

Rainfall and Floods during 1962 Southwest Monsoon period*

1. Introduction

Rainfall during the 1962 Southwest Monsoon season as a whole was more or less normal over the country. Rainfall distribution week by week was, however, not uniform, the month of August being particularly dry outside peninsular India. Excess of rains occurred at other times with the result that most of the rivers in north and central parts of the country were in floods at one time or the other during the season under consideration. Floods in the Himalayan rivers, however, were more frequent although not many flood records came in for test. In fact, except for the unprecedented level in Brahmaputra river of 345·4 ft at Dibrugarh on 19 August no fresh flood records were created. The toll in human lives during the flood season was 173 in Assam and 109 in Punjab; this includes the unfortunate loss of human lives trapped in avalanches in Spiti and Lahaul valleys in Kangra District (Punjab) due to unusual early snowfall. For the third year in succession, Jammu and Kashmir escaped the ravages of severe floods except for a short spell in September. From the flood accounts† it was noticed that the rivers in Assam and Bihar were subjected to many spells of high floods suggesting that there were more occasions of 'break' in monsoon conditions this year than in the preceding two years. Chief features of rain-

fall and associated floods are given in the following paragraphs.

2. Chief features of rainfall

The Arabian Sea branch of the southwest monsoon advanced in south Kerala about 17 May, nearly 10 days in advance and continued to extend to south Konkan. This occurred under the influence of a depression which travelled across the peninsula from the Bay of Bengal and emerged into the Arabian Sea on 18 May. The Bay of Bengal monsoon current which had established over the south Bay because of the above depression, also advanced into Bengal and Assam between 25 and 27 May under the influence of another depression which formed over the central Bay and moved in a northerly direction crossing the Burma coast near Akyab on 25 May. In the rest of northeast India, monsoon was established by 10 June due to a depression which formed in the northwest Bay of Bengal on 6 June about 200 km southeast of Puri. It moved inland on the 7th morning and weakened there. The Arabian Sea branch also advanced far her northwards and reached Surat on 31 May under the influence of another depression which formed in the central Arabian Sea on 28 May near Lat. 17°N and Long. 64°E and moved in a west to north-west direction. Extension of the monsoon over the north and northwestern parts of the country took place gradually as a

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† Flood accounts and damage reports given in the note are as obtained from the Central Water and Power Commission Flood News Letters

TABLE 1
Southwest Monsoon 1962
Percentage departures from normal rainfall for week ending

METEOROLOGICAL SUB-DIVISIONS	JUNE				JULY				AUGUST				SEPTEMBER				1 OCT	1 JUN TO 30 SEP	
	6	13	20	27	4	11	18	25	1	8	15	22	29	5	12	19	26	3	30 SEP
ASSAM (INCLUDING MANIPUR AND TRIPURA)	-28	30	-34	7	-39	-74	-65	-64	-42	-33	1	67	-28	-54	-87	-41	-45	-16	30
SUB-HIMALAYAN WEST BENGAL	-18	-38	-57	16	141	-80	-61	-71	-43	-33	-72	119	30	55	-34	-45	-62	-29	-22
GANGETIC WEST BENGAL	-20	5	-39	-9	-79	-75	20	-15	-10	-9	-44	2	-43	-63	-1	-58	127	151	-18
ORISSA	1	67	-59	-29	-85	128	-20	-24	-71	-9	-38	-58	-33	-79	86	12	-22	-73	-14
BIHAR PLATEAU	8	16	-35	-29	-57	-58	-7	-4	-13	8	-68	-32	-62	4	-62	-53	267	11	-23
BIHAR PLAINS	-34	59	-76	-20	-95	-88	-59	-31	5	-3	-82	-39	-48	-40	-61	-49	81	-23	-12
U. P. EAST	-18	-13	-86	-24	-99	-16	-22	-41	52	55	-89	138	3	-43	-51	-13	47	-99	2
U. P. WEST	-24	-64	-48	-77	-100	-38	-10	31	17	-65	-16	17	-47	-13	-43	62	264	-95	-5
PUNJAB(1) INCLUDING DELHI	55	-88	-83	-27	-36	57	-5	-38	-88	-99	-73	64	-66	-76	311	154	565	-20	23
HIMACHAL PRADESH *																			
JAMMU AND KASHMIR	-49	-31	-18	-90	11	-56	-36	3	-85	-75	-79	-51	-37	-95	-30	-54	633	179	10
RAJASTHAN, WEST	-86	-98	-91	-76	-100	-14	133	34	-100	-100	55	30	-91	-24	22	56	356	-100	9
RAJASTHAN, EAST	-57	-100	-99	-100	-82	-23	138	51	-87	-99	-62	-44	4	-24	54	26	355	-95	2
MADHYA PRADESH, WEST	-34	-91	-76	-86	-81	-36	68	31	-61	-64	101	-50	-62	-4	-100	-59	170	-94	-1
MADHYA PRADESH, EAST	86	-25	-81	-1	-63	-56	-22	12	-39	-21	-29	-56	-32	-17	-19	32	-50	-95	-24
GUJARAT REGION	-20	-28	-31	-73	-96	-20	17	22	-96	-89	46	31	-96	-99	-38	-20	272	-5	-13
SAURASHTRA AND KUTCH	-90	-100	-6	-90	-100	140	-19	-85	-95	-99	184	238	-90	-91	467	-39	-35	-96	12
KONKAN	-96	84	-95	-81	15	116	1	-55	-71	-31	148	-29	-38	59	-31	197	68	-96	3
MADHYA MAHARASHTRA	-32	-39	-80	-93	-22	76	37	-14	-70	-58	144	-60	-34	-33	153	43	-47	-100	-8
MARATHWADA	248	-88	-97	-99	-10	-61	-28	-74	-86	-92	181	-15	1	144	54	81	-56	-100	4
VIDARBHA	-8	-64	-91	-67	5	-74	80	-16	-81	-56	91	-23	-71	79	-16	317	-42	-98	-3
COASTAL ANDHRA PRADESH	159	-88	-100	-28	-35	90	119	55	-61	-33	11	147	-34	89	175	23	-87	-57	24
TELANGANA	74	-99	-100	-89	-23	-4	64	56	-73	-49	23	-42	-26	-2	298	-81	-100	-26	
RAYALASEEMA	188	-91	-79	-15	-20	-72	-80	-90	-28	-25	-63	72	9	93	-54	73	-98	-61	-17
MADRAS STATE	34	-70	89	89	9	15	-53	-76	-15	-55	-78	55	124	142	-39	37	-40	-34	21
COASTAL MYSORE	-78	-56	-84	-34	-36	-32	72	9	-73	76	98	167	30	-33	186	127	3	-88	7
INTERIOR MYSORE, NORTH	17	-64	-99	-49	67	82	71	-48	64	-38	54	16	37	30	19	46	-70	-81	10
INTERIOR MYSORE, SOUTH	7	-94	-61	94	267	93	-11	-20	-73	56	-61	20	-34	155	-49	11	-67	-1	-13
KERALA	-84	-79	-69	-45	19	147	88	-53	-60	95	38	-30	41	223	22	-33	14	-21	4

LESS THAN -50% -50% TO -25% -24% TO +24% +25% TO +50% >50%

* FIGURES TAKEN FROM IDWR SUPPLEMENT DATED 19 11 62

* DATA FOR HIMACHAL PRADESH NOT GIVEN DUE TO NON-AVAILABILITY OF NORMALS

feeble current due to the absence of any depression from 1st week of June to 1st week of July and the monsoon was established all over the country by about 25 June. The monsoon, however, withdrew from the northern parts of the country rather rapidly by about 29 September and from the rest of northeast India and Madhya Pradesh by the 1st week of October. Week by week rainfall distribution (percentage deficit or excess over normal) for the period June to September 1962 over the 28 Meteorological sub-divisions of India is given in Table 1. The important features of Table 1 are as follows—

- (i) The seasonal rainfall over the country as a whole was more or less normal, the departure from normal being

within ± 25 per cent in almost all cases,

- (ii) Outside the coastal areas and sub-montane regions of northeast India, the country as a whole experienced a comparatively dry season up to 1st week of July.
- (iii) Orissa, Gangetic West Bengal, Bihar and adjoining areas of east Madhya Pradesh recorded slight deficit rainfall, and
- (iv) There were more heavy spells of rain over the country as a whole during September and July than in August which is usually the rainiest month; the large excess of rainfall during September over

peninsular India, however, stands out prominently.

A consideration of the chief features of rainfall distribution during the season given above, is likely to lead one to believe that the broad meteorological features giving rise to these could be—

- (a) that absence of 'breaks' in monsoon reported in the preceding two years ended this year by the occurrence of few such meteorological situations;
- (b) that there was a lull in the activity of monsoon depressions during June and August and an increase in their activity in September;
- (c) that the axis of the seasonal trough remained more or less in its normal position except in situations indicated in (a) above.

A study of the synoptic charts reveals the following broad features—

There was no depression either in the Bay of Bengal or in the Arabian Sea between 8 June and 8 July. During July, there were two depressions; one in the Arabian Sea which formed in the morning of 8 July centred close to Porbander and affected the weather on the west coast. The other formed in the Bay of Bengal on 11 July about 300 km east of Visakhapatnam, crossed coast near Gopalpur and weakened into a low on the 13th over Madhya Pradesh. After these, the next depression which affected the weather formed in the Bay of Bengal on 8 September, there being none during the second half of July and the whole of August when there were some breaks in the monsoon. In September, there were two depressions and one cyclonic storm which crossed the peninsula and caused increased monsoon activity during this month as already indicated earlier. In other periods, the seasonal trough of low lay mostly in its normal position.

3. Principal floods of 1962 monsoon season

During the flood season of 1962, major floods occurred mostly in the Himalayan

rivers of north India. Floods in the peninsular India did not figure so prominently as was the case during the flood season of 1961. Following are some of the major floods which occurred in the country during the southwest monsoon season—

- (i) Assam floods of the second week of June
- (ii) Floods in the Brahmaputra valley and north Bengal during the last week of June and early July
- (iii) Widespread floods of Himalayan rivers of Uttar Pradesh, north Bihar, north Bengal and Assam during the second half of August
- (iv) Floods in Madhya Pradesh and Vidarbha during the 3rd week of September
- (v) Floods in the Punjab, Himachal Pradesh and Kashmir towards the 4th week of September

A detailed account of these floods together with the attendant meteorological situations responsible for causing heavy falls of rain in river catchments is given below—

(i) *Assam floods of the second week of June*—Widespread and locally heavy rains occurred in Assam and Manipur states during the second week of June. As a result, the Brahmaputra, the Barak and their major tributaries were in spate causing severe floods in the region. The Brahmaputra and its tributaries, the Dihing, the Nonai, the Sukhajani etc were in spate from 9 June while the Barak and its tributaries, the Kushiya, the Kathakhal etc started rising from 11 June. Due to floods in the Barak river some of the embankments were overtopped and some got breached. In Assam, Cachar district and many other towns were cut off from the rest of the country because of disruption of rail and road communications. Nearly 2 lakhs of people got marooned. In Manipur, all the major rivers of the state, viz., Iril, Namal and Imphal were in spate.

The spell of heavy rain in Assam was caused by a depression which formed in the north Bay of Bengal centred about 200 km east-southeast of Puri on 6 June. Moving north-northeastwards it crossed the Sunderbans coast on 8 June. Thereafter, it weakened but persisted as a low pressure area over lower Assam and neighbourhood till 11 June. Associated with this depression, widespread and locally heavy rain occurred in Assam and sub-Himalayan West Bengal during the second week of June. Some noteworthy amounts of rainfall recorded during this period are—Goalpara 16.2 cm on 9 June, Silchar 15.0 cm, Shillong 13.7 cm, Haflong 12.9 cm and Kailashahr 11.4 cm on 10 June and Imphal 10.5 cm on 11 June.

(ii) *Floods in Brahmaputra valley and north Bengal during the end of June and first week of July*—Within a fortnight Assam experienced a second spell of heavy floods. Apart from Assam, floods also occurred in north Bengal and in the adjoining districts of north Bihar. The Brahmaputra started rising from 23 June and crossed the danger level of 342.0 ft at Dibrugarh on that day itself and recorded the maximum level of 344.4 ft on 27 June. At Gauhati, it crossed the danger mark of 160.0 ft on 26 June and stood at 165.06 ft on 1 July. The major tributaries of the Brahmaputra, viz., the Dihang, the Dihiku and the Subansari were also in high floods during this period.

Due to floods in the Brahmaputra, breaches in embankment occurred at Lakhimpur, Sibsagar, Kamrup and Goalpara districts causing disruption of communications. Dhubri and Barapeta sub-divisions were the worst affected areas. It was estimated that crops worth about Rs. 5 crores were damaged in Dhubri sub-division alone and 51 persons were reported to have lost their lives due to floods in the Brahmaputra valley.

In north Bengal, all the major rivers of the regions, viz., the Teesta, the Torsa, the Jaldhaka and the Keljani crossed

their respective danger levels several times during the above period. The Torsa and the Jaldhaka crossed their respective danger levels on 28 June. The Torsa again crossed its danger level (at Cooch Bihar) on 2 July. The Keljani rose above its danger level at Alipurduar on 2 July. The worst flood-affected areas in north Bengal were Jalpaiguri and Cooch Bihar districts. Medium floods also occurred in all the important rivers of north Bihar, viz., the Kosi, the Gandak, the Kamla and the Baghmati.

The synoptic situations responsible for this widespread inundation were as follows—
(i) An upper air cyclonic circulation, over north Bay on 21 June, moved inland and was over Gangetic West Bengal on the next day. Moving further westwards, it persisted over Bihar State and neighbourhood till 25 June and became unimportant thereafter. Under its influence, monsoon was vigorous over Assam and West Bengal,
(ii) Towards the middle of last week of June the eastern end of the axis of the seasonal trough gradually shifted close to the foot of the Himalayas, causing "break monsoon" conditions. This situation caused concentrated spell of heavy rain in the Himalayas and sub-montane regions of central and eastern Himalayas till the beginning of July. Some noteworthy amounts of rainfall were—

Kalimpong and Passighat recorded 17.3 cm and 17.1 cm respectively on 24th; Cherrapunji 19.5 cm on 26th and 28.6 cm on 27th; Siliguri 21.0 cm, Jalpaiguri 16.7 cm, Buxadwar 15.2 cm and Silchar 16.3 cm on 27th; Jalpaiguri 16.4 cm, Cherrapunji 16.4 cm and Siliguri 15.0 cm on 28th. Cherrapunji recorded 15.8, 27.5 and 35.9 cm on 29 June, 30 June and 1 July respectively and Cooch Bihar recorded 15.3 cm on 2 July.

(iii) *Widespread floods in north Indian rivers from east Uttar Pradesh to Assam during the second half of August*—Practically

all the Himalayan rivers from east Uttar Pradesh to Assam (including Manipur) were in high floods during the above period. In Assam, the Brahmaputra recorded an unprecedented level of 345.4 ft on 19 August at Dibrugarh breaking the past highest record of 344.6 ft registered on 15 July 1961. On 17 August, the major rivers of north Bengal (*viz.*, the Teesta, the Torsa, the Jal-dhaka and the Keljani) and on 18 August the two important rivers of north Bihar and east Uttar Pradesh (*viz.*, the Ghogra and the Gandak) crossed their respective danger levels. At Kanpur, Ganga approached the danger mark of 372 ft on 19 August. The Rapti in east Uttar Pradesh, stood 6 ft above danger level on 22 August and touched an all-time high of 250.05 ft at Birdghat (Gorakhpur) on 23 August. The Brahmaputra was more than 7 ft above the danger mark at Gauhati. Apart from the major rivers mentioned above numerous other rivulets of the region were in high floods inundating large tracts of fertile agricultural land.

The widespread floods caused enormous damage to life and property. In Assam for the third time since the beginning of monsoon season (*i.e.*, from June), all rail and road communications were disrupted for days together. Dibrugarh town was submerged and low lying areas of Gauhati town were inundated. The area around the aerodrome terminal building and the meteorological office at Gauhati airport was under 2 to 5 ft of water. Army had to be called out to take up relief and rescue work. The worst flood-affected districts of Assam were Lakhimpur, Sibsagar, Darang, Kamrup and Goalpara. In West Bengal, the districts of Jalpaiguri and Cooch Bihar were the worst hit by floods. In Bihar, 152 heads of cattle and standing crops over vast areas were washed away. In east Uttar Pradesh the floods took a toll of 20 human lives.

The meteorological factor contributing to exceptionally heavy rains in river catchments of the eastern Himalayas was the

setting in of 'break monsoon' conditions with the shift of the seasonal trough of low northwards. The axis of the trough lay close to the foot-hills during the period 16 to 22 August. Also, a western disturbance moved eastwards across the extreme north of the country during this period. Some noteworthy amounts of rainfall recorded along the eastern Himalayas were—

Passighat 32.1 cm, Butwal (Nepal) 17.9 cm on 17 August; Passighat 31.2 cm, Atrauli (west Uttar Pradesh) 17.0 cm, Ranibirta (Nepal) 18.3 cm on 18 August; Passighat 26.0 cm, Khuntar (west Uttar Pradesh) 17.0 cm, Deemapur (east Uttar Pradesh) 22.3 cm, Lahan (Nepal) 15.2 cm, Girwari (Nepal) 15.0 cm on 19th; and Lahan (Nepal) 15.2 cm on 20 August. Till the time of writing this article, rainfall data from State rain-gauges in Assam are not available and hence isohyetal pattern of the storm have not been included.

(iv) *Floods in Madhya Pradesh, Vidarbha and adjoining States during the 3rd week of September*—Following heavy rains in the central parts of the country during the period 18 to 21 September, major rivers of the region, *viz.*, the Narmada, the Tapti, the Betwa, the Godavari and their tributaries were in spate. Due to high floods in the Narmada, the Khalghat bridge on the Agra-Bombay highway was under 21 ft of water on 20 September. The Tapti was 26 ft above the road bridge in the Khandwa district on 19 September. The low lying areas of Bhopal town were inundated and its surface communications were badly disrupted. Bus traffic was dislocated in most towns in Vidarbha due to bridges being under water and the road bridge between Betul and Itarsi highway was washed away. Heavy rains also caused severe flooding in the Musi river in Telangana and affected nearly 4000 people in the cities of Hyderabad and Secunderabad in Andhra Pradesh. It has been reported that 11 persons lost their lives due to house collapses in Hyderabad.

The weather situation which caused the heavy rains responsible for the flood was as follows—

Under the combined influence of an upper air cyclonic circulation over east Madhya Pradesh during early September and passage of a depression across the peninsula between 8 to 11 September, the central Indian rivers were already in low floods. Subsequently, a deep depression in the Bay of Bengal lay close to coast near Gopalpur on 17th evening, moved westnorthwestwards and lay between Jagdalpur and Titlagarh on 18th morning. During its further movement it lay near Betul on 19th morning and was centred near Jhalawar in Rajasthan on 20th morning. This caused widespread and locally heavy rain in Vidarbha and Madhya Pradesh.

Principal amounts of rainfall were—

Pachmari 22.6 cm, Nagpur 18.4 cm, Chikalda 18.7 cm, Bhikamgaon 17.5 cm, Thandla 17.5 cm, Jaora 17.1 cm, Dhar 17.1 cm, Bara Nagar 15.2 cm, Sardarpur 21.3 cm, Dharnpur 15.1 cm, Mhow 19.4 cm, Kushalgarh 20.5 cm on 19 September; Indore 17.0 cm, Khandala 15.7 cm, Maheshwar 18.1 cm, Khandava 15.6 cm on 20 September; and Ratlam 26.6 cm on 21 September.

(v) *Flood in the Punjab, Himachal Pradesh and Kashmir towards the 4th week of September*—A spell of heavy rain during 20 to 22 September over the Punjab (India), Himachal Pradesh, west Uttar Pradesh and Jammu and Kashmir State caused floods in the major rivers of the region. In the Punjab (India) all the main rivers, viz., the Ravi, the Beas, the Sutlej, the Ghaggar and the Yamuna registered high floods from 21 to 25 September. The Ghaggar

recorded the maximum level of 855.4 ft on 21 September. As a result of these floods, extensive damage was caused to road and railway communications, standing crops and urban and rural property. It has been estimated that total damage caused by September floods in the Punjab (India) alone was of the order of 400 million rupees. The worst affected districts of the Punjab (India) were Patiala, Ludhiana, Karnal, Bhatinda, Sangrur, Ambala, Jullundur and Ferozepore.

During this period, floods also occurred in the neighbouring districts of west Uttar Pradesh, Himachal Pradesh and Kashmir. In west Uttar Pradesh all the major rivers, viz., the Ramganga, the Sharda, the Ghogra, the Tons etc were in medium floods between 22 to 25 September. In Kashmir, the Jhelum crossed the danger level at Sangam and stood 5.6 ft above the danger mark. Due to floods in the Jhelum, breaches occurred in embankments on 22 and 23 September.

Due to heavy precipitation over the Punjab Himalayas during 20 to 22 September, mountain passes leading to Lahul and Spiti valleys in the interior of the Himalayas were blocked due to heavy snow. Heavy snow unusually early on mountain slopes also caused avalanches in these regions marooning a party of 2500 labourers and officers of the Punjab PWD engaged in road construction work. About 30 persons perished due to avalanches and intense cold while trekking through the snow bound passes.

Heavy rains over the Punjab and neighbourhood were caused by the same Bay depression which was centred near Jhalawar on the morning of 20 September, moved in a northerly direction and was centred about 100 km east of Jaipur on 21st. Later it weakened into a low pressure area, which moved northeastwards and lay over north Punjab between 22 and 23 September.

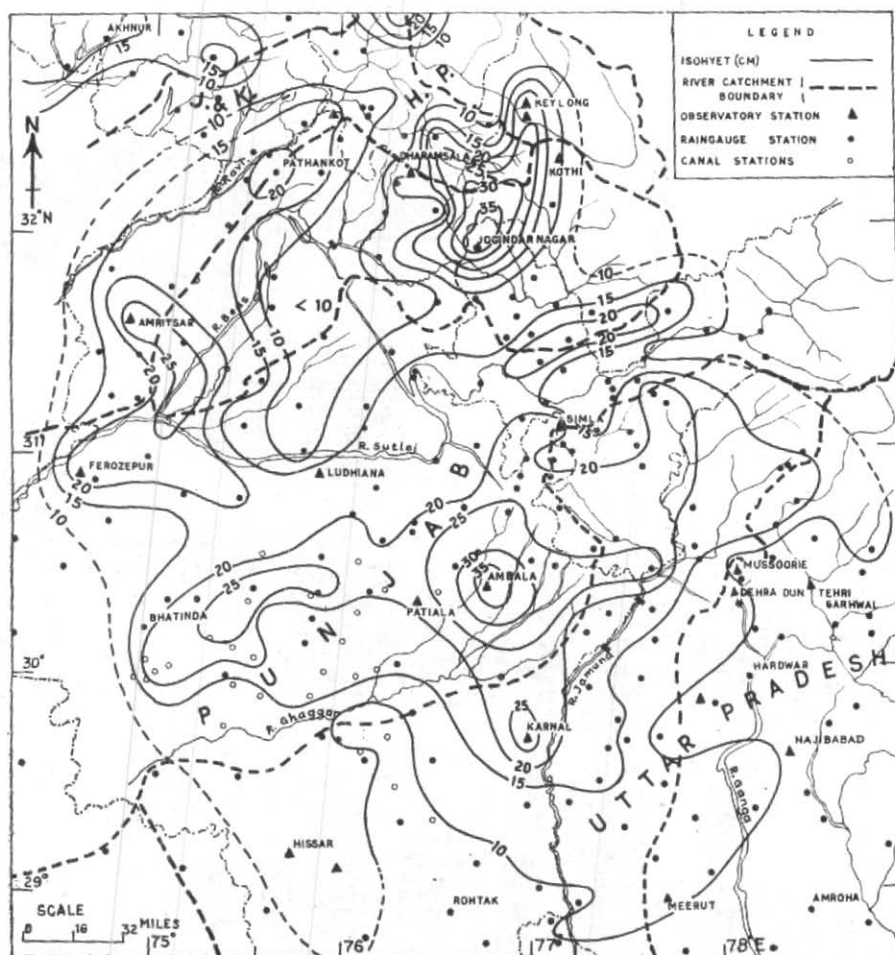


Fig. 1. Punjab storm of 20-22 Sep 1962
(Isohyets in cm)

At the same time, a western disturbance moved eastwards across the extreme north of the country. The synchronization of the western disturbance with the depression over the Punjab caused exceptionally heavy falls of rain over mountainous and sub-mountainous regions of northwest India. Percentage departure from normal rainfall for the week ending 26 September for the Punjab (India) and Jammu and Kashmir were +560 and +633 respectively. This gives an idea of the heavy rainfall during

this period over this region. A few noteworthy amounts of rainfall recorded during the period are as follows—

Ambala 19.7 cm, Chandigarh 17.2 cm, Simla 15.8 cm, Rupar 17.9 cm, Dedhipur 15.8 cm, Nainital 17.5 cm on 21 September; and Nainital 19.3 cm on 22 September.

The isohyetal pattern of the Punjab storm for the period 20 to 22 September is given in Fig. 1. It can be seen from this

TABLE 2

Area (sq. miles)	500	1000	2000	5000	10,000
Depths (cm) of 20-22 Sep 1962 storm	32.5	29.0	24.9	20.0	18.5
Depths (cm) of 3-5 Oct 1955 storm	64.8	62.5	58.2	50.8	45.0

that the storm had two main heavy rainfall centres, *viz.*, at Joginder Nagar and Ambala. Both these centres received about 40 cm of rain during the storm period. Depth-area-duration analysis of the storm was made and actual depths of precipitation for the various areas for the storm period are reproduced in Table 2. Actual DDA statistics of the severest 3-day storm of the Punjab on record, *viz.*, the 3-5 October 1955 is also included to enable one to have an idea of the intensity of the storm in question.

4. Conclusions

(i) The southwest monsoon rainfall of 1962 was more or less well distributed over the country. Although the catchments of the eastern Himalayan rivers received more rainfall than during the preceding two years, the fluctuations of monsoon over the country were evenly distributed. The

rivers in Assam, north Bengal and Bihar had many spells of floods. Assam experiencing most of the flood ravages. This happened because 'break' conditions in monsoon occurred on quite a few occasions.

(ii) The month of August was conspicuous by the absence of depressions but nevertheless, for reasons stated in (i) above, there were floods in Bihar, Bengal and Assam during this month.

(iii) The depressions which recur towards the Punjab from Madhya Pradesh or Rajasthan during the close of the monsoon season are capable of causing very heavy floods in the Punjab, west Uttar Pradesh and the neighbourhood. The passage of a western disturbance over extreme north India at the same time as an eastern depression over Punjab and neighbourhood causes snowfall usually early over the hills.