ROYAL OBSERVATORY, HONG KONG.

TECHNICAL NOTES, NO. 1.

SYNOPTIC SITUATIONS ASSOCIATED WITH STRONG WINDS AT THE ROYAL OBSERVATORY.

INTRODUCTION. This investigation covers the period 9.9.45 to 30.11.49 inclusive, the entire post-war period for which observations are available. From 9.9.45 until 9.5.46 observations were made only during the hours 0900-1700 H.K.St.T. This is the most probable explanation for the absence of many cases of strong winds during that period. Up to 31.3.47 all winds were estimated, but after that date readings of the Dines Anemometer were used.

Occasions of less than six hourly reports per day of strong winds were neglected: while such occasions were numerous they did not, at a rough estimate, amount to more than twice the number of six or more occurrences per day.

Also neglected were all occasions of strong winds due to the area being in the circulation of a tropical storm.

ANALYSIS OF RESULTS. This is best shown by the tables below.

TABLE I.

Distribution in each month.

JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL
4	6	11	9	6	4	2	0	0	1	3	1	47

TABLE II.

Relation to onset of cold surges. (Oct.-Apr. inc.)

Immediately following surge.	Occurring 3 or more days after.	Total.
15	19	34

In addition one occurrence in May was associated with a weak late surge.

TABLE III.

Directions of strong winds.

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
0	0	0	14	27	1	0	0	1	2	2	0	0	0	0	0	47

TABLE IV.

Directions of Isobars.

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
0	0	0	4	16	10	9	4	0	2	2	0	0	0	0	0	47

The most noteworthy features are concentration of strong winds in the late winter and early spring, and the preponderance of easterly surface winds

and east to southeast isobaric gradients. It must be borne in mind, however, that the surface wind in different parts of the Colony is influenced, for the main part, by local topographic features - our experience at Kai Tak shows that only too well - and further, the paucity of data in the neighbourhood is such that the directions assigned to the isobars would be very different on many occasions if a dense network of stations were available.

ANALYSIS OF SYNOPTIC SITUATIONS. It proved possible to identify every occasion of strong winds with one of six synoptic patterns; it is, of course, possible that many situations are oversimplified due to the lack of data. The six patterns were as follows:-

1. COLD SURGES. Less than one third of the total and less than one half of the winter cases of strong winds occurred immediately after the passage of a cold surge. Most surges appeared to be characterised by long periods of winds of force 4-5 with only an occasional force 6. These surges accounted for many of the isolated cases of strong winds not included in this investigation. Of the fifteen occasions associated with cold surges, five occurred with isobaric gradients north of east, and the remaining ten with gradients south of east.

2. STRONG WINDS WELL IN THE REAR OF A SURGE. This type is divided into three distinct synoptic patterns.

(a) In the rear of the surge the continental anticyclone intensifies or moves southeast or possibly does both of these things. Pressure rises rapidly over land to the north and much less ratidly over the sea to the south, probably because of the large temperature contrast between land and sea. This results in a considerable increase in pressure gradient over the coastal region of South and Southeast China, and the consequent occurrence of strong winds in that region. This is the commonest cause of strong winds in the rear of a surge.

(b) The surface trough associated with the surge becomes stationary just south of the China coast. The cause of strong winds in this situation is obscure, but two possibilities are suggested. Firstly the continental anticyclone may intensify or move southeast without any corresponding change in the trough, or, secondly, small wave disturbances, undetectable with the data at present available, move east along the trough, causing a temporary tightening of the pressure gradient. This second possibility is thought to be the more likely.

(c) The surge trough becomes stationary just south of the China coast and another trough develops from Central China to Tonkin, leaving a small but strong ridge over Southeast China; strong winds appear to occur when Hong Kong lies on the south or southwest side of this ridge, with easterly or southeasterly isobaric gradients. This situation occurs in late winter and spring with the passage of an upper westerly trough which reaches the surface in Central China.

3. DEVELOPMENT OF THE TONKIN LOW. These situations are a feature of spring and early summer and can be divided into two types.

(a) A small depression exists over the Gulf of Tonkin and deepens, at the same time troughing eastwards, giving an elongated depression extending from the vicinity of 20°N, 115°E to the Tonkin coast. Isobaric gradients are between ESE and SSE but the strong winds caused at Hong Kong are easterly. This situation is somewhat similar to 2b above, but in this case the development of the trough eastward is much more obvious.

(b) A large depression is centred over Tonkin and its circulation extends from east of Hainan to Yunnan. This depression deepens considerably causing the pressure gradient to increase. The isobaric gradient over Hong Kong lies between south and southwest, and the resulting strong winds are southwesterly. This situation accounts for all the periods of prolonged strong winds in the summer except those due to tropical storms.

CONCLUSIONS. The distribution of strong winds according to the situation enumerated above is shown in Table V.

TABLE V.

Synoptic Situation	1	2a	2b	2c	3a	3b
Occasions of Strong Winds	16	9	5	4	7	6

Thus it is seen that distribution among the three main types is very even. The greatest single cause of strong winds is, as would be expected, the cold surge, but the number of occasions of strong winds occurring well behind a surge is surprisingly high.

The principal cause of isolated winds of force 6-7 is the showery summer weather, when many squalls are recorded. As has already been mentioned the only other cause is the surge accompanied by fresh winds with the occasional strong gust.

R.C. BANNISTER.
1st December, 1949.