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COMPARISON OF HONG KONG STANDARD BAROMETER WITH SUB-REGIONAL STANDARD BAROMETER IN TOKYO 1994

by

WONG On

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Prepared by

Royal Observatory
134A Nathan Road
Kowloon
Hong Kong

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1. Introduction

In order to ensure consistency in the standards of pressure measuring instruments and prevent discontinuities in pressure data across international boundaries, the World Meteorological Organization (WMO 1981) recommends regional comparisons of national standard barometers with a regional standard barometer at least once every ten years.

Comparisons between Hong Kong's Standard Barometer and the Sub-regional Standard Barometer at the Japan Meteorological Agency (JMA) in Tokyo were carried out in 1957, 1973 (Chen and Wong 1973), 1983 (Lee and Yeung 1987) and recently in 1994. This note reports the results of the last comparison conducted in 1994.

2. Procedures for Comparison

Following WMO's (1983) recommended procedures (see Appendix 1 for details), inter-regional comparison between the Hong Kong's Standard Barometer, C (Fig. 1), and the Sub-regional Standard Barometer, B (Fig. 2), in Tokyo was carried out in 3 phases :

(a) Initial comparison at the Royal Observatory;
(b) Comparison at JMA in Tokyo, Japan;
(c) Final comparison at the Royal Observatory.

Initial comparison at the Royal Observatory between the Hong Kong's Standard Barometer, C, and the travelling barometer was performed during January to Feburary 1994. A total of 45 readings were taken. The travelling barometer was a Fortin barometer, P (Fig. 3). Two precision aneroid barometers (PAB), N1 and N2 (Fig. 4), were also used as supporting travelling barometers. Characteristics of the aforementioned barometers are listed in Appendix 2.

As the Fortin barometer had to be transported in an inverted position with the cistern end uppermost, a specially designed wooden travelling case (Fig. 5) was built to house it during transit. N1 and N2 were packed in specially built wooden boxes with their inlets sealed. On 25 February 1994, the travelling barometer and the PABs were carried by the author to Tokyo by Japan Air Lines (JAL). With the assistance of JAL, the Fortin barometer was secured in the business class Cloak Room on board the plane and the two PABs in front of a seat. After arriving in Tokyo, the barometers were immediately taken to JMA Headquarters with the help of JMA's staff. They were then installed in the Calibration Room beside the Sub-regional Standard Barometer, B. The Fortin barometer and the PABs were found to be in good working condition.

Comparison at JMA in Tokyo between the Sub-regional Standard Barometer and the travelling barometers took place during 1-4 March 1994. A total of 34 readings were taken.

On 5 March 1994, on the return journey to Hong Kong, the travelling barometers were secured on a JAL plane as before. After arrival, they were immediately installed beside the Hong Kong's Standard Barometer at the Royal Observatory.

Final comparison between Hong Kong's Standard Barometer and the travelling barometers at the Royal Observatory was performed during 10-16 March 1994. A total of 45 readings were taken.

During all comparison, mercury barometers were placed side by side and the precision aneroid barometers were placed on a nearby table. An electric fan was installed in order to keep the room temperatures uniform. A microbarograph and a digital barometer were used to monitor the pressure changes. Readings were taken only when pressure were steady and not fluctuating or changing rapidly. At each observation, the readings of the attached thermometer were read first so that heat effects from the observer on the thermometer were avoided.

For the periods of comparison, no tropical cyclones occurred over the South China Sea and the Western North Pacific. Weather over Hong Kong in January was mainly fine. It was unusually warm and humid with scarce rainfall. For the whole of February and 10-16 March in Hong Kong, the weather was generally cloudy with occasional rain. The amount of sunshine was less than half of normal. In Tokyo for the first week of March, the weather was mainly fine. No rapid fluctuation of pressure was observed on the barograph records.

3. Data Analysis

All readings taken during the barometer comparison were shown in Tables 1,2, 4, 5, 7 and 8. Pressure readings were reduced to standard condition with the following corrections before differences of readings were calculated :

(a) Manufacturer's index correction;

P' = P(as read) + manufacturer's index correction

(b) Attached thermometer correction;

T' = T(as read) + thermometer correction

(c) Temperature correction (CFT)

$$CFT = - P' \frac{(\beta - \alpha)\, T'}{(1 + \beta\, T')}$$

for Fortin type with P' in hPa and T' in degree Celsius; and

$$CFT = -\left[P' \frac{(\beta - \alpha)(T' - 32) + 30\,\alpha}{1 + \beta\,(T' - 32)} + \frac{V}{A}(\beta - 3\,\gamma)(T' - 62)\right]$$

for Kew-pattern inch type Hong Kong's Standard Barometer with P' in inches of mercury and T' in degree Fahrenheit.

where

α = coefficient of expansion (length) of brass
$(1.84 \times 10^{-5}$ /°C or 1.02×10^{-5} /°F)
β = coefficient of expansion of mercury (1.82×10^{-4} /°C)
γ = composite coefficient of linear expansion of the glass and steel
$(1.0 \times 10^{-5}$ /°C)
V/A = 1.5 inches for the Hong Kong's Standard Barometer

(d) Gravity correction (CFG)

$$CFG = (P' + CFT)\frac{(g_{\varphi,h} - g_0)}{g_0}$$

where

g_0 = standard gravity
= 9.80665 m/s^2 for Fortin type barometers and
= 9.8062 m/s^2 for the Hong Kong Standard barometer
(see Appendix 2 and UK Meteorological Office 1956)

$g_{\varphi,h}$ = gravity on the place of the standard barometer at latittude φ and height h above MSL.
= $9.80616(1-0.0026373 \cos 2\varphi + 0.0000059 \cos^2 2\varphi) - 0.0000939h$
= 9.7877 m/s^2 at ROHq, Hong Kong
= 9.7978 m/s^2 at JMA, Tokyo, Japan

The rate of change of barometric pressure at 30 minutes before and 30 minutes after the time of observation, mean hourly speed and maximum gusts of surface winds centred at the time of observations at the locations of the pressure observations are shown in Tables 3, 6 and 9.

4. Results

Mean differences for barometer readings were calculated using the following equations :

(a) Mean differences between the travelling barometers (P, N1 and N2) and Hong Kong's Standard Barometer C :

i. For P

$$\overline{C - P} = 1/2 \left[(\overline{C - P})_{before} + (\overline{C - P})_{after} \right]$$
$$= 1/2 \left[[-0.03(0)] + [-0.08(6)]] \right.$$
$$= -0.05(8) \text{ hPa}$$

ii. For N1

$$\overline{C - N1} = 1/2 \left[(\overline{C - N1})_{before} + (\overline{C - N1})_{after} \right]$$
$$= 1/2[[-1.27(3)] + [-1.43(4)]]$$
$$= -1.35(4) \text{ hPa}$$

iii. For N2

$$\overline{C - N2} = 1/2 \left[(\overline{C - N2})_{before} + (\overline{C - N2})_{after} \right]$$
$$= 1/2[[-0.54(3)] + [-0.62(4)]]$$
$$= -0.58(4) \text{ hPa}$$

where the overbars denote mean values and subscripts denote readings at ROHq before and after the journey to JMA respectively.

(b) Mean differences between the travelling barometers (P, N1, N2) and Japan's Sub-regional Standard Barometer B :

i. For P

$$\overline{B - P} = -0.20(7) \text{ hPa}$$

ii. For N1

$$\overline{B - N1} = -1.49(0) \text{ hPa}$$

iii. For N2

$$\overline{B - N2} = -0.68(8) \text{ hPa}$$

(c) Mean differences between Hong Kong's Standard Barometer C and Japan's Sub-regional Standard Barometer B :

i. Using P

$$\overline{B - C} = \overline{(B - P)} - \overline{(C - P)}$$
$$= \mathbf{-0.14(8)} \text{ hPa}$$

ii. Using N1

$$\overline{B - C} = \overline{(B - N1)} - \overline{(C - N1)}$$
$$= -0.13(6) \text{ hPa}$$

iii. Using N2

$$\overline{B - C} = \overline{(B - N2)} - \overline{(C - N2)}$$
$$= -0.10(5) \text{ hPa}$$

5. Conclusion

The present comparison established that the Standard Barometer C of Hong Kong gave pressure readings 0.15 hPa higher than the Sub-regional Standard Barometer B in Tokyo. It is recommended that an index correction of -0.15 hPa be applied to the Hong Kong's Standard Barometer.

When compared with the index correction of +0.16 hPa of 1973 and -0.04 hPa in 1983, one could see a decreasing drift of the index correction for the Hong Kong's Standard Barometer. The drift might be caused by contamination of mercury or to a lesser extent by rising of air bubbles through the mercury column to the space above. In view of the steady drift, it is recommended to replace the Hong Kong's Standard Barometer in the near future.

Acknowledgment

The author wish to express his sincere thanks to the Director-General and staff of the Japan Meteorological Agency, particularly to members of the Observations Department, for their thoughtful arrangements and hospitality.

Sincere thanks are also due to Dr. B.Y. Lee of the Royal Observatory for his valuable advice and help in preparing this note.

References

(1)	World Meteorological Organization	1981	Manual on the Global Observing System, WMO-No. 544
(2)	World Meteorological Organization	1983	Guide to Meteorological Instruments and Methods of Observation, WMO-No. 8
(3)	Chen, T.Y. & Wong, N.Y.	1973	International Comparison of Barometers between Hong Kong and Tokyo, R.O.T.N. (Local) No. 15
(4)	Lee, H.N. & Yeung M.Y.	1987	Comparison of Barometers and Pyrheliometers between Hong Kong and Tokyo, R.O.T.N. (Local) No. 38
(5)	U.K. Meteorological Office	1956	Handbook of Meteorological Instruments, Part I, M.O. 577

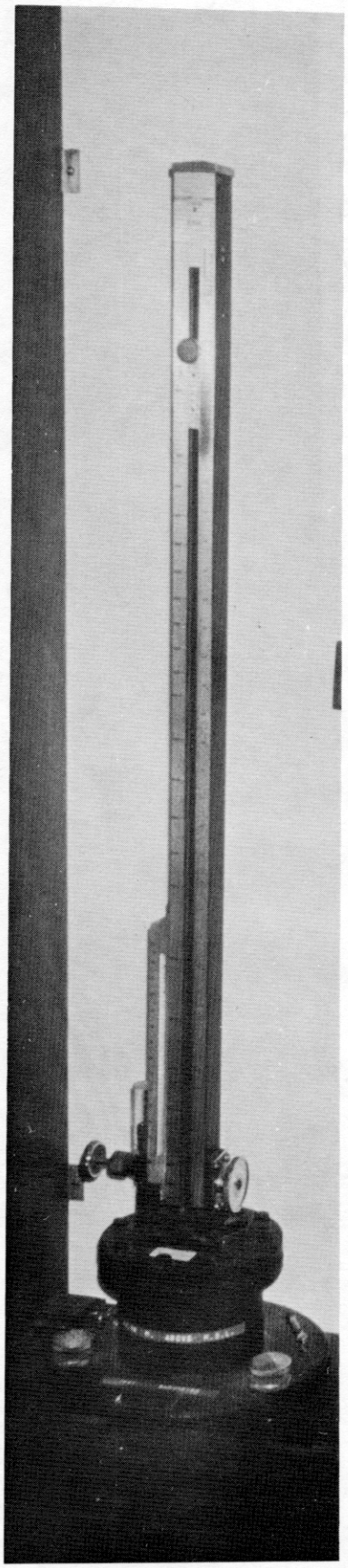

Fig. 1 Hong Kong's Standard Barometer, C

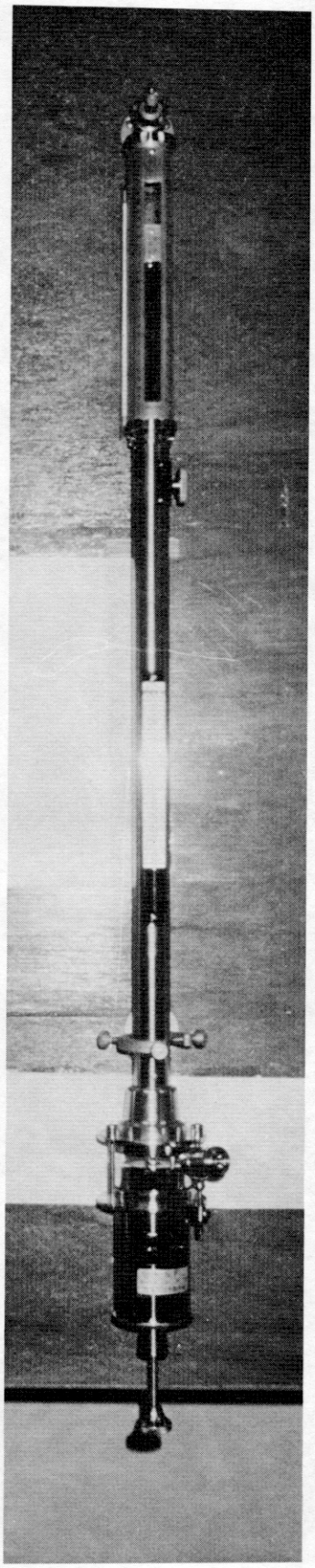

Fig. 2 Sub-regional Standard Barometer, B

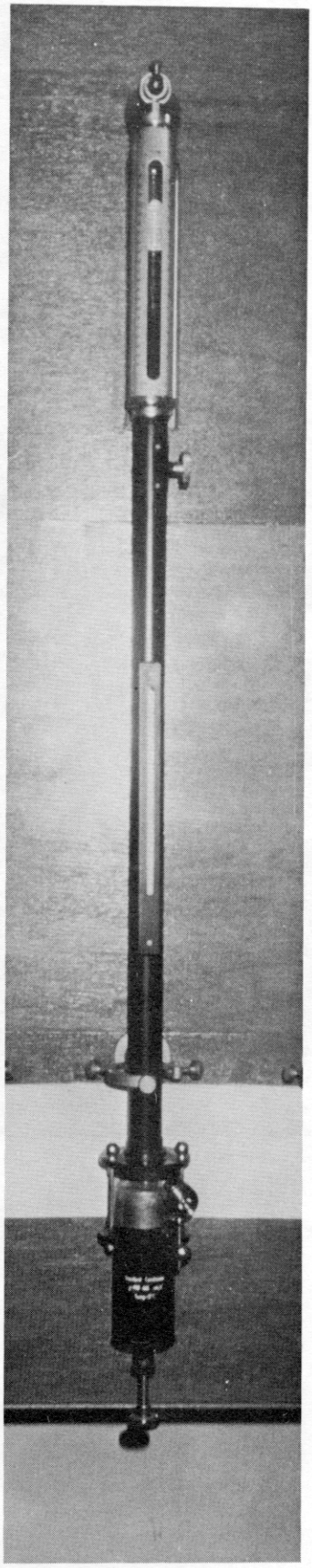

Fig. 3 Fortin Travelling Barometer, P

Fig. 4 Precision Aneroid Barometers, N1 and N2

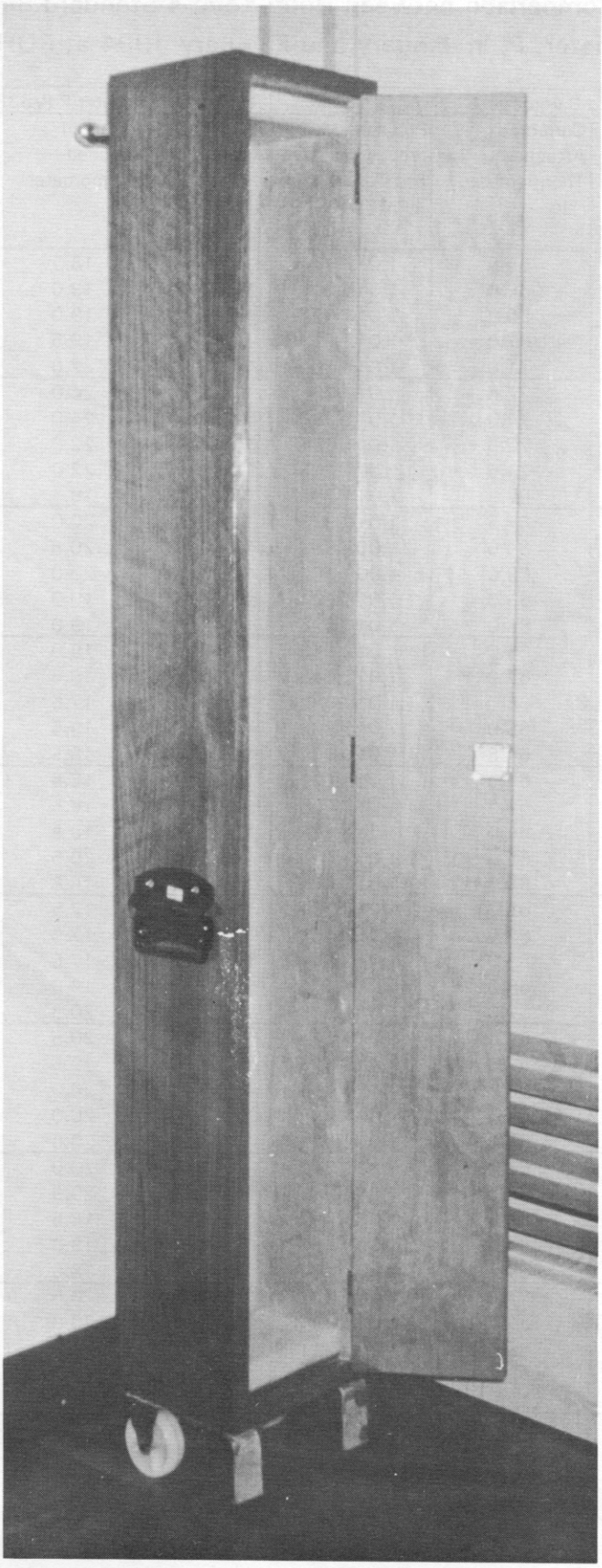

Fig. 5 Wooden Travelling Case for the Fortin Barometer

Table 1 : Result of Comparison between Hong Kong's Standard Barometer, C, and Travelling Barometer, P, in January and February 1994 at ROHq

Time of Readings (HK Local time)	HK Standard Barometer C			Travelling Barometer P (V633)			Difference (C - P)
	Pressure As Read (inHg)	Corrected Attached Thermometer (°F)	Pressure reduced to Std Condition (hPa)	Pressure As Read (hPa)	Corrected Attached Thermometer (°C)	Pressure reduced to Std Condition (hPa)	(hPa)
7 Jan 10:00	30.198	65.5	1,017.444	1,022.60	18.5	1,017.549	-0.105
12:00	30.164	66.0	1,016.251	1,021.40	19.0	1,016.273	-0.022
14:00	30.088	66.0	1,013.691	1,018.90	19.0	1,013.785	-0.095
16:00	30.062	67.0	1,012.719	1,018.00	19.5	1,012.807	-0.088
11 Jan 14:00	30.058	71.0	1,012.201	1,017.90	22.0	1,012.296	-0.094
16:00	30.048	72.5	1,011.721	1,017.60	24.0	1,011.668	0.053
12 Jan 10:00	30.078	74.0	1,012.588	1,018.50	24.0	1,012.563	0.025
12:00	30.052	72.5	1,011.856	1,017.50	22.0	1,011.898	-0.042
16:00	29.968	71.5	1,009.123	1,014.70	22.0	1,009.114	0.010
13 Jan 10:00	30.036	67.5	1,011.795	1,017.10	19.5	1,011.912	-0.116
12:00	30.010	67.5	1,010.920	1,016.20	20.0	1,010.934	-0.014
14:00	29.974	68.0	1,009.659	1,015.10	20.5	1,009.758	-0.098
16:00	29.980	68.0	1,009.862	1,015.20	20.0	1,009.939	-0.078
14 Jan 10:00	30.136	65.0	1,015.404	1,020.50	19.0	1,015.377	0.026
12:00	30.100	66.0	1,014.095	1,019.30	19.0	1,014.183	-0.088
14:00	30.048	66.0	1,012.343	1,017.50	19.0	1,012.392	-0.049
16:00	30.044	67.0	1,012.113	1,017.40	19.5	1,012.210	-0.098
19 Jan 10:00	30.238	63.0	1,019.032	1,024.00	17.5	1,019.108	-0.076
12:00	30.218	65.0	1,018.166	1,023.40	19.5	1,018.180	-0.014
14:00	30.158	64.5	1,016.193	1,021.20	18.5	1,016.156	0.036
16:00	30.130	65.0	1,015.201	1,020.30	18.5	1,015.261	-0.059
21 Jan 10:00	30.224	61.5	1,018.705	1,023.40	16.5	1,018.677	0.028
25 Jan 14:00	30.006	64.0	1,011.120	1,016.20	18.5	1,011.181	-0.061
16:00	29.990	65.0	1,010.485	1,015.60	19.5	1,010.420	0.065
26 Jan 10:00	30.172	65.0	1,016.616	1,021.70	18.5	1,016.654	-0.038
28 Jan 12:00	30.144	62.0	1,015.961	1,020.90	17.5	1,016.023	-0.062
14:00	30.070	62.0	1,013.468	1,018.30	17.0	1,013.518	-0.051
16:00	30.040	63.0	1,012.361	1,017.30	17.5	1,012.440	-0.080
2 Feb 14:00	30.192	66.0	1,017.194	1,022.40	19.0	1,017.268	-0.074
3 Feb 12:00	30.206	67.0	1,017.569	1,022.90	20.5	1,017.517	0.053
14:00	30.138	67.5	1,015.231	1,020.50	20.5	1,015.129	0.102
16:00	30.120	67.0	1,014.673	1,019.90	19.5	1,014.698	-0.025
4 Feb 10:00	30.146	68.5	1,015.404	1,020.70	20.0	1,015.411	-0.007
12:00	30.112	68.5	1,014.259	1,019.60	20.0	1,014.317	-0.057
14:00	30.046	68.5	1,012.037	1,017.50	20.5	1,012.145	-0.109
16:00	30.024	68.0	1,011.343	1,016.60	20.0	1,011.332	0.011
8 Feb 16:00	29.896	68.5	1,006.985	1,012.40	20.5	1,007.072	-0.087
9 Feb 10:00	30.074	65.5	1,013.267	1,018.30	18.5	1,013.271	-0.004
18 Feb 12:00	29.972	64.5	1,009.926	1,014.90	18.0	1,009.970	-0.043
14:00	29.908	64.5	1,007.770	1,012.60	18.0	1,007.681	0.089
22 Feb 14:00	29.832	67.0	1,004.972	1,010.30	20.5	1,004.983	-0.011
23 Feb 10:00	29.914	67.5	1,007.686	1,013.00	20.0	1,007.751	-0.064
14:00	29.844	68.0	1,005.281	1,010.70	21.0	1,005.299	-0.018
16:00	29.822	68.5	1,004.493	1,009.90	21.0	1,004.503	-0.011
24 Feb 14:00	30.006	69.0	1,010.642	1,016.00	21.0	1,010.571	0.071

N =	45
Sum =	-1.369
Mean (C - P) =	**-0.030**
Std deviation =	**0.058**

Table 2 : Result of Comparison between Hong Kong's Standard Barometer, C, and Travelling Barometers, N1 and N2, in January and February 1994 at ROHq

Time of Readings (HK Local Time)	HK Standard Barometer C			Travelling Barometers N1 and N2			
	Pressure As Read (inHg)	Corrected Attached Thermometer (°F)	Pressure reduced to Std Condition (hPa)	Pressure As Read (610) N1 (hPa)	Difference (C - N1) (hPa)	Pressure As Read (A162) N2 (hPa)	Difference (C - N2) (hPa)
7 Jan 10:00	30.198	65.5	1,017.444	1,018.85	-1.406	1,018.15	-0.706
12:00	30.164	66.0	1,016.251	1,017.55	-1.299	1,016.85	-0.599
14:00	30.088	66.0	1,013.691	1,015.00	-1.309	1,014.30	-0.609
16:00	30.062	67.0	1,012.719	1,014.00	-1.281	1,013.31	-0.591
11 Jan 14:00	30.058	71.0	1,012.201	1,013.31	-1.109	1,012.70	-0.499
16:00	30.048	72.5	1,011.721	1,012.90	-1.179	1,012.20	-0.479
12 Jan 10:00	30.078	74.0	1,012.588	1,013.70	-1.112	1,013.05	-0.462
12:00	30.052	72.5	1,011.856	1,013.10	-1.244	1,012.40	-0.544
16:00	29.968	71.5	1,009.123	1,010.32	-1.197	1,009.53	-0.407
13 Jan 10:00	30.036	67.5	1,011.795	1,013.15	-1.355	1,012.43	-0.635
12:00	30.010	67.5	1,010.920	1,012.20	-1.280	1,011.45	-0.530
14:00	29.974	68.0	1,009.659	1,010.89	-1.231	1,010.15	-0.491
16:00	29.980	68.0	1,009.862	1,011.20	-1.338	1,010.50	-0.638
14 Jan 10:00	30.136	65.0	1,015.404	1,016.60	-1.196	1,015.97	-0.566
12:00	30.100	66.0	1,014.095	1,015.35	-1.255	1,014.70	-0.605
14:00	30.048	66.0	1,012.343	1,013.75	-1.407	1,013.05	-0.707
16:00	30.044	67.0	1,012.113	1,013.45	-1.337	1,012.75	-0.637
19 Jan 10:00	30.238	63.0	1,019.032	1,020.42	-1.388	1,019.73	-0.698
12:00	30.218	65.0	1,018.166	1,019.40	-1.234	1,018.70	-0.534
14:00	30.158	64.5	1,016.193	1,017.40	-1.207	1,016.72	-0.527
16:00	30.130	65.0	1,015.201	1,016.52	-1.319	1,015.84	-0.639
21 Jan 10:00	30.224	61.5	1,018.705	1,020.05	-1.345	1,019.34	-0.635
25 Jan 14:00	30.006	64.0	1,011.120	1,012.30	-1.180	1,011.50	-0.380
16:00	29.990	65.0	1,010.485	1,011.61	-1.125	1,010.86	-0.375
26 Jan 10:00	30.172	65.0	1,016.616	1,017.90	-1.284	1,017.20	-0.584
28 Jan 12:00	30.144	62.0	1,015.961	1,017.21	-1.249	1,016.50	-0.539
14:00	30.070	62.0	1,013.468	1,014.79	-1.322	1,014.05	-0.582
16:00	30.040	63.0	1,012.361	1,013.67	-1.309	1,012.90	-0.539
2 Feb 14:00	30.192	66.0	1,017.194	1,018.70	-1.506	1,017.95	-0.756
3 Feb 12:00	30.206	67.0	1,017.569	1,018.85	-1.281	1,018.05	-0.481
14:00	30.138	67.5	1,015.231	1,016.50	-1.269	1,015.80	-0.569
16:00	30.120	67.0	1,014.673	1,015.96	-1.287	1,015.27	-0.597
4 Feb 10:00	30.146	68.5	1,015.404	1,016.70	-1.296	1,016.00	-0.596
12:00	30.112	68.5	1,014.259	1,015.46	-1.201	1,014.77	-0.511
14:00	30.046	68.5	1,012.037	1,013.37	-1.333	1,012.58	-0.543
16:00	30.024	68.0	1,011.343	1,012.50	-1.157	1,011.86	-0.517
8 Feb 16:00	29.896	68.5	1,006.985	1,008.26	-1.275	1,007.35	-0.365
9 Feb 10:00	30.074	65.5	1,013.267	1,014.55	-1.283	1,013.85	-0.583
18 Feb 12:00	29.972	64.5	1,009.926	1,011.20	-1.274	1,010.45	-0.524
14:00	29.908	64.5	1,007.770	1,009.04	-1.270	1,008.15	-0.380
22 Feb 14:00	29.832	67.0	1,004.972	1,006.22	-1.248	1,005.39	-0.418
23 Feb 10:00	29.914	67.5	1,007.686	1,009.04	-1.354	1,008.24	-0.554
14:00	29.844	68.0	1,005.281	1,006.59	-1.309	1,005.70	-0.419
16:00	29.822	68.5	1,004.493	1,005.75	-1.257	1,004.92	-0.427
24 Feb 14:00	30.006	69.0	1,010.642	1,011.82	-1.178	1,011.10	-0.458
				N =	45	N =	45
				Sum =	-57.275	Sum =	-24.435
				Mean (C - N1) =	**-1.273**	Mean (C - N2) =	**-0.543**
				Std deviation =	**0.081**	Std deviation =	**0.095**

Table 3 : Wind and Pressure Information during Barometer Comparison in January and February 1994 at ROHq

Time (HK Local Time)	Pressure change (hPa/h)	Surface Wind	
		Hourly Mean (m/s)	Max. Gust (m/s)
7 Jan 10:00	0.3	5.5	10.0
12:00	-0.3	5.5	9.0
14:00	-0.7	5.0	8.5
16:00	0.2	5.0	7.5
11 Jan 14:00	-0.5	5.0	9.0
16:00	0.4	5.0	9.0
12 Jan 10:00	-0.2	6.5	12.0
12:00	-0.8	5.5	9.0
16:00	0.1	4.5	8.5
13 Jan 10:00	0.4	2.0	5.0
12:00	-0.8	1.5	6.0
14:00	-0.2	3.0	7.5
16:00	0.7	1.0	4.0
14 Jan 10:00	0.0	0.5	2.5
12:00	-1.1	0.5	3.0
14:00	-0.6	1.0	5.0
16:00	0.2	2.0	4.5
19 Jan 10:00	0.0	6.5	12.0
12:00	-1.0	6.0	10.5
14:00	-1.0	5.0	10.0
16:00	-0.3	4.0	7.5
21 Jan 10:00	0.0	1.5	3.5
25 Jan 14:00	-0.9	3.0	5.0
16:00	0.0	2.0	4.5
26 Jan 10:00	0.0	1.0	2.5
28 Jan 12:00	-0.6	3.5	6.5
14:00	-1.1	3.0	6.5
16:00	0.0	3.5	7.0
2 Feb 14:00	-1.1	4.0	7.5
3 Feb 12:00	-1.0	5.0	10.0
14:00	-1.0	6.5	11.5
16:00	-0.2	5.0	8.0
4 Feb 10:00	0.5	5.0	9.0
12:00	-0.8	4.5	7.5
14:00	-1.1	4.5	9.0
16:00	0.0	4.5	8.5
8 Feb 16:00	0.4	2.0	5.0
9 Feb 10:00	0.3	0.5	3.0
18 Feb 12:00	-1.0	7.0	12.5
14:00	-1.2	5.5	11.0
22 Feb 14:00	-1.0	6.5	11.5
23 Feb 10:00	0.4	6.5	10.0
14:00	-1.0	6.0	10.0
16:00	0.0	5.0	8.0
24 Feb 14:00	-0.4	5.5	9.5

Table 4 : Result of Comparison between Sub-regional Standard Barometer, B, and Travelling Barometer, P, in March 1994 in Tokyo

Time of Readings (Tokyo Local Time)	Sub-regional Standard Barometer B			Travelling Barometer P (V633)			Difference (B - P)
	Pressure As Read (hPa)	Corrected Attached Thermometer (°C)	Pressure reduced to Std Condition (hPa)	Pressure As Read (hPa)	Corrected Attached Thermometer (°C)	Pressure reduced to Std Condition (hPa)	(hPa)
1 Mar 10:30	1,021.57	19.1	1,017.514	1021.85	19.30	1,017.720	-0.206
11:00	1,021.17	19.1	1,017.115	1021.38	19.40	1,017.235	-0.120
11:30	1,020.60	19.2	1,016.531	1020.88	19.40	1,016.737	-0.206
13:30	1,018.52	19.3	1,014.443	1018.85	19.30	1,014.732	-0.289
14:00	1,018.35	19.9	1,014.174	1018.59	19.60	1,014.423	-0.249
14:30	1,018.24	19.9	1,014.065	1018.55	19.60	1,014.383	-0.318
15:00	1,018.15	19.9	1,013.975	1018.42	19.60	1,014.254	-0.279
15:30	1,018.14	19.9	1,013.965	1018.37	19.70	1,014.188	-0.222
16:00	1,018.20	19.9	1,014.025	1018.48	19.70	1,014.297	-0.272
2 Mar 10:00	1,022.30	19.2	1,018.224	1022.61	19.20	1,018.493	-0.269
10:30	1,022.06	19.3	1,017.969	1022.39	19.50	1,018.224	-0.256
11:05	1,021.95	19.5	1,017.826	1022.19	19.80	1,017.975	-0.149
11:30	1,021.62	19.6	1,017.481	1021.88	19.80	1,017.667	-0.186
13:30	1,019.92	19.6	1,015.788	1020.22	19.80	1,016.013	-0.226
14:00	1,019.91	19.6	1,015.778	1020.18	19.80	1,015.974	-0.196
14:30	1,019.88	19.7	1,015.731	1020.07	19.90	1,015.848	-0.116
15:00	1,019.76	19.7	1,015.612	1020.05	19.90	1,015.828	-0.216
15:30	1,020.15	19.8	1,015.984	1020.36	19.90	1,016.136	-0.153
16:00	1,020.27	19.8	1,016.103	1020.57	19.90	1,016.345	-0.242
3 Mar 10:00	1,025.18	19.5	1,021.043	1025.51	19.70	1,021.298	-0.256
10:30	1,024.90	19.6	1,020.747	1025.13	19.70	1,020.920	-0.173
11:00	1,024.38	19.6	1,020.229	1024.67	19.70	1,020.462	-0.232
11:30	1,023.95	19.7	1,019.784	1024.18	19.70	1,019.974	-0.189
13:30	1,021.87	19.7	1,017.713	1022.08	19.80	1,017.866	-0.153
14:00	1,021.35	19.8	1,017.179	1021.63	19.80	1,017.418	-0.239
14:30	1,021.70	19.8	1,017.527	1022.03	19.90	1,017.799	-0.272
15:00	1,021.88	19.8	1,017.706	1022.06	19.90	1,017.829	-0.123
15:35	1,021.96	19.8	1,017.786	1022.19	20.00	1,017.942	-0.156
16:00	1,021.56	19.9	1,017.371	1021.81	20.00	1,017.564	-0.193
17:00	1,021.47	20.1	1,017.248	1021.68	20.20	1,017.401	-0.153
17:20	1,021.32	20.1	1,017.099	1021.49	20.10	1,017.229	-0.129
17:40	1,021.46	20.1	1,017.238	1021.76	20.10	1,017.497	-0.259
4 Mar 9:30	1,018.26	19.5	1,014.151	1018.45	19.40	1,014.317	-0.166
10:00	1,018.14	19.5	1,014.031	1018.38	19.70	1,014.198	-0.166

N =	34
Sum =	-7.028
Mean (B - P) =	**-0.207**
Std deviation =	**0.055**

Table 5 : Result of Comparison between Sub-regional Standard Barometer, B, and Travelling Barometers, N1 and N2, in March 1994 in Tokyo

Time of Readings (Tokyo Local Time)	Sub-regional Standard Barometer B			Travelling Barometers N1 and N2			
	Pressure As Read (hPa)	Corrected Attached Thermometer (°C)	Pressure reduced to Std Condition (hPa)	Pressure As Read (610) N1 (hPa)	Difference (B - N1) (hPa)	Pressure As Read (A162) N2 (hPa)	Difference (B - N2) (hPa)
1 Mar 10:30	1,021.57	19.1	1,017.514	1,019.05	-1.536	1,018.26	-0.746
11:00	1,021.17	19.1	1,017.115	1,018.54	-1.425	1,017.73	-0.615
11:30	1,020.60	19.2	1,016.531	1,018.00	-1.469	1,017.25	-0.719
13:30	1,018.52	19.3	1,014.443	1,015.98	-1.537	1,015.14	-0.697
14:00	1,018.35	19.9	1,014.174	1,015.72	-1.546	1,014.92	-0.746
14:30	1,018.24	19.9	1,014.065	1,015.61	-1.545	1,014.80	-0.735
15:00	1,018.15	19.9	1,013.975	1,015.53	-1.555	1,014.75	-0.775
15:30	1,018.14	19.9	1,013.965	1,015.41	-1.445	1,014.71	-0.745
16:00	1,018.20	19.9	1,014.025	1,015.52	-1.495	1,014.77	-0.745
2 Mar 10:00	1,022.30	19.2	1,018.224	1,019.66	-1.436	1,018.91	-0.686
10:30	1,022.06	19.3	1,017.969	1,019.49	-1.521	1,018.70	-0.731
11:05	1,021.95	19.5	1,017.826	1,019.29	-1.464	1,018.50	-0.674
11:30	1,021.62	19.6	1,017.481	1,018.87	-1.389	1,018.11	-0.629
13:30	1,019.92	19.6	1,015.788	1,017.23	-1.442	1,016.48	-0.692
14:00	1,019.91	19.6	1,015.778	1,017.18	-1.402	1,016.40	-0.622
14:30	1,019.88	19.7	1,015.731	1,017.20	-1.469	1,016.34	-0.609
15:00	1,019.76	19.7	1,015.612	1,017.13	-1.518	1,016.30	-0.688
15:30	1,020.15	19.8	1,015.984	1,017.45	-1.466	1,016.61	-0.626
16:00	1,020.27	19.8	1,016.103	1,017.61	-1.507	1,016.80	-0.697
3 Mar 10:00	1,025.18	19.5	1,021.043	1,022.56	-1.517	1,021.71	-0.667
10:30	1,024.90	19.6	1,020.747	1,022.22	-1.473	1,021.43	-0.683
11:00	1,024.38	19.6	1,020.229	1,021.80	-1.571	1,020.90	-0.671
11:30	1,023.95	19.7	1,019.784	1,021.38	-1.596	1,020.50	-0.716
13:30	1,021.87	19.7	1,017.713	1,019.23	-1.517	1,018.40	-0.687
14:00	1,021.35	19.8	1,017.179	1,018.66	-1.481	1,017.91	-0.731
14:30	1,021.70	19.8	1,017.527	1,018.98	-1.453	1,018.23	-0.703
15:00	1,021.88	19.8	1,017.706	1,019.11	-1.404	1,018.31	-0.604
15:35	1,021.96	19.8	1,017.786	1,019.24	-1.454	1,018.39	-0.604
16:00	1,021.56	19.9	1,017.371	1,018.86	-1.489	1,018.03	-0.659
17:00	1,021.47	20.1	1,017.248	1,018.81	-1.562	1,018.02	-0.772
17:20	1,021.32	20.1	1,017.099	1,018.64	-1.541	1,017.83	-0.731
17:40	1,021.46	20.1	1,017.238	1,018.70	-1.462	1,017.85	-0.612
4 Mar 9:30	1,018.26	19.5	1,014.151	1,015.72	-1.569	1,014.88	-0.729
10:00	1,018.14	19.5	1,014.031	1,015.42	-1.389	1,014.68	-0.649
				N =	34	N =	34
				Sum =	-50.644	Sum =	-23.394
				Mean (B - N1) =	**-1.490**	Mean (B - N2) =	**-0.688**
				Std deviation =	**0.056**	Std deviation =	**0.051**

Table 6 : Wind and Pressure Information during Barometer Comparison in March 1994 in Tokyo

Time (Tokyo Local Time)	Pressure change (hPa/h)	Surface Wind Hourly Mean (m/s)
1 Mar 10:00	-0.8	
11:00	-1.1	
12:00	-1.1	3.0
13:00	-1.0	
14:00	-0.6	
15:00	-0.4	3.0
2 Mar 10:00	-0.4	
11:00	-0.6	
12:00	-0.7	8.0
13:00	-0.8	
14:00	-0.3	
15:00	0.2	
3 Mar 11:00	-0.9	
12:00	-1.4	5.0
13:00	-0.6	
14:00	-0.3	
15:00	0.1	9.0
16:00	-0.6	
17:00	-0.1	

Table 7 : Result of Comparison between Hong Kong's Standard Barometer, C, and Travelling Barometer, P, in March 1994 at ROHq

Time of Readings (HK Local Time)	HK Standard Barometer C			Travelling Barometer P (V633)			Difference (C - P)
	Pressure As Read (inHg)	Corrected Attached Thermometer (°F)	Pressure reduced to Std Condition (hPa)	Pressure As Read (hPa)	Corrected Attached Thermometer (°C)	Pressure reduced to Std Condition (hPa)	(hPa)
10 Mar 11:10	30.186	66.8	1,016.915	1,022.22	19.5	1,017.006	-0.091
12:00	30.163	66.7	1,016.150	1,021.38	19.3	1,016.203	-0.053
13:45	30.096	66.1	1,013.950	1,019.18	19.0	1,014.064	-0.113
14:15	30.096	68.1	1,013.759	1,019.06	20.1	1,013.763	-0.004
14:45	30.092	68.7	1,013.567	1,019.04	20.4	1,013.693	-0.127
15:15	30.090	68.9	1,013.480	1,018.95	20.8	1,013.538	-0.058
15:45	30.089	69.6	1,013.379	1,018.84	21.0	1,013.396	-0.016
16:15	30.080	69.0	1,013.134	1,018.66	20.9	1,013.233	-0.099
16:45	30.076	68.4	1,013.056	1,018.34	20.3	1,013.014	0.043
11 Mar 9:45	30.072	64.8	1,013.267	1,018.40	18.1	1,013.436	-0.170
10:15	30.074	64.9	1,013.324	1,018.44	18.4	1,013.426	-0.102
10:45	30.073	64.8	1,013.300	1,018.46	18.4	1,013.446	-0.146
11:15	30.060	64.8	1,012.862	1,017.95	18.4	1,012.939	-0.077
11:45	30.046	64.9	1,012.381	1,017.52	18.4	1,012.511	-0.130
12:15	30.037	64.8	1,012.087	1,017.30	18.3	1,012.309	-0.221
13:45	29.997	64.8	1,010.740	1,015.82	18.2	1,010.852	-0.112
14:15	29.980	65.6	1,010.091	1,015.22	18.6	1,010.189	-0.099
14:45	29.963	65.4	1,009.537	1,014.75	18.8	1,009.689	-0.152
15:15	29.953	65.1	1,009.229	1,014.42	18.6	1,009.393	-0.164
15:45	29.957	65.7	1,009.306	1,014.46	18.8	1,009.400	-0.094
12 Mar 10:15	29.969	64.3	1,009.844	1,014.89	17.8	1,009.993	-0.148
10:45	29.962	65.6	1,009.484	1,014.69	18.5	1,009.679	-0.194
11:15	29.968	66.7	1,009.581	1,014.75	19.0	1,009.656	-0.075
11:45	29.960	67.4	1,009.245	1,014.57	19.4	1,009.411	-0.166
14 Mar 9:45	30.248	65.5	1,019.129	1,024.28	18.7	1,019.188	-0.059
10:45	30.247	65.5	1,019.095	1,024.33	18.8	1,019.221	-0.126
12:15	30.216	65.7	1,018.031	1,023.13	18.8	1,018.027	0.004
13:45	30.173	65.4	1,016.612	1,021.80	18.7	1,016.720	-0.109
14:15	30.172	65.5	1,016.568	1,021.81	18.7	1,016.730	-0.162
14:45	30.154	65.5	1,015.962	1,021.12	18.7	1,016.044	-0.082
15:15	30.154	65.5	1,015.962	1,021.18	18.7	1,016.103	-0.141
15:45	30.140	65.3	1,015.509	1,020.58	18.6	1,015.523	-0.013
16:45	30.138	65.4	1,015.432	1,020.61	18.7	1,015.536	-0.104
15 Mar 13:45	30.178	69.0	1,016.434	1,021.88	20.4	1,016.519	-0.085
16 Mar 9:45	30.175	71.0	1,016.141	1,021.68	21.9	1,016.072	0.069
10:15	30.173	71.0	1,016.074	1,021.65	21.9	1,016.042	0.032
10:45	30.174	70.8	1,016.126	1,021.70	21.8	1,016.108	0.018
11:15	30.163	70.8	1,015.756	1,021.42	21.8	1,015.830	-0.074
11:45	30.156	70.9	1,015.511	1,021.18	21.8	1,015.591	-0.080
12:15	30.142	70.9	1,015.039	1,020.70	21.9	1,015.097	-0.058
13:45	30.081	70.7	1,013.005	1,018.66	21.4	1,013.151	-0.146
14:15	30.074	70.8	1,012.759	1,018.38	21.8	1,012.806	-0.047
14:45	30.062	71.0	1,012.336	1,018.00	21.9	1,012.412	-0.076
15:15	30.055	71.0	1,012.100	1,017.72	21.9	1,012.133	-0.033
15:45	30.058	71.1	1,012.192	1,017.82	21.9	1,012.233	-0.041

N =	45
Sum =	-3.880
Mean (C - P) =	**-0.086**
Std deviation =	**0.064**

Table 8 : Result of Comparison between Hong Kong's Standard Barometer, C, and Travelling Barometers, N1 and N2, in March 1994 at ROHq

Time of Readings (HK Local Time)	HK Standard Barometer C			Travelling Barometers N1 and N2			
	Pressure As Read (inHg)	Corrected Attached Thermometer (°F)	Pressure reduced to Std Condition (hPa)	Pressure As Read (610) N1 (hPa)	Difference (C - N1) (hPa)	Pressure As Read (A162) N2 (hPa)	Difference (C - N2) (hPa)
10 Mar 11:10	30.186	66.8	1,016.915	1,018.30	-1.385	1,017.50	-0.585
12:00	30.163	66.7	1,016.150	1,017.55	-1.400	1,016.75	-0.600
13:45	30.096	66.1	1,013.950	1,015.36	-1.410	1,014.55	-0.600
14:15	30.096	68.1	1,013.759	1,015.16	-1.401	1,014.37	-0.611
14:45	30.092	68.7	1,013.567	1,015.00	-1.433	1,014.20	-0.633
15:15	30.090	68.9	1,013.480	1,014.90	-1.420	1,014.08	-0.600
15:45	30.089	69.6	1,013.379	1,014.82	-1.441	1,014.00	-0.621
16:15	30.080	69.0	1,013.134	1,014.51	-1.376	1,013.72	-0.586
16:45	30.076	68.4	1,013.056	1,014.32	-1.264	1,013.50	-0.444
11 Mar 9:45	30.072	64.8	1,013.267	1,014.65	-1.383	1,013.90	-0.633
10:15	30.074	64.9	1,013.324	1,014.74	-1.416	1,013.98	-0.656
10:45	30.073	64.8	1,013.300	1,014.67	-1.370	1,013.90	-0.600
11:15	30.060	64.8	1,012.862	1,014.22	-1.358	1,013.45	-0.588
11:45	30.046	64.9	1,012.381	1,013.82	-1.439	1,013.05	-0.669
12:15	30.037	64.8	1,012.087	1,013.48	-1.393	1,012.70	-0.613
13:45	29.997	64.8	1,010.740	1,012.19	-1.450	1,011.30	-0.560
14:15	29.980	65.6	1,010.091	1,011.50	-1.409	1,010.64	-0.549
14:45	29.963	65.4	1,009.537	1,010.90	-1.363	1,010.05	-0.513
15:15	29.953	65.1	1,009.229	1,010.54	-1.311	1,009.70	-0.471
15:45	29.957	65.7	1,009.306	1,010.66	-1.354	1,009.84	-0.534
12 Mar 10:15	29.969	64.3	1,009.844	1,011.43	-1.586	1,010.55	-0.706
10:45	29.962	65.6	1,009.484	1,011.10	-1.616	1,010.25	-0.766
11:15	29.968	66.7	1,009.581	1,011.12	-1.539	1,010.27	-0.689
11:45	29.960	67.4	1,009.245	1,010.83	-1.585	1,009.95	-0.705
14 Mar 9:45	30.248	65.5	1,019.129	1,020.64	-1.511	1,019.88	-0.751
10:45	30.247	65.5	1,019.095	1,020.70	-1.605	1,019.90	-0.805
12:15	30.216	65.7	1,018.031	1,019.58	-1.549	1,018.73	-0.699
13:45	30.173	65.4	1,016.612	1,018.10	-1.488	1,017.30	-0.688
14:15	30.172	65.5	1,016.568	1,018.14	-1.572	1,017.33	-0.762
14:45	30.154	65.5	1,015.962	1,017.44	-1.478	1,016.71	-0.748
15:15	30.154	65.5	1,015.962	1,017.46	-1.498	1,016.71	-0.748
15:45	30.140	65.3	1,015.509	1,016.96	-1.451	1,016.22	-0.711
16:45	30.138	65.4	1,015.432	1,016.91	-1.478	1,016.13	-0.698
15 Mar 13:45	30.178	69.0	1,016.434	1,017.80	-1.366	1,017.06	-0.626
16 Mar 9:45	30.175	71.0	1,016.141	1,017.55	-1.409	1,016.75	-0.609
10:15	30.173	71.0	1,016.074	1,017.45	-1.376	1,016.65	-0.576
10:45	30.174	70.8	1,016.126	1,017.50	-1.374	1,016.72	-0.594
11:15	30.163	70.8	1,015.756	1,017.15	-1.394	1,016.35	-0.594
11:45	30.156	70.9	1,015.511	1,016.90	-1.389	1,016.12	-0.609
12:15	30.142	70.9	1,015.039	1,016.44	-1.401	1,015.65	-0.611
13:45	30.081	70.7	1,013.005	1,014.46	-1.455	1,013.68	-0.675
14:15	30.074	70.8	1,012.759	1,014.15	-1.391	1,013.33	-0.571
14:45	30.062	71.0	1,012.336	1,013.75	-1.414	1,012.93	-0.594
15:15	30.055	71.0	1,012.100	1,013.52	-1.420	1,012.70	-0.600
15:45	30.058	71.1	1,012.192	1,013.59	-1.398	1,012.48	-0.288
				N =	45	N =	45
				Sum =	-64.516	Sum =	-28.086
				Mean (C - N1) =	**-1.434**	Mean (C - N2) =	**-0.624**
				Std deviation =	**0.078**	Std deviation =	**0.093**

Table 9 : Wind and Pressure Information during the Barometer Comparison in March 1994 at ROHq

Time (HK Local Time)	Pressure change (hPa/h)	Surface Wind	
		Hourly Mean (m/s)	Max. Gust (m/s)
10 Mar 11:10	-0.2	4.0	8.5
12:00	-0.9	3.5	9.5
13:45	-0.4	5.5	11.0
14:15	-0.3	6.5	11.5
14:45	-0.2	6.0	11.5
15:15	-0.2	5.0	10.0
15:45	-0.3	3.5	10.0
16:15	-0.3	3.5	11.0
16:45	-0.3	5.0	11.5
11 Mar 9:45	-0.2	8.0	15.0
10:15	0.0	8.0	15.0
10:45	-0.5	7.0	13.0
11:15	-0.9	5.0	10.0
11:45	-0.8	5.5	11.5
12:15	-0.9	5.5	11.5
13:45	-0.8	4.5	9.0
14:15	-1.2	5.0	10.0
14:45	-0.9	5.0	10.0
15:15	-0.2	5.0	9.5
15:45	0.2	5.5	9.0
12 Mar 10:15	-0.6	5.5	9.0
10:45	-0.3	6.0	10.0
11:15	-0.3	6.0	10.0
11:45	-0.6	5.0	9.5
14 Mar 9:45	0.2	2.0	6.5
10:45	0.2	2.5	6.5
12:15	-1.3	2.0	6.0
13:45	-1.0	1.0	4.0
14:15	-0.7	1.5	5.5
14:45	-0.6	1.5	5.5
15:15	-0.5	2.0	8.0
15:45	-0.7	2.5	8.0
16:45	0.2	2.0	6.0
15 Mar 13:45	-1.1	5.5	10.5
16 Mar 9:45	0.2	4.0	8.0
10:15	0.0	4.0	8.0
10:45	-0.3	3.5	7.5
11:15	-0.6	3.5	6.0
11:45	-0.7	3.5	6.0
12:15	-0.9	3.0	6.0
13:45	-1.4	2.5	5.5
14:15	-0.7	3.5	5.5
14:45	-0.7	3.5	6.0
15:15	-0.1	3.5	6.0
15:45	-0.3	3.0	5.5

Appendix I

WMO's Recommendation on Inter-regional Barometer Comparison

1. Categories of Barometers

Barometers are classified into various categories as follows :

A A primary or secondary standard barometer capable of independent determination of pressure to an accuracy of at least ±0.05 hPa;

B A working standard barometer of a design suitable for routine pressure comparisons and with known errors, which have been established by comparison with a primary or secondary standard;

C A reference standard barometer used for comparisons of travelling standard and station barometers at field supervising stations of a national Meteorological Service;

S A mercury barometer located at an ordinary meteorological station;

P A mercury barometer of good quality and accuracy, which may be carried from one station to another and still retain its calibration;

N A portable precision aneroid barometer of first class quality.

Barometers of categories B, C, P should have the property of high stability and have a tube of at least 12 mm bore.

The Sub-regional Standard Barometer in Tokyo is of category B. The Hong Kong's Standard Barometer is of category C. The Fortin travelling barometer and the precison aneorid barometers are of categories P and N respectively.

2. Summary of General Procedure for Comparison of barometers in different locations

i. If barometer "1" is to be compared with barometer "2", a qualified observer should carry two or more travelling standards from barometer "1" to barometer "2" and return to "1", thus closing the circuit.

ii. The travelling standards should be placed next to the barometer to be compared and all the instruments given equal exposure for at least 24 hours before official comparative readings are begun. An air current from an electric fan played on the instruments will aid in equalizing their temperature. The temperature of the room should be kept as uniform as practicable.

iii. Comparative readings should not be made if the pressure fluctuates rapidly. A microbarograph of good quality should be used at each location to indicate the conditions of pressure variation.

iv. Comparative readings should be made at uniform intervals of time not less than 15 minutes in duration.

v. At least ten comparative barometer readings are required for barometers in Categories A, B, C for standardization purposes.

vi. If meteorological conditions permit, the comparative readings should be made at different pressures covering a range from low to high.

vii. Readings should include the attached thermometer observations, the readings of the travelling standards and the barometers being compared, the wind speed, direction and gusts, the corrections for gravity, temperature and instrument errors, the actual elevation above sea-level of the zero point of the barometers, the latitude, the longitude, the name of place, and the date and time of observations.

Appendix II

Characteristics of Barometers and Locations Concerned

1. Sub-regional Standard Barometer in Tokyo - (B)

Type : Fortin Mercurial
Manufacturer : Tokyo Suzuki Manufactory Co. Ltd.
Serial number : K9340
Date of construction : December 1965
Bore of tube : 15 mm
Reference temperature : 0 °C
Reference gravity : 9.80665 m/s^2
Range of scale : 870-1070 hPa
Least count of vernier : 0.05 hPa
Index error : +0.04 hPa by interferometric primary standard barometer at National Research Laboratory of Meteorology in December 1993.
Location : 1-3-4 Otemachi, Chiyoda-ku, Tokyo, Japan
Lat. 35° 41' N
Long. 139° 46' E
Height of cistern above M.S.L. 2.13 m
Value of local gravity 9.7978 m/s^2

2. Standard Barometer of Hong Kong - (C)

Type : Kew Mercurial
Manufacturer : Negretti & Zambra, London
Serial number : M 6726
Date of construction : 1950
Bore of tube : 12.7 mm
Reference temperature : 0 °C for mercury,
16.7 °C for scale
Reference gravity : 9.8062 m/s^2
Range of scale : 2-34 inHg
Least count of vernier : 0.002 inHg
Index error : -0.04 hPa by sub-regional standard in Tokyo in 1983
Location : Tsim Sha Tsui, Kowloon, Hong Kong
Lat. 22° 18' 13.2" N
Long. 114° 10' 18.7" E
Height of cistern above M.S.L. 40 m
Value of local gravity 9.787675 m/s^2

3. Travelling Barometers

According to WMO's recommendation, a Fortin barometer (P) and two precision aneroid barometers (N1 and N2) were used as travelling standards.

A Fortin barometer is suitable for use as a travelling standard because the mercury coloumn can be raised to the top of the glass tube by turning the adjusting screw plunger before the barometer is moved, thus reducing the chance of air bubbles entering the barometer tube.

Precision aneroid barometers are used because they have the necessary stability and accuracy, a negligible temperature coefficient, and are free from hysteresis effects.

i. Fortin Barometer (P)

Type :	Fortin Mercurial
Manufacturer :	F. Darton & Co. Ltd. England
Serial number :	V 633
Date of construction :	1972
Bore of tube :	12.7 mm
Reference temperature :	0 °C for mercury,
Reference gravity :	9.80665 m/s^2
Range of scale :	895-1100 hPa
Least count of vernier :	0.1 hPa

Index error : -0.09 hPa by sub-regional standard in Tokyo in 1983

ii. Precision Aneroid Barometer (N1)

Type :	Precision aneroid, M2236
Manufacturer :	Mechanism Ltd. England
Serial number :	610
Date of construction :	1973
Range of scale :	900-1050 hPa
Least count of scale :	0.05 hPa

Index error : -0.19 hPa by sub-regional standard in Tokyo in 1983

ii. Precision Aneroid Barometer (N2)

Type :	Precison aneroid, M2236
Manufacturer :	Negretti & Zambra Ltd. England
Serial number :	A162
Date of construction :	1982
Range of scale :	900-1050 hPa
Least count of scale :	0.05 hPa

Index error : +0.04 hPa by sub-regional standard in Tokyo in 1983

Appendix III

Corrections for the Hong Kong's Standard Barometer

1. Corrections for attached thermometer

Temperature as read (°F)	Correction (°F)
30.0 - 42.0	0.0
42.0 - 62.0	-0.1
62.0 - 122.0	-0.2

2. Corrections for manufacturer's index error

Pressure as read (inHg)	Correction (inHg)
22.50 - 23.50	0.006
23.50 - 24.50	0.005
24.50 - 25.50	0.004
25.50 - 26.50	0.003
26.50 - 27.50	0.004
27.50 - 28.50	0.004
28.50 - 29.50	0.005
29.50 - 30.50	0.005
30.50 - 31.50	0.003