

HEIGHTS OF TOPS OF *Cb* CLOUDS OVER SOUTHEAST ASIA

1. Ramamurthi (1955) analysed debriefing reports of Comet Jet Aircraft collected during the period May 1952 to December 1953 and showed the frequencies of heights of tops of cumuliform clouds and heights of bases and tops of high and medium clouds over Colombo-Bomay and Delhi-Calcutta routes. Rao (1955) also analysed the heights of base and tops of all genera of high and medium clouds and of thunderclouds from reports by Comet Jet Airliners over India and neighbourhood during the years 1952 and 1953 and discussed their mean heights and seasonal variations. Analysis of meteorological reconnaissance flights and scheduled civil flights by jet aircraft across India (Deshpande 1961, 1964) have also brought out some interesting results on the development of *Cb* clouds from the point of view of jet aviation.

2. In the present study, post flight reports of jet aircraft on routes Hongkong-Calcutta, Bangkok-Calcutta and Singapore-Calcutta for the year 1966 and also for the period from August 1970 to December 1972 were analysed with a view to find the general heights of tops of cumulonimbus clouds along these routes. The post flight reports for the period from August 1970 to December 1972 were mostly from BOAC and Air India operating at flight levels, FL 310, 350, and 390 and on a few occasions at 280. For the year 1966 the reports

TABLE 1

Frequency of *Cb* tops during various seasons and the year

Height of <i>Cb</i> tops (1,000's of ft)	Winter (Dec-Feb)	Premonsoon (Mar-May)	Monsoon (Jun-Sep)	Post monsoon (Oct-Nov)	Annual (with %)
20-25	0	1	4	2	7(3)
26-30	2	1	8	5	16(8)
31-35	5	14	28	16	63(31)
36-40	4	18	55	25	102(50)
41-45	0	1	11	2	14(7)
> 45	0	0	2	0	2(1)
Total	11	35	108	50	204

NOTE—The height of *Cb* tops refer to pressure altitude

were from many International airlines and include SAS, Swiss Air, Lufthansa, Jal and Quantas in addition to BOAC and Air India operating at flight level, FL 320 also in addition to the above levels. Along these routes the aircraft comes across *Sumatras* along Malayan coast, boisterous thunderstorms across south Tennesarim coast, *Nor'westers* along Bengal coast, severe cyclonic storms over Bay of Bengal and *typhoons* of China Sea along Vietnam coast, in addition to the monsoon and

TABLE 2
Monthly distribution of frequency of *Cb* tops

Height of <i>Cb</i> tops (1000's of ft)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
20-25	0	0	0	0	1	0	1	0	3	2	0	0
26-30	0	0	0	1	0	0	5	3	0	2	3	2
31-35	0	2	1	6	7	3	4	10	11	12	4	3
36-40	1	1	1	8	9	9	9	29	8	14	11	2
41-45	0	0	0	0	1	2	3	2	4	2	0	0
> 45	0	0	0	0	0	0	2	0	0	0	0	0
Total	1	3	2	15	18	14	24	44	26	32	18	7

afternoon/evening thunderstorms over coast and land.

3. The accuracy of estimates of heights of tops and bases of clouds by an aircraft pilot is dependent upon the difference in elevations between the aircraft and the cloud (WMO 1966). The estimates are less reliable when the difference in elevation is greater and are generally good within about 2000 ft when the flight level is within approximately 10,000 ft of the cloud. In this analysis there are only about seven cases where the difference between the aircraft and its estimated cloud top was more than 10,000 ft. Most of the reports are within 5000 ft or less. The number of post flight reports analysed during the period under consideration when *Cb* was reported were 122 and the total number of occasions when *Cb* was reported in different sectors of the flights were 204. The flights were mostly in the evening and early part of the night between 12 and 18 GMT when large cumulonimbus clouds will be in

the mature or dissipating stage. The number of *Cb* reports available for morning and afternoon flights were few and the *Cb* tops reported on these few occasions were not different from those of evening. Table 1 gives the frequency of the *Cb* tops during the various seasons and the year in different height groups. Table 2 gives the number of occasions of *Cb* tops in different months during the period of analysis.

4. From the above analysis it can be seen that on the routes Hongkong-Calcutta, Bangkok-Calcutta and Singapore-Calcutta the occurrence of *Cb* clouds of tops below 25,000 ft and above 42,000 ft are less and that the *Cb* tops are generally between 32,000 ft and 42,000 ft on 86 per cent of occasions and between 35,000 ft and 42,000 ft on 68 per cent of occasions and very few occasions above 42,000 ft. There was only one instance when the estimated *Cb* top was 48,000 ft on route Bangkok-Calcutta, reported by Air India on 15 July 1972.

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21 February 1973

REFERENCES

Deshpande, D. V.

1961 *Indian J. Met. Geophys.*, **12**, p. 29.

1964 *Ibid.*, **15**, p. 47.

Ramamurthi, K. M.

1955 *Ibid.*, **6**, p. 243.

Rao, D. V.

1955 *Ibid.*, **6**, p. 299.

WMO

1966 *WMO Tech. Note*, 80,