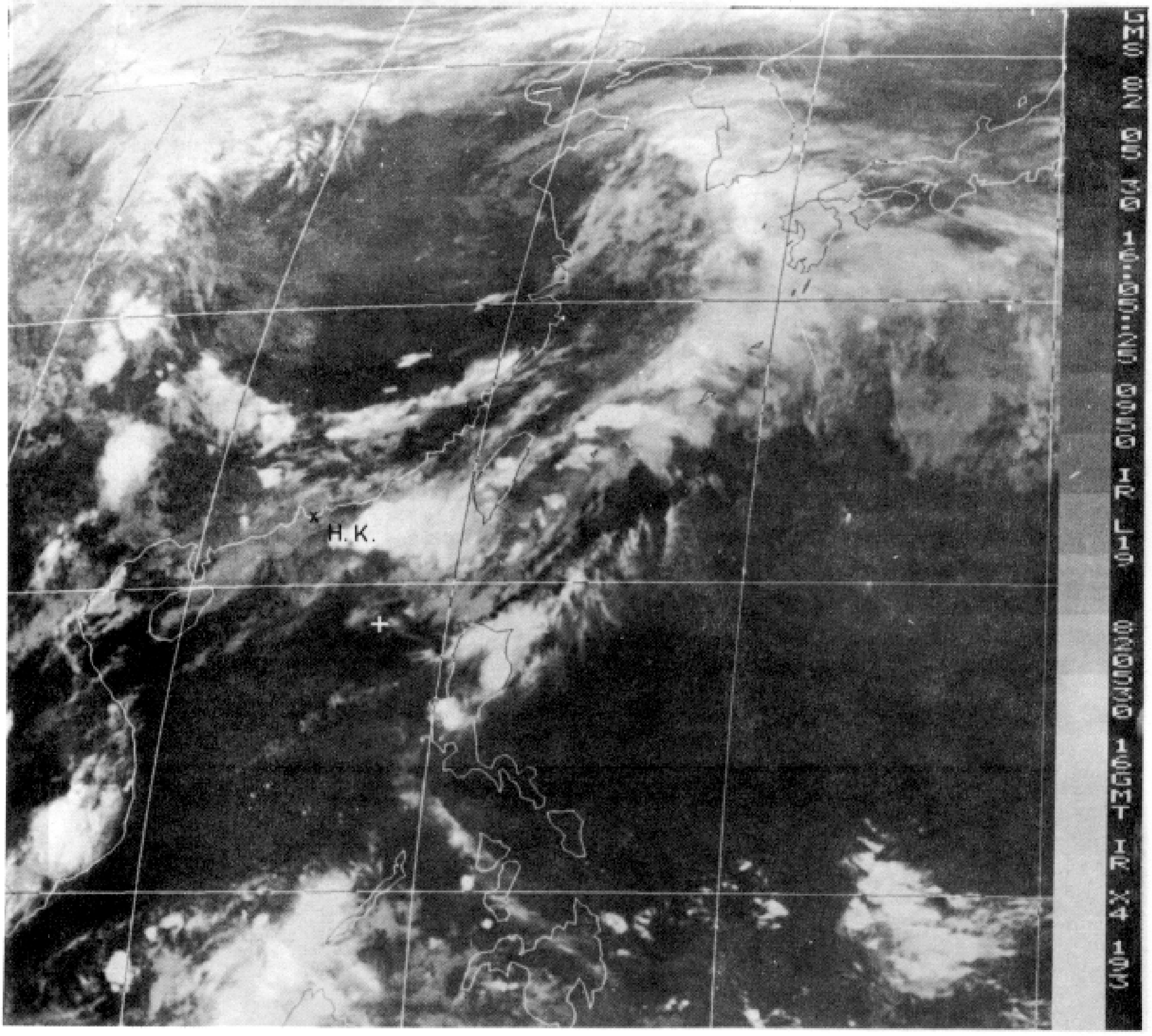


Plate 5. Infrared imagery taken at midnight, 30 May 1982

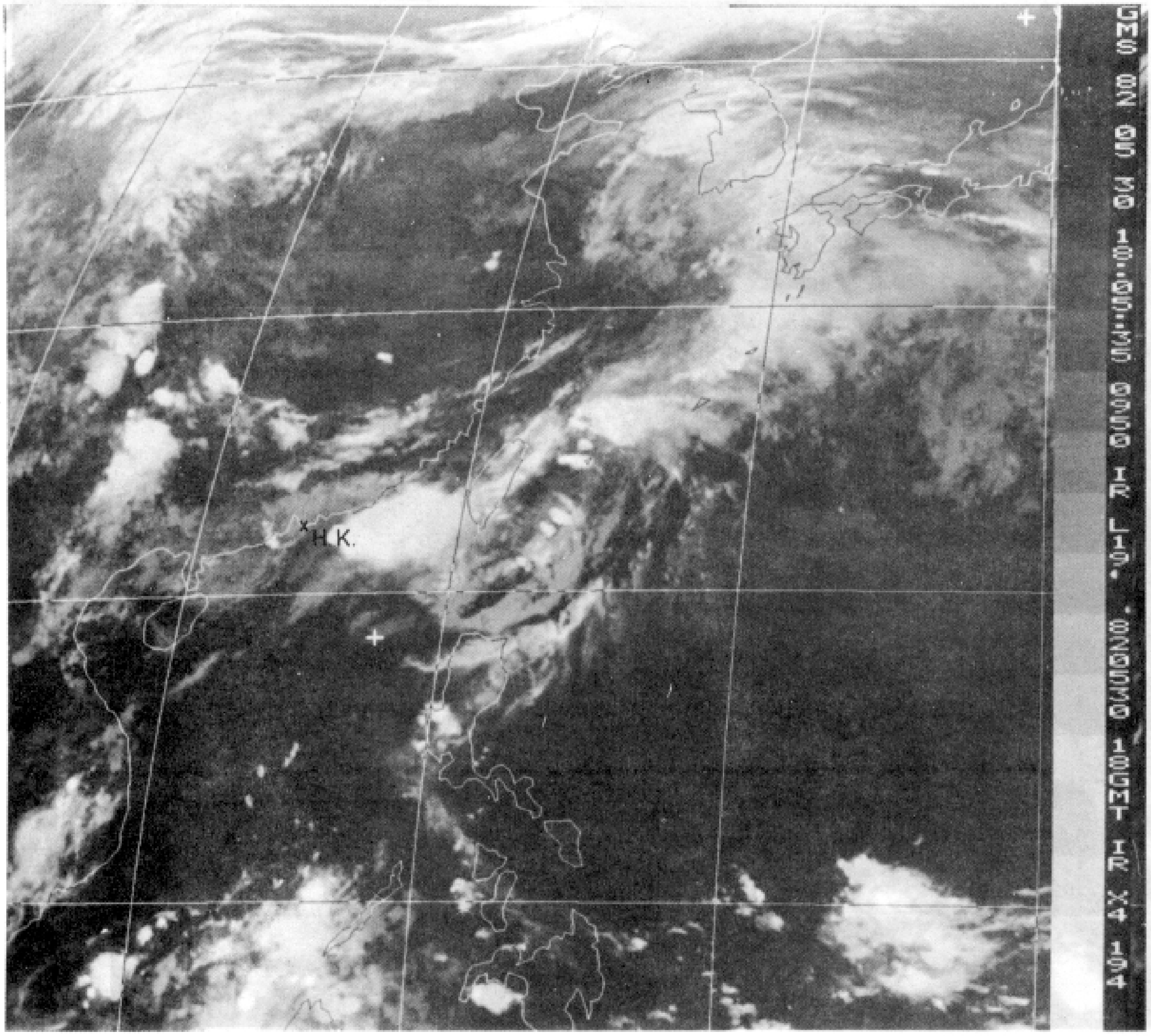


Plate 6. Infrared imagery taken at 2 a.m., 31 May 1982

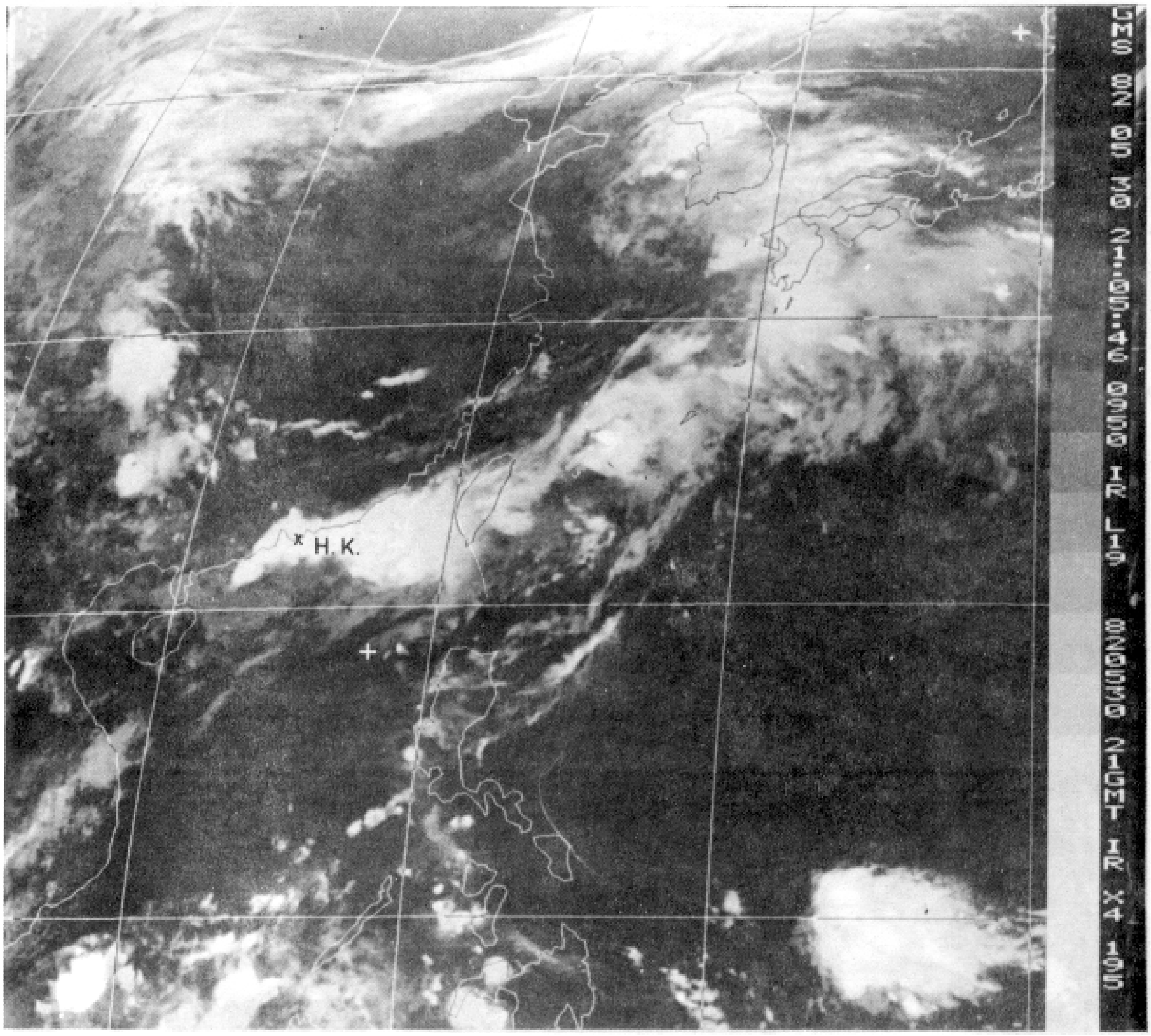


Plate 7. Infrared imagery taken at 5 a.m., 31 May 1982

Plate 8. Landslip and fallen boulders on Tuen Mun Road

Plate 9. Close-up view of the landslip area on Tuen Mun Road

Plate 10. Flooding in Kam Tin

Plate 11. Flooding in Kwun Tong

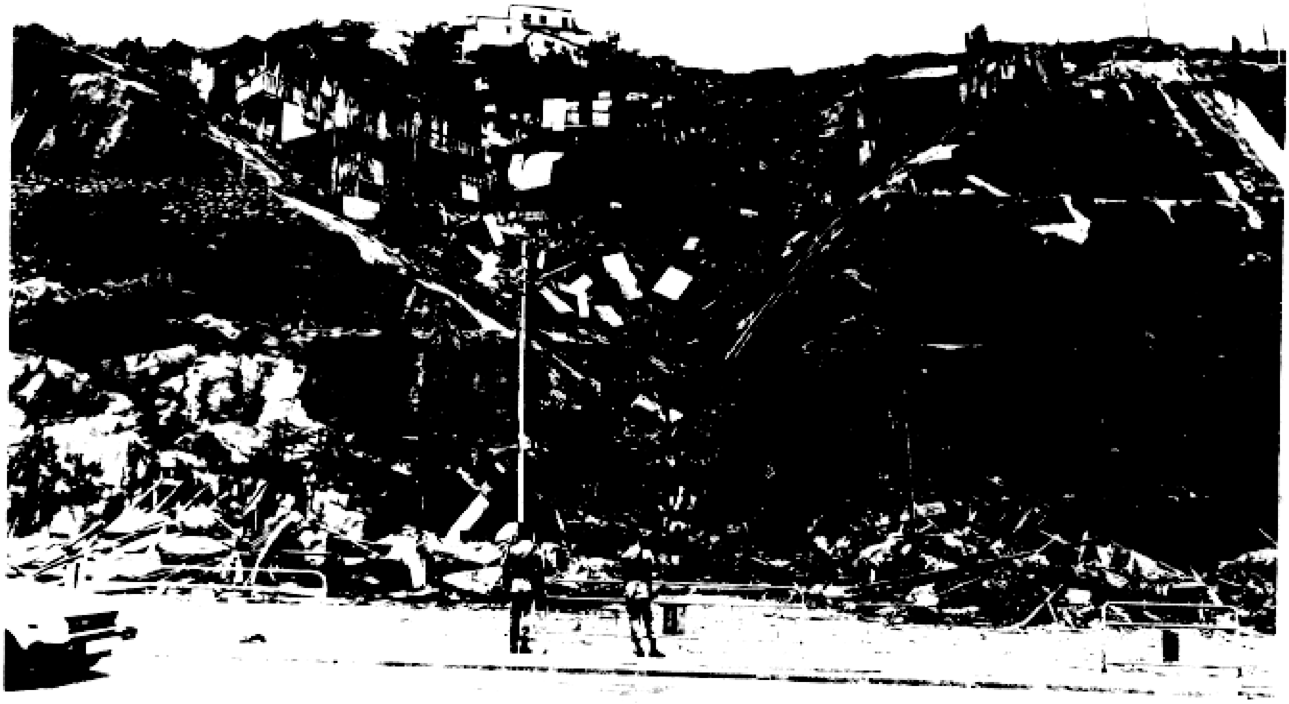


Plate 12. Damaged squatters in Lam Tin

Plate 13. Flooding in the squatter area, Sau Mau Ping