NOAA Technical Memorandum EDS BC-107

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Environmental Data Service

An Annotated Bibliography of Selected Sources on the Climate of India 1940–71

ANNIE E. GRIMES

WASHINGTON, D.C.
October 1973

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NOAA Technical Memorandum EDS BC-107

AN ANNOTATED BIBLIOGRAPHY OF SELECTED SOURCES ON THE CLIMATE OF INDIA 1940-71

Annie E. Grimes

Atmospheric Sciences Library
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INTRODUCTION

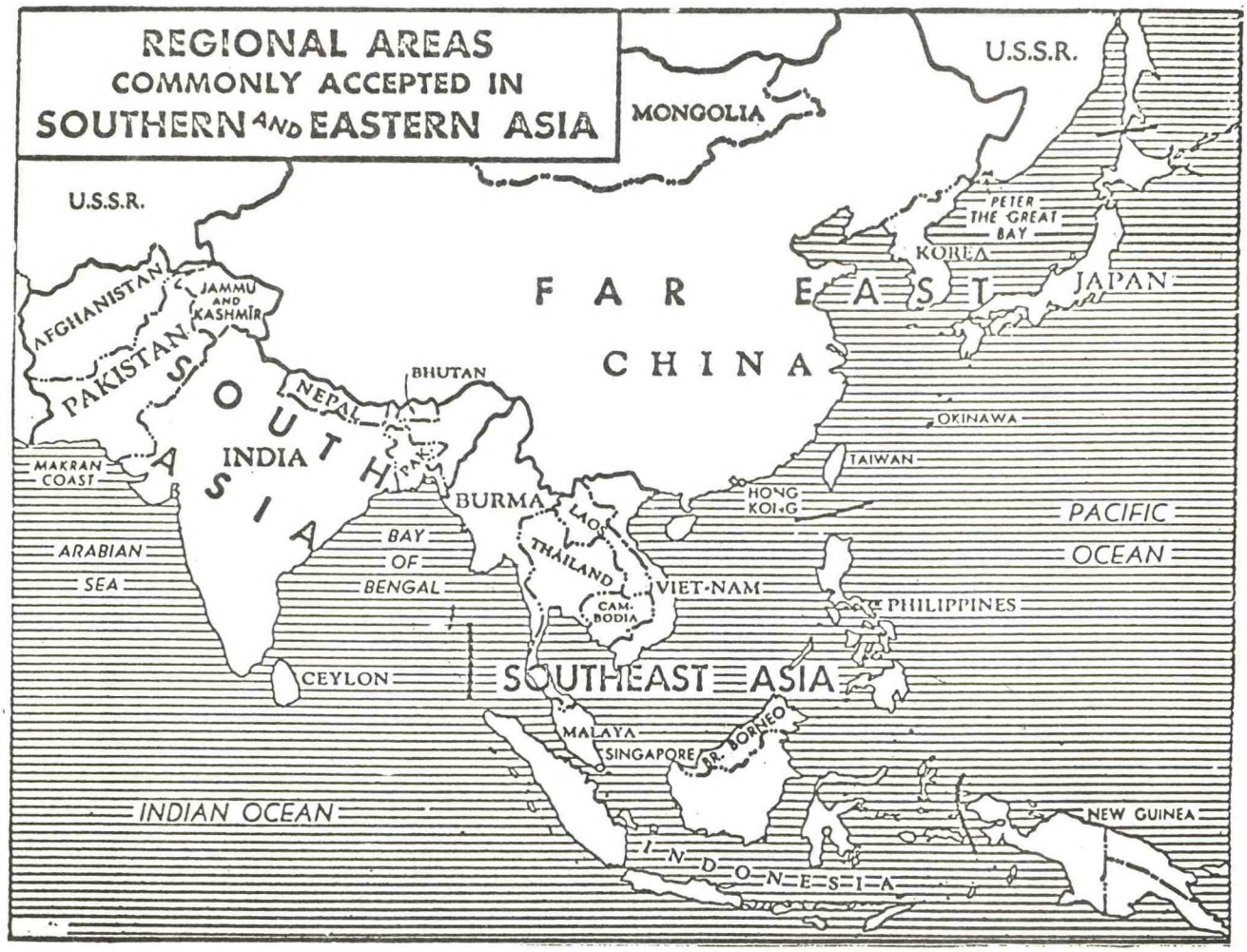
This bibliography is one of a continuing series which was formerly prepared at irregular intervals by the Foreign Branch, Climatology Division, Environmental Data Service. Earlier titles in the series are listed on the inside of the front cover.

This bibliography on the climate of India has been compiled from selected sources in various libraries of the Washington Metropolitan Area. Some sources may be in more than one of these libraries; however, the call number is recorded in the abstract for only one of them in the preferential order listed below:

DAS	Atmospheric Sciences Library
DLC	Library of Congress
DNAL	National Agricultural Library
DGS	U.S. Geological Survey Library

For example, a source listed in the National Agricultural Library was not located at the time of search in the Atmospheric Sciences Library and the Library of Congress, but it may be in the U.S. Geological Survey Library, which is lower on the preferential list.

Translation of foreign titles to English is recorded.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COMMONLY ACCEPTED IN
SOUTHERN AND EASTERN ASIA
MONGOLIA
U.S.S.R.
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PETER THE GREAT BAY
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NEW GUINEA
I N D O N E S I A


SOUTH ASIA
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IRRAWADDY
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GULF OF KUTCH
GULF OF CAMBAY
PALK STRAIT
GULF OF MANNAR
LACCADIVE ISLANDS (India)
MALDIVE ISLANDS
ANDAMAN ISLANDS (India)
NICOBAR ISLANDS (India)
Batticaloa
Dhanushkodi
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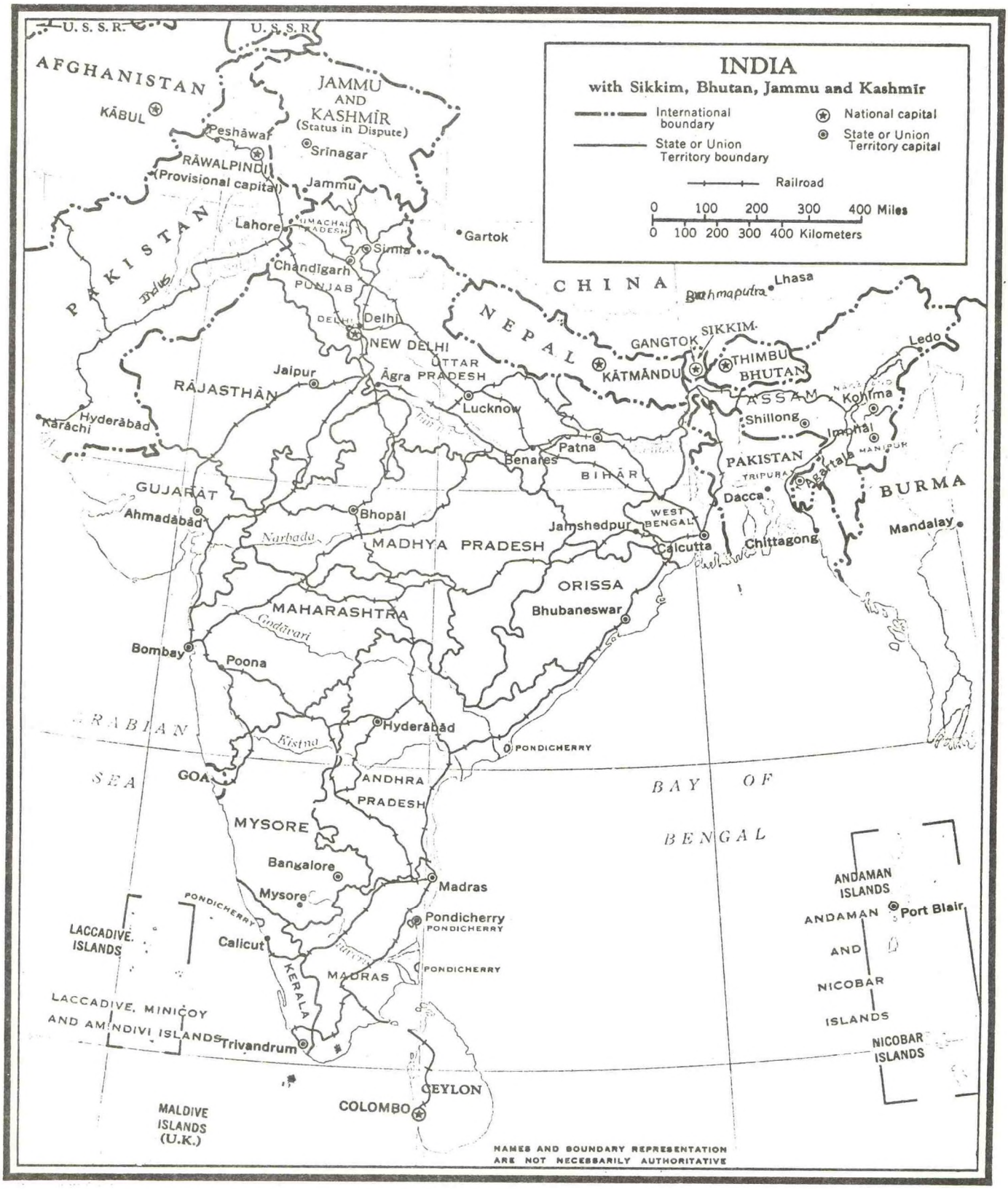
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with Sikkim, Bhutan, Jammu and Kashmīr
International boundary
State or Union Territory boundary
National capital
State or Union Territory capital
Railroad
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0 100 200 300 400 Kilometers
U. S. S. R.
U. S. S. R.
AFGHANISTAN
KĀBUL
JAMMU AND KASHMĪR
(Status in Dispute)
Peshāwar
Srīnagar
RĀWALPINDI
(Provisional capital)
Jammu
PAKISTAN
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MANIPUR
BURMA
GUJARAT
Ahmadābād
Bhopāl
Dacca
WEST BENGAL
Jamshedpur
Calcutta
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ANDAMAN AND NICOBAR ISLANDS
Port Blair
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CEYLON
COLOMBO
MALDIVE ISLANDS (U.K.)
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AN ANNOTATED BIBLIOGRAPHY OF SELECTED SOURCES ON THE CLIMATE OF INDIA

1940 - 1971

Sources and Abstracts

1940

1. Great Britain. Meteorological Office. Weather in the Indian Ocean to latitude 30°S. and longitude 95°E. including the Red Sea and Persian Gulf. Volume II. Local information. Part 5. West coast of India from lat. 20°N. to Cape Comorin including the Maldive and Laccadive Islands and that portion of the Indian Ocean and Arabian Sea within the area 0°-20°N., 60°-77° 33'E. with an appendix on conditions at Bombay. 119 pp. London, 1940. DAS M82/267 G786w.

...Discusses the tropical cyclones and depressions, wind, visibility, clouds, rain and hail, temperature, humidity, thunderstorms, sea and swells, and waterspouts for the west coast of India; gives a summary of typical weather conditions at Bombay in January, April, and June and discusses the wind, visibility, clouds, rain, temperature, humidity, thunderstorms, and sea and swell at this station in the appendix; presents summaries over specified periods (vary by station and element) for 2-8 stations (Bombay, Ratnágiri, Mormugão, Mangalore, Cochin, Trivandrum, Amini, Poona, and Minicoy). These summaries include monthly and annual mean pressure and daily range of pressure (mb); monthly and annual mean, mean extreme, mean of the highest and mean of the lowest, and absolute extreme temperatures; monthly and annual mean total amount and maximum amount in 24 hours of rainfall , mean number of days with rain, mean number of days with thunder heard, mean wind speed, wind direction (8 points and calm) frequency at 0800 and 1630, mean number of days with poor visibility, mean relative humidity, and means at 0800 of cloud amount and wet bulb temperature; monthly wind force frequency at 0800 and 1630; monthly wind speed frequency by direction at surface and specified heights; monthly and annual visibility frequency at 0800 and 1630; monthly cloud amount frequency at 0800 and 1630.

2. Great Britain. Meteorological Office. Weather in the Indian Ocean to latitude 30°S. and longitude 95°E. including the Red Sea and Persian Gulf. Volume II. Local information. Part 7. The coast of Burma including the coast of East Bengal, the west coast of Thailand (Siam) from Victoria Point to Junkseylon Island, the Andaman and Nicobar Islands, and the Bay of Bengal and North Indian Ocean east of longitude 90°E. 140 pp. London, 1940. DAS M82/267 G786w.

Source No. 2 continued

...Summarizes the typical weather conditions in Rangoon; describes the depressions and tropical cyclones, wind, visibility, clouds, rain and hail, temperature, humidity, thunderstorms, sea and swell, waterspouts, mirages, and mud volcanoes; presents tabular summaries over the period (varies by station and element) at 1-3 island stations belonging to India. These summaries include monthly and annual mean pressure, daily range of pressure, mean temperature, absolute and mean extreme temperatures, mean of the highest and mean of the lowest temperatures, mean amount and maximum amount in 24 hours of rainfall, mean number of days with rain and thunder, mean wind speed, wind direction frequency at 0800 and 1800, means at 0800 and 1800 of relative humidity and cloud amount, means at 0800 and 1800 of wet bulb temperature and number of days with poor visibility (< 2 nautical miles), frequencies at 0800 and 1800 of visibility and cloud amount; monthly frequencies of different states of the sea and wind forces at 0800 and 1800; monthly frequency of wind speed by direction at surface and specified heights. These island stations are Table Island, Car Nicobar, and Port Blair.

3. Great Britain. Meteorological Office. Weather in the Indian Ocean to latitude 30° S. and longitude 95°E. including the Red Sea and Persian Gulf. Volume II. Local information. Part 6A. East coast of India from Cape Comorin to the Ganges Delta including that portion of the Bay of Bengal and Indian Ocean within the area 0°-22°N., 77° 30'-90°E. 127 pp. London, 1940. DAS M82/267 G786w.

...Gives a summary of typical weather conditions in Madras and Calcutta; discusses depressions and tropical cyclones, wind, visibility, clouds, rain and hail, temperature, thunderstorms, sea and swell, and waterspouts for the east coast of India from Cape Comorin to the Ganges Delta; presents tabular summaries over specified periods (vary by station and element) for individual stations along the east coast of India. These summaries include for 3-10 stations in India monthly and annual mean pressure and daily range of pressure (mb); monthly and annual mean, mean extreme and absolute extreme temperatures (°F); monthly and annual mean total rainfall amount and maximum amount of rainfall in 24 hours; monthly and annual mean number of days with rainfall; monthly and annual mean number of days with thunder heard; monthly and annual wind direction frequency at 0800 and 1700; monthly and annual mean number of days with poor visibility (< 2 nautical miles) at 0800 and 1700; monthly and annual means at 0800 and 1700 of relative humidity, cloud amount, and wet bulb temperature; monthly and annual mean wind speed;

Source No. 3 continued

monthly wind force frequency (calm, 1-3, 4-7, and 8-12 Beaufort) at 0800 and 1700; monthly wind speed (calm, 3-13,14-27, 28-40, and > 40 knots) frequency by direction (8 points) at surface and specified heights; monthly and annual visibility frequencies at 0800 and 1700; monthly cloud amount frequencies at 0800 and 1700; monthly frequencies of different states of the sea. The stations with tabular summaries in this source are Pamban, Madras, Negapatam, Cocanada, Vizagapatam (Waltair), Purí, Ságar Island (Hooghly River), Calcutta (Alipore Observatory), Nellore, and Masulipatam.

1941

4. Great Britain. Meteorological Office. Weather in the Indian Ocean to latitude 30°S. and longitude 95°E. including the Red Sea and Persian Gulf. Volume II. Local information. Part 4. The Makran Coast from Gwadar to Karachi and the west coast of India to latitude 20°N. including that portion of the Arabian Sea to the north of latitude 20°N. and to the east of a line drawn between Ras Al Hadd and Gwadar. 81 pp. London, 1941. DAS M82/267 G786w.

...Describes the depressions and tropical cyclones, surface and upper winds, visibility, clouds, rain and hail, temperature, humidity, thunderstorms, duststorms, sea and swell, and turbulence and bumpiness along the coast of West Pakistan and the west coast of India to the north of latitude 20°N. The tables include summaries over specified periods (vary by station and element) at 1-2 stations (Dwarka, Veraval, and Ahmedabad) per element. These summaries include monthly and annual mean pressure, mean temperature, mean and absolute extreme temperatures, mean of the highest and mean of the lowest temperatures, mean total amount and maximum amount in 24 hours of rainfall, mean number of days with thunder, mean wind speed and wind direction frequency at 0800 and 1600; monthly and annual means at 0800 and 1600 of relative humidity, cloud amount, wet bulb temperature, and number of days with poor visibility (< 2 nautical miles); monthly wind force frequency at 0800 and 1600, wind speed frequency by direction at surface and specified heights; monthly and annual visibility frequency at 0800 and 1600; monthly cloud amount frequency at 0800 and 1600; monthly frequency of state of the sea at 0800 and 1600.

1943

5. India. Meteorological Department. India's climates: summary for airmen. 47 pp. Poona, 1943. DAS M82.1/54 I39i.

...Summarizes the climates of prepartitioned India. The climatic features of the six primary climatic regions and of subdivisions of each of these regions for the different seasons (winter, summer, rainy season, and autumn) are presented. These features include information on state of the sky; number of rainy days; average rainfall per day; number of days with thunder and duststorms; visibility, fog, and haze; surface and upper winds.

1944

6. India. Meteorological Department. Aviation climatological tables. 70 pp. Bombay, 1944. DAS M82.2/54 I39a.

... Consists of monthly summaries of prevailing wind directions and mean wind speeds (mph) at surface and 1600 feet above the ground for morning and for afternoon and at heights of 3300, 6600, 10,000 and 13,000 ft. above sea level; maximum and minimum temperatures (°F); mean total rainfall amount and number of rainy days; maximum and minimum air densities; low and total cloud amounts for morning and for afternoon; frequencies in days of low cloud amount (0-3 and 7-10 tenths) for morning and for afternoon; frequency of height of base of low clouds above ground (0-150, 150-1000, 1000-2000, 2000-3000, 3000-5000, 5000-6500, 6500-8000 feet and no low cloud) in days; visibility frequency in days within specified ranges (< 1100 yds., 1100 yds.-2.5 miles, 2.5-6.25 miles and 6.25-12.5 miles) for morning and afternoon; mean numbers of days with thunder hail, duststorms, squalls and fog. The above data are for 70 stations in India, Pakistan, Burma, Ceylon, and adjacent areas. Periods of record vary by element.

7. Iyer, V. Doraiswamy. Wet bulb temperatures in India. India. Meteorological Department, Technical Note No. 11. 6 pp. Poona, 1944. DAS M(055) I39te.

... Briefly discusses the wet bulb temperature in India, diurnal variation of the wet bulb temperature and the wet bulb maximum temperature. The table presents monthly (May-October) percentage number of occasions when wet bulb maximum temperature is within defined limits (61-65, 66-70, 71-75, 76-78, 79-80, 81-85, 86-90,

and 91-95°F.) based on data for the period 1918-1922 for Lucknow, Delhi, Ambala, and Indore in India and for 8 stations in Pakistan.

8. Mathur, V.S. Climate of Western U.P. (West of the Ganges). The Indian Geographical Journal, XIX (4): 132-138. Madras, October-December 1944. DLC DS401 .I36.

... Discusses the climate of Western U.P. during the hot weather, cold weather, and rainy seasons. Tables present monthly (October-February) mean total rainfall amount and annual number of rainy days for Meerut, Agra, Cawnpore, and Allahabad and comparative daily rainfall amounts during July and August at Agra and Pilibhit.

1945

9. India. Meteorological Department. Diurnal variation of pressure. Technical Note No. 15. 13 pp. Bombay, 1945. DAS M(055) I39te.

... Provides for the forecaster tabular monthly mean pressure changes in 3 - hourly intervals (0000-0300, 0300-0600, ..., 2100-0000) for Rangoon in Burma, Leh in Kashmir, 24 stations in India, and 3 stations in Pakistan.

1946

10. Great Britain. Meteorological Office. Flying conditions in the S.W. monsoon in India and neighbouring areas. Synoptic Divisions Technical Memorandum No. 117. London, 1946. DAS M(055) G786s.

...This note supersedes Parts I and II of Synoptic Divisions Memorandum No. 85, which have been largely incorporated in it. This paper presents information on the meteorology of the SW monsoon, cyclonic storms, features of the monsoon as they affect flying, monsoon flying over the sea, monsoon flying over land, effect of the monsoon on air-route operation, and flying conditions over the hills of eastern India and Burma. The table contains percentage frequency of occasions on which cloud tops lay at specified heights over various areas of NE India, East Pakistan, and Burma during a.m. and p.m. for the period June-September 1944.

11. India. Meteorological Department. Upper air data. Parts A and B. 1936-1946. DAS M06.7/54 I39up.

Source No. 11 continued

...Part A, Monthly means of pilot balloon data, consists of tabular monthly summaries of mean wind speed and resultant wind direction and velocity at surface and specified heights at 1-3 hours for 34-58 pilot balloon stations in India, Pakistan, Burma, and the Persian Gulf Area for each year (1936-1946). Part B, Sounding balloon and aeroplane data, contains tabular upper air temperatures and humidities obtained from sounding balloon ascents and descents at 4-12 stations in India and Pakistan for each year, 1936-1946; monthly means of pressure, dry and wet bulb temperatures, and relative humidity at surface and specified heights at Ambala (October 1939-June 1940) and Calcutta (April-May 1941, July-December 1943) based on data from aeroplane ascents; monthly and annual normal means of pressure, temperature with standard deviation, relative humidity with standard deviation, potential temperature, saturation temperature, saturation potential temperature and mixing ratio at surface and specified heights for Agra, Poona and Hyderabad, and Madras (June-November).

12. Roy, A.K. Air masses in India. India Meteorological Department, Technical Note No. 16. 33 pp. Bombay, 1946. DAS M(055) I39te.

...Discusses the air masses of each season (winter, southwest monsoon, hot or pre-monsoon and post-monsoon) and the identification of air masses in India. Appendix I contains a list of air masses in India for each season and the regions where they normally occur. Appendix II gives a brief description of the broad climatological features as they are associated with each of these air masses. In Appendix III the tables present the mean properties (temperature, potential temperature, relative humidity, saturation temperature, and saturation potential temperature) of air masses at heights of 1, 1.5, 2, 2.5, 3, 4, and 5 km, based primarily on soundings at about 1800 for 4 stations per month (Agra, Poona, Calcutta, Bangalore, Hyderabad, and Madras) in India and 2 stations in Pakistan for January, April, July, and October. These are representative months for each season.

1948

13. Jagannathan, P. Regression of climatic elements on latitude, longitude and elevation in India. Part I. Mean temperature. India Meteorological Department, Scientific Notes, X (121): 83-105. Delhi, 1948. DAS M(055) I39s.

Source No. 13 continued

...Deals with the relationship between the mean temperature and the location and elevation of a station. The tables present monthly and annual mean temperatures for 166 stations in India and Pakistan.

14. Jagannathan, P. Regression of climatic elements on latitude, longitude and elevation. Part II. Diurnal range of temperature. India Meteorological Department, Scientific Notes, X (122):107-118. Delhi, 1948. DAS M(055) I39s.

...Discusses the distribution of the mean daily range of temperature over India, Nepal, and Pakistan as a function of position and time. The tables present monthly and annual normal daily ranges of temperature (°F) for Katmandu in Nepal and 166 stations in India and Pakistan.

1949

15. India. Meteorological Department. Meteorology for airmen in India. Part I. General meteorological features. Second edition. 58 pp. Bombay, 1949. DAS M82.1/54 I39m.

...Discusses the monsoons, seasonal (northeast monsoon, hot weather, southwest monsoon, and retreating southwest monsoon) general climatic conditions and rainfall, rainfall variations, temperature, diurnal range of temperature, humidity, air density, variation of temperature and humidity with height, lapse rate and the stability of the atmosphere, saturation adiabatic lapse rate, adiabatic diagrams, seasonal upper winds, cyclonic depressions and storms, local winds and disturbances, clouds, visibility, weather phenomena affecting visibility, and weather charts of prepartitioned India. The tables contain monthly and annual mean densities of air in grammes per cubic meter at heights of 1,2,3,4,6, 8 and 10 km for northern India and Deccan; monthly and annual mean lapse rates in degrees Centigrade per km at height ranges of surface-2, 2-4, 4-6, 6-8, and 8-10 km for northern India and Deccan; monthly and annual mean frequencies of thunderstorms at 8 stations (New Delhi, Nagpur, Calcutta, Bombay, Hyderabad, Bangalore, Madras, and Trivandrum) in India, 3 stations in Burma, and 3 stations in Pakistan; monthly and annual number of days per year on which hail may be expected at 7 stations (New Delhi, Nagpur, Calcutta, Shillong, Bombay, Bangalore, and Madras) in India, Srinagar in Kashmir, Rangoon in Burma, and 3 stations in Pakistan; monthly (January, April, July, and October) frequencies of base of low clouds above ground for specified heights (0-150, 150-1000, 1000-2000, 2000-3000, 3000-5000, 5000-6500, 6500-8000 feet, no low clouds) for 14 stations in India, 4 stations in Burma, and 6 stations in Pakistan. The graphs present monthly frequencies of visibility (0-3, 4-5, 6, 7, and 8-9) at 0800 and 1800 for 11 stations in India, 4 in Pakistan, and 3 in Burma.

16. Jagannathan, P. Climatology of Trichinopoly Airfield. India Meteorological Department, Technical Note No. 27. 17 pp. Delhi, 1949. DAS M(055) I39te.

...Discusses the general climatic conditions, meteorological characteristics, typical weather in different seasons, and suitability of weather for flying at Trichinopoly. The tables present summaries over an unspecified period of monthly mean air density at 0500 and 1600 at Trichinopoly Airfield; monthly normal rainfall amount and number of rainy days at Trichinopoly Cantonment; monthly maximum amount of rain in 24 hours and monthly maximum and minimum rainfall amounts with years of occurrence at Trichinopoly; monthly (June-August) prevailing wind direction and mean speed at heights of 0.5, 1.0, 2.0, and 3.0 km for Cochin and Trichinopoly; monthly normal number of thunderstorm days at Trichinopoly Cantonment. The source also contains tabular monthly mean rainfall amount at the Cantonment and Airfield, monthly (March-November) mean number of thundery days and duration within which about 70 % of the thunderstorms started at the Airfield, monthly prevailing wind direction with mean velocity for prevailing direction, monthly mean wind speed at Trichinopoly Airfield, and monthly frequency of weather phenomena constituting aviation risk for hourly intervals at Trichinopoly Airfield based on data for 2 years (1945 and 1946); monthly number of storms and number of storms and depressions that crossed the coast between Madras and Negapatam and between Negapatam and Cape Comorin during the years 1891 and 1940.

17. Naqvi, S.M. Coefficient of variability of the monsoon rainfall in India and Pakistan. Pakistan Geographical Review, IV (2): 7-17. Lahore, 1949. DLC DS376 .P29.

...Discusses the coefficient of variability of monsoon rainfall, seasonal forecast for the monsoon rainfall and floods and droughts in India and Pakistan. From an examination of reliable rainfall data for individual stations two of the conclusions are (1) the coefficient of variability is small where the monsoon rainfall is primarily due to orography and (2) the coefficient of variability is large in areas with scanty monsoon rainfall. The table presents the normal rainfall amount (in.) and its standard deviation and coefficient of variation based on data for specified periods (vary by station) at 78 stations in India and Pakistan.

1950

18. Banerji, S.K. Methods of foreshadowing monsoon and winter rainfall in India. Indian Journal of Meteorology & Geophysics, 1 (1):4-14,

January 1950. DAS M(05) I39i. Also slightly revised in: Irrigation and Power (The Central Board of Irrigation Journal), 7 (6): 643-651, November 1950. DAS P.

...Discusses the short-range and long-range forecasts - their respective scope and utility; history of seasonal forecasting in India; facts about India's rainfall; standard 80 % expectation based on past behaviour of season's rainfall, or an intelligent layman's forecast; method in use for preparation of seasonal forecasts; cases in which the calculated value of the probable rainfall shows a large departure, positive or negative, from the normal; standard of accuracy and the degree of latitude of seasonal forecasts; limitation of the methods; non-issue of seasonal forecasts in respect to north-east India; desired future developments.

19. Malurkar, S.L. Notes on analysis of weather of India and neighbourhood. Memoirs of the India Meteorological Department, XXVIII (IV): 139-215. Delhi, 1950. DAS M(055) I39m.

...Analyzes the tropical weather of the Indian area (India, Pakistan, Burma, and Ceylon) to make it useful for weather forecasting. The author discusses such topics as the southwest monsoon, tropical cyclonic storms, weather in winter months, and western disturbances and presents a preliminary survey of medium-long range forecasting of rain over India.

20. Rao, K. Nagabhushana. Distribution of saturation potential temperature with height and latitude. Indian Journal of Meteorology and Geophysics, 1(1): 17-23. Delhi, January 1950. DAS M(05) I39i.

...Contains brief explanatory notes on the distribution of saturation potential temperature with height and latitude. The tables present summer and winter saturation potential temperatures at surface and specified heights (1/2, 1, 1 1/2, 2, 2 1/2 gkm. and for each gkm. from 3 to 17) at Peshawar, Jacobabad, Agra, Jodhpur, Ahmedabad, Sambalpur, and Poona. Summer tabular summaries are also recorded for Alipore and Madras and winter tabular summaries for Bangalore.

1951

21. Chaudhury, A.M. An aerological study of a western disturbance over Indo-Pakistan. Pakistan Journal of Scientific Research, III (4): 115-137. Lahore, October 1951. DNAL 475 P173.

...The increase of upper-air data over the Asiatic Continent in recent years permits more detailed aerological studies of the "western disturbances" passing across Pakistan and northern India

during the colder season. This is a study of the first of those disturbances that developed after the monsoon season of 1945 (October 10-14, 1945). It turns out that the western disturbance is the southern part of a major trough in the long wave train in the westerlies passing across Siberia. Its characteristics are quite similar to those encountered in higher latitudes.

During the period a strong high-level cyclone developed just south of the Himalayas, the intensity of which decreased downward to go over into an anticyclone near the surface. The structure of this centre is analyzed, and conditions during its formation are compared with those postulated in different hypotheses on the development of such disturbances. Some forecasting methods are suggested. - Author's abstract.

22. Desai, B.N., and Koteswaram, P. Air masses and fronts in the monsoon depressions in India. Indian Journal of Meteorology and Geophysics, 2(4): 250-265. Delhi, 1951. DAS M(05) I39i.

... From a synoptic and aerological study of the data of radiosonde ascents at Vizagapatam, Cuttack, Calcutta and Akyab during a depression in the Bay of Bengal in the beginning of July 1945, it is observed that different air masses took part both in the formation stage of the depression and during its subsequent intensification into a storm and movement westnorthwestwards. The depression formed with the passage of a low-pressure wave from the east across Burma into the northeast Bay of Bengal and the simultaneous arrival of Em air which underwent a cyclonic vorticity under the combined influence of the Arakan-Chittagong-Khasi hills and the seasonal trough of low pressure. It is seen that very heavy rain which occurred locally in southwest Bengal and Orissa before the formation of the depression and in the southwest sector of the depression or storm was associated with the quasi-stationary partition between the westerly NEm monsoon air from the Arabian sea which had travelled across the Peninsula and the easterly (bending southwards) warm NTm air or "old monsoon air" (mixture of NEm and TmS - subsided Tropical maritime air) in the lower levels and Tm air in the higher levels; the intensity of the rainfall varied with the slope of this partition, the slope being at times as much as 1 in 30.

It is also shown that during the monsoon season the northern boundary of the westerly NEm air constitutes a sloping surface running west to east, its height increasing north to south and steepness and vertical extent depending upon the strength of the monsoon current. If moist easterly air current backs and strikes and ascends over this sloping partition under the influence of the prevailing pressure distribution, rainfall will occur even without temperature

Source No. 22 continued

and moisture contrast between the westerly and easterly currents, the partition acting like a mountain barrier, the amount and extent of rainfall depending upon its steepness.

This study supports the mechanism of the formation of depressions in the north Bay of Bengal during the monsoon season suggested by Desai in an earlier paper. - Authors' abstract.

23. Desai, B.N. Some aspects of tropical meteorology with special reference to the Indian weather - an examination of Malurkar's concepts regarding them. Indian Journal of Meteorology and Geophysics, 2(2):113-120. Delhi, 1951. DAS M(05) I39i.

...Is an examination of the validity of some conclusions of Malurkar concerning points dealt with in his pamphlet on "Forecasting weather in and near India." In this article the author discusses the Intertropical Front (ITF) during the year, the ITF and its structure, movement of low pressure across the equator, depressions to the south of the equator and western disturbances of India, heavy rain during depressions and cyclones. Following this discussion he gives conclusions.

24. India. Meteorological Department. Kodaikanal Observatory; 1901-1951. 44 pp. New Delhi, 1951. DAS MO1 I39k.

...Discusses the instruments, routine solar work, international programs, eclipse and other expeditions, and development plans at the Kodaikanal Observatory; surveys the work during the last 50 years at this observatory; lists the publications issued from this observatory; presents monthly and annual normal mean daily maximum and minimum temperatures, absolute maximum and minimum temperatures (°F), mean number of hours with bright sunshine, mean monthly rainfall amount and mean number of rainy days based on data for an unspecified period at Kodaikanal.

25. Koteswaram, P. Physical properties of the upper atmosphere over India. Indian Journal of Meteorology and Geophysics, 2(2): 101-112. Delhi, April 1951. DAS M(05) I39i.

...From available data from sounding balloon ascents and sound propagation experiments, the height-temperature curve for Central India from ground up to 100 km has been constructed. It is seen that the isothermal region which is found in the lower stratosphere over middle

Source No. 25 continued

latitudes does not exist over India and that temperature steadily increases above the tropopause. This result is in agreement with Nazarek's conclusion from V-2 rocket soundings that the isothermal region does not exist over New Mexico in the lower stratosphere. The vertical distribution of pressure, temperature, and density for levels above 10 km is discussed. Mean monthly geostrophic west wind components have been worked out for lat. 25°N. approximately for levels between 10 km and 20 km, and their variations are discussed. By comparison of Central Indian data with Central European data, west wind components during summer have been computed up to 100 km. The comparison indicates that the summer easterlies over North India in the troposphere extend up to about 30 km with strong westerlies aloft. - Author's abstract.

26. Krishna Rao, P.R., and Ramachandra Aiyar, T.V. Climate of Bangalore. Souvenir pamphlet issued in connection with the 38th Indian Science Congress in January 1951, pp. 116-130. Bangalore. DGS 031(640) In2b.

...Describes the 4 seasons, the temperature, humidity, sunshine, rainfall, winds, and important weather phenomena of Bangalore. A table contains monthly summaries of mean daily maximum and minimum temperatures (°F), mean temperature (°F), mean of the monthly highest and mean of the monthly lowest temperatures (°F), absolute maximum and minimum temperatures (°F), mean monthly diurnal range of temperature (°F), mean wet bulb temperature (°F), mean relative humidity (%), mean number of hours of bright sunshine per day, mean wind speed (mph), and mean wind direction at Bangalore based on observations of 45-60 years between 1881 and 1940 at the Central Observatory, Bangalore. There is also a table with monthly and annual summaries over 60 years (up to and including 1940) of mean total rainfall amount (inches), mean number of rainy days, maximum rainfall amount in 24 hours with date of occurrence, and highest and lowest amounts of rainfall with years of occurrence at Bangalore.

27. Malurkar, S.L. Surface wet bulb potential temperatures in and near India - normal values and a study in disturbed weather. Indian Journal of Meteorology and Geophysics, 2(1):25-40. Delhi, 1951. DAS M(05) I39i.

...In the extra-tropical latitudes, it has become customary to identify air masses by the temperature and occasionally humidity characters of the air streams. Though in India various entities like Dry Bulb, Wet Bulb, Maximum and Minimum, and their anomalies have been plotted, there has been no critical examination of some concept which could be used. The temperatures obtained by the

Source No. 27 continued

Radio-sonde observations are still very short of the requirements in the tropics where the space gradient of quantities is small. Surface observations are available over many more stations and over a much longer period that comparisons would be easier. The quantity envisaged is the Wet Bulb Potential Temperature introduced by Normand obtained by surface observations. The larger number of observations that are available partly offsets the effect of nearness to the ground.

Normal Wet Bulb Temperature charts for the twelve months are given. During a pre-monsoon cyclonic storm of 1930, the field over India has been plotted for a number of days. From the latter charts, an interpretation is made to reason differing air masses entering into the storm field. Incidentally, it is also shown that secondaries of western disturbances show off as disconnected pools of air which seem to move in some Northeasterly direction. It is suggested that if 24-hour changes in the quantity are plotted, it would help identification of air masses.

A simple analysis is given so that the derivation between Normand's Wet Bulb Potential and Rossby's Equivalent or Equivalent Potential Temperatures is brought out and a nomogram connection can be drawn. - Author's abstract.

28. Mooley, D.A. Normal density distribution in the atmosphere. Indian Journal of Meteorology and Geophysics, 2(2): 127-137. Delhi, 1951. DAS M(05) I39i.

...Is an investigation into the density distribution in the atmosphere. This study is based on data for India, Pakistan, America, Great Britain, Batavia, and Swan Island. The data for Indian stations include the following: tabular (also presented on graphs) normal density (gm/m^3) at surface and specified heights (0.5 gkm and for each 1-gkm interval from 1.0 to 30.0 gkm) in summer and winter for 4-7 stations; monthly normal density (gm/m^3) at heights of 7, 8, 9, and 10 gkm for 7 stations. The stations are Madras, Poona, Sambulpur, Calcutta, Ahmedabad, Jodhpur, and Agra.

29. Pramanik, S.K., and Hariharan, P.S. Maximum dew-point temperatures in India. Indian Journal of Meteorology and Geophysics, 2(2): 138-141. Delhi, 1951. DAS M(05) I39i. Also in International Association of Hydrology, Tome 1, Publication No. 36, Assemblée Générale de Rome 1954. pp. 425-429. DAS M(06) I611g. S. Hyd.

...Examines the maximum dew point temperatures at 24 representative stations in India. The tables contain the following summaries over

Source No. 29 continued

specified periods for these stations: monthly and annual highest dew point temperatures (°F) at 0800 and 1700 IST recorded during the five-year period July 1944-June 1949; highest dew point temperature (°F) among those during five of the rainiest days in the years 1901-1940.

30. U.S. Hydrographic Office. Sailing directions for the west coast of India including Ceylon and the Maldive and Laccadive Islands. H.O. Pub. No. 159. Fourth Edition, 342 pp. Washington, 1951. DAS M82/267 U58sd.

...On pages 14-29 discusses the atmospheric pressure, seasonal winds, coastal winds, land and sea breezes, calms, gales, tropical cyclones, temperature, precipitation, thunderstorms, cloudiness, relative humidity, fog, haze, and exceptional visibility for the west coast of India, southeast coast of Pakistan, Maldive and Laccadive Islands, and Ceylon. On pages 294-298 there are tables for 9 stations (Pamban, Trivandrum, Cochin, Mangalore, Mormugão, Ratnigiri, Bombay, Surat, and Dwarka) in India with monthly and annual mean temperature (°F), mean extreme and absolute extreme temperatures (°F), mean relative humidity, mean total amount of rainfall (inches), mean number of rainy days, maximum amount of rainfall in 24 hours, wind direction frequency (%), and mean cloud amount (0-10). The period of record varies by station and element.

1952

31. Banerji, S.K. The climate of India. The Journal of the Bombay Natural History Society, 50 (4): 718-733. Bombay, August 1952. DLC QH1 .B61.

...Describes the climatic variations, the northeast monsoon, southwest monsoon, post-monsoon period, rainfall variations, cyclones and depressions, character of the southwest monsoon rainfall, and the micro-climate of India; discusses briefly the periodic variations and climatic trends, aridity factor and precipitation ratio, classification of climates, influence of topography on climate, diurnal variation of climatic elements, and climatological folk-lores; presents a table with monthly mean maximum and minimum temperatures and annual absolute maximum and minimum temperatures at 18 stations in India.

32. Krishna Rao, P.R. Some high sounding balloon ascents and upper air temperautures up to 35 km over India. Indian Journal of Meteorology and Geophysics, 3 (3): 173-185. Delhi, July 1952. DAS M(05) I39i.

...Has as its purpose to get a picture of the normal temperature distribution in summer and winter up to 35 km over India by collect-

Source No. 32 continued

ing together the data obtained from 34 high sounding balloon ascents reaching 30 km and above and utilizing these along with more numerous data for the lower levels from a larger number of stations. The discussion includes information on the data, the results obtained from the data and the upper air distribution over India in summer and winter. The tables contain the pressures and temperatures for 34 ascents for heights from 10 km upwards, the height and type of tropopause and the highest point reached with the corresponding pressures and temperatures for each ascent and seasonal (summer and winter) mean temperatures at different heights (for each 1-km interval for 10-36 km) at 6-7 stations (Agra, Calcutta, Ahmedabad, Sambulpur, Poona, Madras, and Bangalore). Illustrative graphs and diagrams are included.

33. Pramanik, S.K., and Hariharan, P.S. The climate of Rajasthan. National Institute of Science of India, Bulletin No. 1, Proceedings of the Symposium of the Rajputana Desert, pp. 167-178. 1952. DGS S(640) N2lib.

...Examines the rainfall, temperature, humidity, wind, and various weather phenomena such as thunderstorms, duststorms, hail, and fog at the observatory stations in Rajasthan to determine the main climatological features of the area. Rainfall is also studied at selected raingauge stations. The tables present monthly and annual rainfall amounts and number of rainy days, maximum amount of rainfall (inches) in 24 hours, mean maximum and minimum temperatures (°F), absolute maximum and minimum recorded temperatures, mean relative humidity at 0800 and 1700 I.S.T., mean wind direction at 0800 and 1700 I.S. T., mean wind speed (mph), number of days with thunder, number of days with duststorms, number of days with hail, and number of days with fog for 9-20 stations in Rajasthan.

34. Rahmatullah, M. Synoptic aspects of the monsoon circulation and rainfall over Indo-Pakistan. Journal of Meteorology, Boston, 9(3): 176-179, June 1952. DAS M(05) A512j.

...The circulation and rainfall distribution over India during August 1949 were studied with a view toward determination of the degree of steadiness of monsoonal weather conditions. Not less than five different patterns of flow, each with a characteristic distribution of precipitation, were found to prevail in turn during this month alone. - Author's abstract.

35. Sinha, K.L. An analysis of the space distribution of rainfall in India and Pakistan. Indian Journal of Meteorology and Geophysics, 3(1): 1-16, January 1952. DAS M(05) I39i.

Source No. 35 continued

...In the India Meteorological Department it is a long standing practice to describe the occurrence of rainfall over the various meteorological divisions of the country, in terms of widespread, local, and few falls according to the distribution of rainfall. The same terms have also been in use in forecasts of rainfall to indicate the expected distribution of rainfall. With an idea of obtaining the number of occasions of the different types of distribution of rainfall in different parts of the country, statistics have been compiled in respect of all the meteorological subdivisions of pre-partition India from ten years' data of the years 1930-39, published in the Indian Daily Weather Reports. Tables are given showing for each division the average number of days of widespread. local, and few falls together with the highest and lowest number of days under each category. The number of days of rainfall (sum of the days of all the three types of rainfall distribution) and the number of days of widespread rainfall for each meteorological subdivision in different months of the year have been discussed.

With regard to the number of days of rainfall of the meteorological subdivisions, it is seen that some divisions show only one peak during the year while others have two peaks. The peak which all the divisions have is due to the southwest monsoon and the other is practically due to the western disturbances. The peak observed during the month of active western disturbances is noticeable in the south up to the Madras Deccan, showing that the secondary or tertiary effects of the western disturbances are occasionally produced so far south as the Madras Deccan. - Author's abstract.

1953

36. Chatterjee, S. B. Climostatical regions. Geographical Review of India, 15 (1): 36-55. March 1953, Calcutta. DLC G1 .C17.

...Discusses the characteristic climatic graph of monthly and annual averages of weather elements. This discussion includes a system of methods for grouping the various types of weather and climate according to some basis of classification suitable to India, Burma, Ceylon, and Pakistan. The study also presents information on climatic provinces as derived from limits between timber forest, steppe, and desert.

37. Chatterjee, Sujan Bandhaba. India climatology; climostatics, climatic classification of India with special reference to the monsoons. 417 pp. Calcutta, 1953. DAS M82/54 C495i.

...Is primarily a collection of reprints of original articles published from time to time by the author in the Geographical Review of India,

Source No. 37 continued

formerly Calcutta Review, and some journals of Calcutta College. Chapter I contains a discussion on the scope of India climatology; meteorology and geography; methodology; influence classification, hydrologic cycle and comfort zones; differential relief and drainage as agents of diversity; ocean currents around India; weather hazards in flying, air routes, aerodromes, and meteorological observatories. Chapter II deals with the general methods in climatology. The text includes information on the representation of characteristic climatic features on maps, monsoon classification, statistical analysis, climo-statical characteristics of undivided India, and arithmetical means. Chapter III contains information on precipitation characteristics. In Chapter IV on the fundamentals of classification of climates the author describes the clouds, range of temperature, wind velocity, relative humidity, precipitation provinces, upper air data, air masses, and seasons of undivided India. Chapter V deals with the climo-statical regions of India. A description of Indian monsoon conditions is recorded in Chapter VI. Synoptic applications and conclusions are given in Chapter VII. The appendices contain (1) January, July, and annual number of rainy days and % of annual normal precipitation and (2) a list of selected meteorological stations of all classes of undivided India.

38. Great Britain. Hydrographic Office. Bay of Bengal pilot comprising the southern and eastern coasts of Ceylon, the eastern coast of India, the coast of East Pakistan, the coast of Burma, and western coast of Thailand from Pakchan River to Ko Phuket; also the Andaman and Nicobar Islands. Eighth edition, 1953. 527 pp. London, 1953. DAS M82/548.9 G786b 1953.

...Describes the general weather and climate, pressure, winds, cyclones, nor'westers, western depressions, gales, local winds, hail, thunderstorms, waterspouts, visibility and fog, air and sea temperatures, and humidity in the Bay of Bengal. Tabular monthly and annual summaries over specified periods of mean pressure (mb.), mean daily maximum and minimum temperatures (°F), mean of the highest and mean of the lowest temperatures (°F), means at 0800 and 1700 of relative humidity and cloud amount (0-10), mean total amount (in.) of rainfall, mean number of days with ≥ 0.1" of rainfall, wind direction (8 points and calm) frequencies at 0800 and 1700, mean wind speed (knots) at 0800 and 1700, mean number of days with wind force ≥ 8 Beaufort, and mean number of days with visibility $< 1/2$ n. mile at 1-14 stations in India.

39. India. Meteorological Department. Climatological tables of observatories in India. 508 pp. New Delhi, 1953. DAS M82.2/54 I39c.

Source No. 39 continued

...Consists of tabular monthly and annual summaries over specified periods (vary by station and element) of means at 0800 and 1700 of dry bulb and wet bulb temperatures, relative humidity, total cloud amount and low cloud amount; frequencies at 0800 and 1700 of wind force, wind direction, total cloud amount, low cloud amount and visibility; mean daily maximum and minimum temperatures; mean of the highest and mean of the lowest temperatures; absolute maximum and minimum temperatures with dates of occurrence; mean total amount and maximum amount in 24 hours of rainfall with date of occurrence; total rainfall of wettest month and of driest month with years of occurrence; mean wind speed; mean number of days with precipitation $\geq .01"$, thunder, hail, duststorms, squalls and fog. These data are for over 250 observatory stations covering the Indian area prior to partition, Ceylon, Afghanistan, Tibet, Iran, Arabia and Burma.

40. Pramanik, S.K. and Jagannathan, P. Climatic changes in India - (I) Rainfall. Indian Journal of Meteorology and Geophysics, 4(4): 291-309. Delhi, October 1953. DAS M(05) I39i.

...Examines the rainfall data of India and Pakistan to determine the rainfall trends. The text includes information on the data used, the distribution of annual rainfall, randomness of the rainfall series, trends, and trends in seasonal rainfall. The tabular data include summaries over specified periods (vary by station) of annual mean total rainfall, standard deviation, coefficient of variability and highest and lowest annual rainfall as percentage of mean for 27 stations in India and 3 in Pakistan.

41. World Meteorological Organization. World distribution of thunderstorm days. Part 1: Tables. WMO No. 21. TP. 6. 204 pp. Geneva, 1953. DAS M(06) W927p.

...Contains monthly, seasonal and annual mean number of days with thunderstorms based on 15 years of data for 139 stations in India.

1954

42. Balasubramaniam, V. Weather at Ahmedabad and Poona on occasions of 'below minima' conditions at Santacruz. Indian Journal of Meteorology and Geophysics, 5(1):80-82. Delhi, January 1954. DAS M(05) I39i.

...Studies the weather conditions at Poona and Ahmedabad when weather is below minima (visibility < 1000 yds and cloud base < 800 ft) at Santacruz Airport. The tables based on data for 5 years (1947-1951) present the number of occasions of bad weather at Santacruz

Source No. 42 continued

according to their duration and the associated conditions at Poona and Ahmedabad; the number of occasions of bad weather at Santacruz of duration more than twelve hours and the associated conditions at Poona and Ahmedabad.

43. Desai, B.N. The seasons of India. Bombay Geographical Magazine, II (1): 34-45. Bombay, December 1954. DGS S(640) B63m.

...Presents striking contrasts in meteorological conditions in India and describes these conditions in the northeast monsoon (December to February), hot weather (March to May), southwest monsoon (June to September), and retreating southwest monsoon (October to November) seasons.

44. Pramanik, S.K., and Jagannathan, P. Climatic changes in India - (II) Temperature. Indian Journal of Meteorology and Geophysics, 5 (1):29-47. Delhi, January 1954. DAS M(05) I39i.

...Is a study on temperature trends in India. The discussion in this text gives information on the data, tests for randomness, long-term trends, maximum and minimum temperatures, and moving averages. There are summaries for specified periods (vary by station but within the period 1876-1950) for 27 stations in India and 3 in Pakistan of tabular mean, standard deviation, and coefficient of variation of maximum and minimum temperatures; tabular miscellaneous computed temperature values; moving temperature averages on graphs.

45. Ramakrishnan, K. P., and Gopinatha Rao, B. Some broad features of the occurrence of squalls in different parts of India. Indian Journal of Meteorology and Geophysics, 5(4): 337-340. Delhi, October 1954. DAS M(05) I39i.

...This study includes tables giving the monthly and annual number of squalls with maximum speed in gusts $\geq$ 30 mph in 5 years (generally 1948-1952) for 12 stations in India; monthly number of days with at least one squall and number of distinct squalls at Cochin in 10 years (1943-1952); number of squalls with maximum speed in gust $\geq$ 40 mph in 5 years (generally 1948-1952) for 12 stations; seasonal (October-March, April-September) number of squalls within specified ranges (30-39, 40-49, 50-59, 60-69, 70-79, 80-89, and 90-99 mph) of maximum gust speed and highest gust speed with date of occurrence at 12 stations (generally for the period 1948-1952).

46. Daji, J.A. The climate of the Bombay State. Journal of the Indian Society of Soil Science, 3 (2): 133-152, New Delhi, December 1955. DLC S590 .I5.

...Discusses the precipitation, regional distribution of rainfall, seasonal distribution of rainfall, intensity of rainfall, temperature, humidity, evaporation, evaporation-precipitation ratio, and climatic zones in the Bombay State. This study presents the following tabular data for the Bombay State: seasonal and annual mean rainfall amount and mean number of rainy days and annual rainfall intensity for 27 districts; monthly mean maximum and minimum temperatures and monthly and annual mean temperature for 22 stations; monthly mean diurnal variation in temperature for 7 stations; mean relative humidity based on observations at 0800 and 1700 for 15 stations; monthly and annual mean evaporation (in.) and evaporation-precipitation ratio for 14 stations; Lang's rain factor, Meyer's NS quotient, Vilensky's precipitation evaporation ratio, Thornthwaite's PE index, and Thornthwaite's TE index for 14-30 stations. The period of record for these data is not specified.

47. Mull, S., and Chakravarty, K.C. Suitability of rain-making methods in different parts of India during various seasons. Symposium on Artifical Rain held in February 1953, pp.92-103. New Delhi, 1955. DAS MO9.67 S989.

...Discusses briefly the artificial rain-making in India with particular reference to prevailing meteorological conditions over the country. The tables present the annual normal rainfall for different subdivisions of India; monthly mean total rainfall amount, number of rainy days, and number of cloudy days for the six meteorological subdivisions of India; monthly and annual mean, highest mean, and lowest mean freezing level over India; seasonal (winter, pre-monsoon, monsoon, and post-monsoon) frequency distribution of heights of bases and tops of clouds suitable for seeding.

48. Pramanik, S.K., and Jagannathan, P. Climatic changes in India - (III) Pressure. Indian Journal of Meteorology and Geophysics, 6(2): 137-148. Delhi, April 1955. DAS M(05) I39i.

...Examines the pressure of the morning synoptic hour of 25 observatories distributed over India and adjacent areas to determine the changes in this element. The discussion presents information on the test for oscillatory changes, tests for secular trends, analysis of trend for uniform period 1901-1950, and linear trends

for January and July. The tables contain for 2 stations in Burma, 4 in Pakistan, and 19 in India the latitude, longitude, period of data used, the mean annual pressure and its standard deviation; distribution of turning points and phase lengths in the series of mean pressure values; coefficients of orthogonal polynomials; square roots of variances accounted for by polynomials; decade averages of 0800 pressure; January, July, and annual linear trends of pressure (1901-1950).

49. Pramanik, S.K., and Koteswaram, P. Heights of tops of low clouds over India. Symposium on Artificial Rain held in February 1953, pp. 104-111. New Delhi, 1955. DAS M09.67 S989.

...Briefly discusses the suitability of rain making experiments in different parts of India in different seasons, taking into consideration the cloud top data and the general climatological conditions. This study is based on 7,285 air craft reports during the period 1948-1951. A table presents the monthly means of freezing levels in feet over 11 radiosonde stations in India, summarized over the period 1947-1950.

50. Satakopan, V., and Sen, B.K. Distribution of dry cloudy days in India. Symposium on Artificial Rain held in February 1953, pp. 112-120. New Delhi, 1955. DAS M09.67 S989.

...Provides information on seasons and areas of India with abundance of clouds but yield no rain. The tables present (1) stations where the annual number of days with low cloud amount 7-10 tenths is greater than the number of days with rain, (2) stations (with all cloud amount 7-10 tenths) having ≥ 60 number of dry cloudy days per year, and (3) stations (with all cloud amount 4-10 tenths) having ≥ 60 number of dry cloudy days per year.

1956

51. Hariharan, P.S. A study of the extension of cold waves at the surface in relation to upper winds at 3000 ft in India. Indian Journal of Meteorology and Geophysics, Delhi, 7(4): 363-370, October 1956. DAS M(05) I39i.

...Is a study connecting the march of minimum temperatures over large areas of the country in the form of cold waves with antecedent upper winds. This includes an analysis of six synoptic situations in which well-marked cold spells appeared over West Pakistan and northwest India and moved eastward..

52. Iyer, V. Doraiswamy, and Pradhan, R.N. Monthly frequencies of rainfall in India. Memoirs of the India Meteorological Department,

Source No. 52 continued

XXX (VI): 217-289. Delhi, 1956. DAS M(055) I39m.

...Presents monthly and annual mean total rainfall amount and rainfall frequency (no rain, .01-.09, .10-.25, .26-.50, .51-.75, .76-1.00, 1.01-1.50, 1.51-2.00, 2.01-3.00, 3.01-4.00, 4.01-5.00, 5.01-6.00, 6.01-7.00, and 7.01-8.00") in days and % at 69 representative stations in India, Pakistan, Kashmir, and Nepal based on data for 1931-1940.

53. Mooley, D.A. Zonal wind circulation and vertical temperature distribution along the Indian longitudes during the monsoon and winter seasons. Indian Journal of Meteorology and Geophysics, 7 (2): 113-128. Delhi, April 1956. DAS M(05) I39i.

...Has as its purpose to study conditions during the monsoon based on all temperature data and calculated (geostrophic) and actual zonal winds for all stations lying between 71 1/2° and 80 1/2°E and between latitudes 7° and 35°N. The author describes the observational data, tabulation and analysis of data, and distribution of temperature and wind. The tables contain the coordinates, elevation and period of record of temperature for all radiosonde stations (New Delhi, Jodhpur, Nagpur, Poona, Madras, and Trivandrum in India; 2 stations in Pakistan; Ratmalana in Ceylon) for January, February, July, and August during the period 1944-1949; seasonal (monsoon and winter) mean temperature and relative humidity at levels of 1000, 900, 850, 800, 700, 600, 500, 400, 300, 250, 200, 150, 100, 80, and 60 mb for the radiosonde stations; seasonal (monsoon and winter) mean temperature with range for each year and over the period (1944-1949) at levels of 900, 850, 800, 700, 600, 500, 400, 300, 250, 200, 150, and 100 mb for New Dehli and Poona; winter frequencies of winds $\geq$ 70 knots at heights of 6.0, 7.5, 9.0, 10.0, 11.0, 12.0, 13, 14, 15, 16, and 17 km at specified mean latitudes; winter frequencies of winds $\geq$ 100 knots at heights of 6.0, 7.5, 9.0, 10.0, 11.0, and 12.0 km at specified mean latitudes; normal vector winds in knots and direction in degrees at heights of 11 and 12 km for January and February (based on data up to 1950) at Ambala, New Delhi, Agra, Gwalior, Jabalpur, Ahmedabad, Nagpur, and Malegaon.

54. Pisharoty, P. R., and Desai, B.N. "Western Disturbances" and Indian weather. Indian Journal of Meteorology and Geophysics, 7 (4): 333-338. Delhi, October 1956. DAS M(05) I39i.

...Suggests some of the features of the interaction of the weather between the tropics and extratropics. The author discusses the western disturbances of the winter, hot weather period, monsoon period, and post-monsoon period. Some of the ideas presented do not have adequate data to justify them.

55. Shanbhag, G.Y. The climates of India and its vicinity according to a new method of classification. The Indian Geographical Journal, XXXI (1 & 2): 1-25. Madras, January-March and April-June 1956. DLC DS401 .I36.

...Reviews the efforts of various authors to classify climates; discusses the meteorological, physical, and biological factors involved in transpiration; lists the requirements for evaporation; gives the elements of climatic classification.

56. Subrahmanyam, V.P. Climatic types of India according to the rational classification of Thornthwaite. Indian Journal of Meteorology and Geophysics, 7 (3): 253-264. Delhi, July 1956. DAS M(05) I39i.

...Analyzes the climatic data of about 250 stations in India, Pakistan, Burma, and Ceylon for the classification of the climatic types of the area according to the 1948 scheme of Thornthwaite. The tables contain for 23 stations in India, 4 stations in Pakistan, and 3 stations in Burma monthly and annual normal mean temperature (°C) and precipitation (cm) and mean potential evapotranspiration (cm); annual water need, water surplus, and water deficiency; moisture index; climatic type; climatic subtype. Most of the stations have more than 35 years of record.

1957

57. Basu, S.C. Fog over Upper Assam. Indian Journal of Meteorology and Geophysics, 8 (1):67-71. Delhi, January 1957. DAS M(05) I39i.

...Discusses the monthly frequency, hourly distribution, simultaneous occurrence, time of onset, type and meteorological conditions favorable for the formation of fog based on data observed at Gauhati and Mohanbari Airfields and Tezpur and Dibrugarh pilot balloon observatories for the period 1950-1952. The tables present station coordinates; short description of locality of each station; monthly and annual frequencies of fog at Gauhati, Mohanbari, or Dibrugarh and Tezpur; monthly (November-February) hourly (1600-1700, 1701-1800, ... 0401-0500) distribution of occasions of fog at Gauhati, Mohanbari, and Tezpur; monthly (November-February) frequencies of simultaneous occurrences of fog at all stations (Gauhati, Mohanbari, and Tezpur), at Gauhati and Mohanbari, at Gauhati and Tezpur and at Tezpur and Mohanbari for each hour from 1600 to 0500; frequency of onset of fog at specified hours (1600-1859, 1900-1959, 2000-2059, 2100-2159, 2200-2259, 2300-2359, 0000-0059, and 0100-0200) during the period November-February at Gauhati, Mohanbari or Dibrugarh and Tezpur. These data are summaries over the period November 1950-February 1951 and November 1951-February 1952. The source also contains tabular monthly (November-

Source No. 57 continued

January) % of occasions of fog in association with western disturbances and % of occasions of fog when area was not affected by any disturbance for each year (1950 and 1951) at Gauhati and Mohanbari.

58. Das, P.K. Experiments with numerical forecasting in India. 75th Anniversary Volume of the Journal of the Meteorological Society of Japan, pp. 275-279. November 1957. DAS M(05) M589sjs.

...Charney's equation for a non-divergent barotropic model has been applied to a depression in the Bay of Bengal. The equations were solved by relaxation method, and the predicted height changes were compared with those observed. The agreement was not discouraging, although there was considerable room for improvement.

The limitations of the above model, specially in low latitudes, is discussed with special reference to the non-barotropic nature of the atmosphere and the quasi-geostrophic approximation. - Author's abstract.

59. India. Meteorological Department. Report on the administration. 1875-1941, 1944-1957. Simla. DAS M(06) I39a.

...Presents information on the general work and administration of the Meteorological Department of India from its establishment. This includes descriptive data on the observatories, weather reporting, forecasting, warning service, research and investigation, and meteorological instruments. The format changes from time to time, and the work of the Department has expanded over the years.

60. Jagannathan, P. Seasonal oscillations of air temperature in India and neighbourhood. Indian Journal of Meteorology and Geophysics, 8 (2): 155-168. Delhi, April 1957. DAS M(05) I39i.

...The annual and half-yearly oscillations in the mean temperature of air at 4 ft above ground level at 167 meteorological stations in India and neighborhood have been separated. The dependence of the components of the vectors of the different oscillations on the location of the stations has been determined. Regression equations for representing the components of the oscillations as a linear function of lat., long., and elevation have been derived. The fit of these representations has been found to be fairly good, the correlation between the actual and the calculated values being of the order of 0.8 to 0.9, generally. The significance of the gradients with respect to the positional co-ordinates has been discussed. - Author's abstract.

61. Mooley, D.A. The role of western disturbances in the production of weather over India during different seasons. Indian Journal of Meteorology and Geophysics, 8 (3): 253-260. Delhi, 1957. DAS M(05) I39i.

...Defines western disturbances and discusses the widespread and locally heavy rain, incidence of cold waves, induced disturbances and the upper air anticyclonic circulation over the central parts of the country and the adjoining parts of the peninsula, absence of western disturbances or movement of weak disturbances and spell of hot weather in winter months, and the role of the western disturbances during the monsoon.

62. Pisharoty, P. R., and Asnani, G.C. Rainfall around monsoon depressions over India. Indian Journal of Meteorology and Geophysics, 8(1): 15-20. Delhi, January 1957. DAS M(05) I39i.

...Rainfall that occurred for 2 to 3 days within a radius of 350 mi from the centre of a depression along its track has been combined using the data of all raingage stations within that area. Such "composite" charts of rainfall were prepared for a sample of three mid-monsoon depressions in the year 1944. Falls of heavy rain of 3" and above in 24 hrs are confined to an area lying to the left-hand side of the track. On any particular morning, the heavy rainfall area extends to about 300 mi ahead and to about 300 mi behind the center of the depression on that morning, measured, respectively, along the expected and past track of the depression.

The width of the area is about 250 mi and extends to the left of the track. It is further noticed that out of this belt, about 30% of the area is almost the maximum over which there may be rainfall of 3" of more in 24 hrs. The results are discussed from a forecasters's point of view. - Authors' abstract.

63. Ramdas, L.A. Evaporation and potential evapo-transpiration over the Indian sub-continent. The Indian Journal of Agricultural Science, XXVII (II): 137-149. New Delhi, June 1957. DAS P.

...Discusses briefly the spatial distribution of the mean annual evaporation and the mean annual potential evapotranspiration over the Indian sub-continent. The area includes India, Pakistan, and Burma.

1958

64. Iyer, V. Doraiswamy. High maximum temperatures on the north Konkan coast. Indian Journal of Meteorology and Geophysics, 9(3):259-266. Delhi, July 1958. DAS M(05) I39i.

Source No. 64 continued

...Discusses the occurrences of hot spells over the north coast of Konkan represented by Colaba. The text presents information on the data, the rise of maximum temperature in October-November, and subsidence along the Konkan and Kathiawar coasts. The tables contain the following monthly summaries over specified periods: mean daily maximum, mean monthly maximum and highest maximum temperatures (1940 normals) in °F for the north Konkan coast (Colaba, Alibag, and Ratnagiri) and the north Circars coast (Gopalpur, Calingapatam, Vizagapatam, and Cocanada); frequencies of occurrence of the highest maximum temperature (°F) at Colaba (1891-1955), Alibag (1930-1955), and Ratnagiri (1891-1945, 1951-1955) with Harnai (1946-1950); frequencies of occurrence of maximum temperature (°F) for 1930-1939 at Colaba, Alibag, and Ratnagiri.

65. Krishnan, A.; Raman, P.K.; Vernekar, A.D. Probable maximum twenty-four-hour rainfall over India. Proceedings of the Symposium on Meteorological and Hydrological Aspects of Floods and Droughts in India. pp. 196-202. New Delhi, April 18-20, 1958. DAS M79.4 S989pr.

...Presents the results of a study on the annual maximum 24-hour rainfall intensities at 150 observatories based on data for more than 20 years during the period 1901-1950. The table contains annual highest maximum rainfall with month and year of occurrence, mean maximum rainfall, standard deviation of maximum, and probable extreme rainfall values expected once in specified periods (25, 50, 100, and 250 years) at 26 stations.

66. Lal, S.S. Rainfall around slow moving monsoon depressions over India. Proceedings of the Symposium on Meteorological and Hydrological Aspects of Floods and Droughts in India. pp. 53-56. New Delhi, April 18-20, 1958. DAS M79.4 S989pr.

...The spatial distribution of heavy rainfall around two slow-moving monsoon depressions has been studied using the technique of composite charts. It has been shown (i) that heavy rainfall is confined to a belt of width about 250 miles to the left of the track and (ii) that the length of the belt susceptible to heavy rain during the next 24 hours is equal to 300 miles plus the distance the depression is expected to move during the same period. - Author's abstract.

67. Parthasarathy, K. Maximum point rainfall and frequency of rainfall of ten inches and over in twenty-four hours over India. Proceedings of the Symposium on Meteorological and Hydrological Aspects of Floods and Droughts in India. pp. 31-36. New Delhi, April 18-20, 1958. DAS M79.4 S989pr.

Source No. 67 continued

...Analyzes the occurrences of very heavy rainfall data at more than 3000 rain gauge stations during the period 1891-1955 and presents generalized charts of the maximum point rainfall in different districts of India. The discussion includes information on the source of data and the procedure followed, chief features and use of charts, and the frequency of rainfall $\geq$ 10" in 24 hours.

68. Ramakrishnan, K.P., and Krishnan, A. Spells of (1) heavy rain and (2) rainless days at selected stations in India. Proceedings of the Symposium on Meteorological and Hydrological Aspects of Floods and Droughts in India. pp. 164-167. New Delhi, April 18-20, 1958. DAS M79.4 S989pr.

...Consists of explanatory notes and tabular summaries based on data for the period 1901-1950 at Akola, Nagpur, Raipur, Visakhapatnam, Bhagamandla, Mangalore, Madras, Trivandrum and Nagapattinam. These summaries include total number of occasions when rain exceeded specified limits in 1-7 consecutive days, highest amounts of rainfall occurring in spells of 1-7 consecutive days, frequencies of dry spells of different durations and longest spell of consecutive rainless days.

69. Raman, P.K., and Krishnan, A. Intensity, duration and frequency relation of rainfall at selected stations in India. Proceedings of the Symposium on Meteorological and Hydrological Aspects of Floods and Droughts in India. pp. 21-30. New Delhi, April 18-20, 1958. DAS M79.4 S989pr.

...Analyzes the heavy rainfall of short durations from autographic raingauge records of New Delhi, Alipore (Calcutta), and Madras for the period 1946-1955. The author describes the data used, the methods of analysis, the results, and the use of curves. The tables present maximum rainfall intensities for different durations for the period 1946-1955 and maximum intensity of rain per hour for different durations equalled or exceeded once in 10 years for these three stations.

70. Rao, K.N., and Raman, P.K. Diurnal variation of rainfall in India. Proceedings of the Symposium on Meteorological and Hydrological Aspects of Floods and Droughts in India. pp. 186-191. New Delhi, April 18-20, 1958. DAS M79.4 S989pr.

...Gives the results of a study on rainfall based on 24 hour (0830-0830) totals, totals for 0830-1730, and hourly data for a large number of stations with records of more than 10 years. The

Source No. 70 continued

table presents 3-hourly rainfall amounts as percentage of 24-hour rainfall amounts for each month (June-September) at 13 stations in India.

71. Rao, K.N. Heavy rainfall in India. Proceedings of the Symposium on Meteorological and Hydrological Aspects of Floods and Droughts in India. pp. 11-14. New Delhi, April 18-20, 1958. DAS M79.4 S989pr.

...The extent of contribution of a few heavy falls to the annual or seasonal totals has been considered. Tables giving the monthly frequency of days of very heavy falls ($\geq$ 10" in 24 hours) in the various divisions of the country have been included. Assam and Bombay have the high annual average of 17 and 10 respectively. - Author's abstract.

72. Subrahmanyam, V.P. Droughts and aridity in India - a climatic study. Proceedings of the Symposium on Meteorological and Hydrological Aspects of Floods and Droughts in India. pp. 171-177. New Delhi, April 18-20, 1958. DAS M79.4 S989pr.

...Defines drought; discusses the kinds of drought, water balance, and drought and combating droughts; gives conclusions. The table presents precipitation, potential and actual evapotranspiration, water surplus and water deficiency data for Lumding, Calcutta, Visakhapatnam, Cuddalore, and Bombay.

73. Venkateswara Rao, D., and Mukherjee, A.K. On forecasting hailstorms by the method of vectorial wind changes. Indian Journal of Meteorology and Geophysics, 9 (4): 313-322. Delhi, October 1958. DAS M(05) I39i.

...The conditions leading to the occurrence of a number of hailstorms over northwest India have been investigated. The method of assessment of convergence by using 24-hour vectorial wind changes was found in these situations to be superior to the conventional methods and of definite prognostic value. The border region between cyclonic and anticyclonic wind shear patterns was found suitable for thunderstorm development whenever the cyclonic shear appeared in a moist air stream, notwithstanding the unfavorableness of the winds and of thermal structure aloft. Strong upper winds and pronounced vertical shear are found to promote transformation of the thunderstorms so formed into hailstorms. The direction of the associated squall, if any, lies close to the isallobaric wind.

The variety of shapes and sizes of hailstones in the same or in different storms is attributable to the simultaneous occurrence

of elementary hailstones characterised by concentric shells together with larger stones formed by the compounding together of two or more elementary stones. Compound hailstones possess a single common glazed-ice envelope and breed just above the freezing level. Their jaggedness results from non-uniform accretion of supercooled water. The maximum size attained by hailstones is related to the severity of turbulence in a storm only if the specimen examined is of the elementary variety. - Authors' abstract.

74. Venkiteshwaran, S.P., and Venkataraman, R. Measurement of dew at the Central Agricultural Meteorological Observatory, Poona. Indian Journal of Meteorology and Geophysics, 9 (4): 363-370. Delhi, October 1958. DAS M(05) I39i.

...Discusses the amount of dew and number of dew days at Poona, variation of the amount of dew with height, and time of occurrence of dew and duration; describes the Duvdevani dew gauge; presents tabular summaries for each year and over the period (1952-1955) of number of nights with dew, total amount of dew deposited at specified heights (1, 3, 5, 10, 30, 50, and 75 cm, 1, 2, 6, and 11.5 m) above the surface, number of nights with no dew, and number of rainy nights at Poona.

1959

75. Ghosh, S.K. Climatic pattern of India. Geographical Review of India, XXI (2, 3, 4): 18-32. Calcutta, December 1959. DLC G1 .C17.

...Applies Köppen's, Thornthwaite's (1931), De Martonne's, and Gorczynski's classifications of climate to India, but these did not give a satisfactory climatic division of the country. After a search was made in this direction of other meteorological elements, it was concluded that the pattern obtained by suitably combining the mean annual rainfall and the difference in the mean temperature of the hottest and coldest months in India provides perhaps the best classification of climate.

76. Mathur, L.S. Weather radar organization and some observations in India. Journal of the Institution of Telecommunication Engineers, 6 (1): 12-122. New Delhi, December 1959. DLC TK5101 .I55.

...The paper describes in detail the organization of weather radar stations established by the India Meteorological Department in India, including the plans for the immediate future network of storm-detecting radar stations in the country. A brief summary of the specifications of different types of storm-detecting radars used by the department has also been given together with photographs

Source No. 76 continued

of the installations so far completed. A few typical examples of different types of weather radar echoes obtained from thunderstorm, monsoon rain, duststorm, etc., have also been given. The examples selected give a broad classification of different types of weather radar echoes as obtained in tropics and act as the starting point for a more detailed classification of weather radar echo patterns observable in this part of the world. - Author's abstract.

77. Ramamurthi, K.M. 'Below minima' conditions of weather over New Delhi (Palam) and their simultaneity of occurrence at New Delhi (Safdarjung), Agra, Allahabad, Lucknow and Jodhpur. Indian Journal of Meteorology and Geophysics, 10 (1): 37-46. Delhi, January 1959. DAS M(05) I39i.

...Analyzes the occurrence and duration of low clouds and visibility at Palam for the period 1949-1953 below some common limits; studies prevailing weather conditions over Safdarjung Aerodrome; shows the simultaneity of the occurrence of below minima weather conditions at Agra, Allahabad, Lucknow, and Jodhpur Aerodromes to assess their suitability for alternates to the Palam Airport at New Delhi. The tables present for Palam, Safdarjung, Agra, Allahabad, Lucknow, and Jodhpur summaries based on the period 1949-1953 of number of occasions of visibility < 1100 yards in association with (1) duststorms and (2) dust raising winds or dust fog; number of occasions of visibility < 1100 yards for specified periods (< 1, 1-2 and > 2 hours) in association with (1) duststorms and (2) dust raising winds or dust fog; number of occasions of visibility < 1100 yards in association with fog; number of occasions of visibility < 1100 yards within defined periods (< 1, 1-2, and > 2 hours) in association with fog; monthly number of occurrences of fog. The source also presents tables with (1) monthly and annual summaries based on the period 1949-1953 showing the frequency of visibility < 1100 yards over Palam and simultaneous occurrences of the same or of low clouds with base ≤ 600 feet over the other five aerodromes and (2) monthly summaries of visibility < 1100 yards over Palam in association with duststorms, dust raising winds, and dust fog and of their simultaneous occurrence at the other five aerodromes.

78. Singh, Ujagir. Climatic characteristics of Allahabad. The Journal of Scientific Research, Banaras Hindu University, IX (2): 13-31. Banaras, June 1959. DGS S(640) J823.

...Describes the temperature conditions, character of rainfall, the monsoon period, winter rainfall, pressure, winds, relative humidity,

Source No. 78 continued

cloudiness, fog, hail, and the climate and human comfort in Allahabad. In addition to the textual data the study presents the following for Allahabad: monthly wind roses based on data for an unspecified period; monthly values of mean temperature, rainfall and relative humidity on a graph based on data for an unspecified period; tabular monthly mean daily maximum and minimum temperatures (also on graphs) based on data for 60 years (1881-1940); climograph; hythergraph; monthly highest recorded rainfall amounts (1881-1940) on a graph; tabular monthly number of days with wind velocity ≥ 20 mph (1941-1945), tabular monthly mean relative humidity at 0800 and 1700 based on data for an unspecified period.

79. Sinha, K.L. Seasonal features of the spatial distribution of rainfall in pre-partitioned India. Indian Journal of Meteorology and Geophysics, 10 (1): 47-56. Delhi, January 1959. DAS M(05) I39i.

...The spatial distribution of rainfall in accordance with the practice prevalent in the India Meteorological Department, viz, "few fall," "local", and "widespread" during the four seasons and the whole year in the different meteorological sub-divisions of the pre-partitioned India have been studied with a view to find any common features that may exist between the three types of rainfall distribution. Distribution of total number of rainy days in the various meteorological sub-divisions during the four seasons and the year have also been discussed. - Author's abstract.

1960

80. Bharadwaj, O.P. Climate of the Bist Jullundur Doab (Punjab) with reference to variability of rainfall. The National Geographical Journal of India, VI (II): 67-94. Varanasi, June 1960. DGS S(640) N19n.

...Summarizes briefly the (1) seasonal temperatures, wind, pressure, and rainfall, (2) duststorms and whirlwinds of the hot season, (3) depressions of the cold season, and (4) annual temperatures, rainfall, variability of rainfall of the Bist Jullundur Doab. The tables contain monthly (March-June) summaries for each year (1946-1949) of depressions that crossed northwestern India, monthly and annual mean temperatures (°F) at Hoshiarpur and Jullundur, 5-day normals of mean extreme temperatures and mean relative humidity at Ludhiana, monthly rainfall variability at Hoshiarpur Garhshankar, Nawanshahr, Phillaur, and Nakrodar.

81. Pant, P.S. Diurnal variation of upper air temperatures. Indian Journal of Meteorology and Geophysics, 11(4): 371-376. Delhi, October 1960. DAS M(05) I39i.

Source No. 81 continued

...Shows the diurnal variation in upper air temperatures. The diurnal range varies with latitude, altitude, and season. The author discusses the data used in this study and the method of analysis. The tables present monthly (April, July, October, and December) mean temperature (°K) at specified hours (0000 and 1200 GMT based on data for 1957 and 1958 and at 0300 and 1500 GMT for 1955 and 1956), apparent diurnal range of temperature (°K) and nocturnal cooling at levels of 850, 700, 500, and 300-mb levels at New Delhi, Nagpur, and Madras.

82. Pisharoty, P.R., and Asnani, G.C. Flow pattern over India and neighbourhood at 500 mb during the monsoon. Symposium on Monsoons of the World, New Delhi, 19-21 February 1958. pp. 112-117. Delhi, 1960. DAS M53.21 S989sy.

...Daily 500-mb charts for the months of July, 1954 and 1955 over the area equator to Lat. 50°N and Long. 45° E to 145° E confirm the existence of a semi-permanent Tibetan high and of a pronounced trough in the westerlies roughly along the Delhi meridian and extending from Lat. 30°N to 70°N. An idealised flow pattern at 500 mb i.e., at about 6 km a.s.l., based on these daily charts, is presented. The pattern is broadly similar to one presented by Flöhn for July and differs from it as far as the portions over Burma and over the equatorial area south of Lat. 5°N are concerned. The migratory lows of the middle latitudes have some effect on the position and nature of this westerly trough and the Tibetan high. Prolonged breaks in the Indian monsoon are accompanied by pronounced changes in 500-mb flow pattern. Such periods appear to coincide with marked weather anomalies over Europe and North America. -Authors' abstract.

83. Ramakrishnan, K.P.; Sreenivasaiah, B.N.; Venkiteshwaran, S.P. Upper air climatology of India and neighbourhood in the monsoon seasons. Symposium on Monsoons of the World, New Delhi, February 19-21, 1958. pp. 3-34. Delhi, 1960. DAS M53.21 S989sy.

...Presents information on the normal distribution of temperature and winds in the upper air based on pilot balloon and radar /rawin data in India and available data from adjacent areas during the monsoon season. The authors describe the data used, the procedure followed, and the results.

84. Ramdas, L.A. The establishment, fluctuations and retreat of the southwest monsoon of India. Symposium on Monsoons of the World, New Delhi, 19-21 February 1958. pp. 251-256. Delhi, 1960. DAS M53.21 S989sy.

Source No. 84 continued

...Reviews the main features of the monsoon and presents a diagram showing the occurrences of floods and droughts in each year 1875-1955 and the 1910 normal rainfall amount in 30 districts of India, Kashmir, and Pakistan.

85. Rao, K.N. Average amount of rainfall on a rainy day in India during the southwest and northeast monsoons. Symposium on Monsoons of the World, New Delhi, February 19-21, 1958. pp. 209-212. New Delhi, 1960. DAS M53.21 S989sy.

...The results of a recent study by the author on the average amount of rainfall on a rainy day in India during the southwest and northeast monsoons are summarised in the present paper. Charts have been included showing isolines of daily rainfall intensities for the months May to December. The highest average daily falls apart from stations in the Khasi hills and the Western Ghats are for the plain stations Amboli (Ratnagiri district), Radhanagari, and Gaganbawada (Kolhapur district). A brief reference has also been made to the number of depressions traversing the different parts of the country in the months of June to September. - Author's abstract.

86. Rao, K.N., and Ramamoorthy, K.S. Seasonal (monsoon) rainfall forecasting in India. Symposium on Monsoons of the World, New Delhi, 19-21 February 1958. pp. 237-250. Delhi, 1960. DAS M53.21 S989sy.

...Seasonal forecasting of rainfall though a subject of great complexity has attracted considerable attention all over the world from very early times. Notable among the countries where the seasonal forecasting of rainfall has been practised for many years is India. The first official forecast was issued in 1886. The correlation method introduced by Walker in 1907 is still the basis of practice followed for issue of seasonal forecasts in India. After a brief description of the salient features of India's rainfall, the paper contains a discussion of the performance of each of the factors in use in the various seasonal forecasts. It is interesting to observe that South American pressure and South Rhodesia rain continue to be the dominant factors in the seasonal forecasting formulae. A table giving particulars of the seasonal forecasts issued at present has been included. Reference has also been made to the influence of sunspots on Indian rainfall. - Authors' abstract.

87. Seshadri, T.N.; Rao, K.R.; Sharma, M.R.; Sarma, G.N.; Ali, Sharafat. Climatological and solar data for India (to design buildings for thermal comfort). 164 pp. Roorkee, 1960. DAS M:69 S493cl.

Source No. 87 continued

...The tables present a station list with coordinates and elevation, monthly (January, May, August, and November) mean and mean extreme temperatures, mean relative humidity, mean vapor pressure, mean total rainfall amount, prevailing wind direction for morning and evening, mean wind speed, climatic zones, comfort conditions, and sky clearance factor for 129 stations in India and Nepal. For the same stations there are also annual summaries of extreme temperatures, mean total rainfall amount, heaviest rainfall within 24 hours, mean number of days with wind force > 4 and >8 Beaufort for morning and evening.

1961

88. Deshpande, D.V. Heights of tops of Cb clouds over India. Indian Journal of Meteorology and Geophysics, 12 (1): 29-32. Delhi, January 1961. DAS M(05) I39i.

...Discusses the heights of Cb tops and the weather phenomena (turbulence, upper winds, temperatures, and icing) near Cb tops, presents typical synoptic situations associated with Cb development and gives conclusions.

89. India. Meteorological Department. Our weather service. 86 pp. Faridabad, March 1961. DAS M(06) I39ou.

...Describes the organization of the India Meteorological Department, its forecasting office, the interests served by this service, the utilization of forecasts and warnings and the weather archives in India. In the Appendices this pamphlet presents information on the weather bulletins issued by the India Meteorological Department, meteorological sub-divisions of India, meteorological offices supplying weather information, definition of words commonly used in weather forecast, weather reports issued to subscribers by telegram and by post, weather charts, storm warning signals and their meanings and selected climatological publications of the India Meteorological Department. There are also statistical summaries of monthly mean maximum and mean minimum temperatures (°F and °C) and mean total rainfall amount (inches and millimeter) for 28 stations in India; mean daily maximum and minimum temperatures, hours of sunshine per day and % of possible and mean number of days with miscellaneous weather phenomena (fog, thunder, duststorms, hail, and squalls) based on 10 years of data for Safdarjung (Willingdon Civil Aerodrome); mean total amount of precipitation, total amount of precipitation in wettest month and driest month, maximum amount of precipitation in one day, and mean number of rainy days based on 60 years of data for Safdarjung; mean wet bulb temperature (50 years) at 0830 and 1730, mean wind speed (20 years) in knots, and wind direction frequency (20 years) in % at Safdarjung.

90. India. Meteorological Department. Radar weather studies in India. Proceedings of the Ninth Weather Radar Conference, Kansas City, Missouri, October 23-26, 1961. pp. 396-403. DAS M01.81 R12apr.

...Describes the installation of radar in India, the work done by India, and the program of future work.

91. Krishna, K. Some features of the topography of mean monthly 300-mb surface over India. Indian Journal of Meteorology and Geophysics, 12 (3): 481-486. Delhi, July 1961. DAS M(05) I39i.

...The range of variation of the monthly mean height of 300-mb surface over India suggests a threefold classification of the radiosonde stations in India. Little relation is seen between the highest mean maximum ground temperature and the highest mean height of 300-mb surface. This surface is practically level over whole of India from June to September and later during the year, slopes down from south to north from 70° N onwards, the slope increasing every month up to January and falling thereafter. Over South India there is very little annual variation. - Author's abstract.

92. Krishnan, A.; Pant, P.S.; Ananthakrishnan, R. Variability of upper winds over India. Indian Journal of Meteorology and Geophysics, 12 (3): 431-438. Delhi, July 1961. DAS M(05) I39i.

...Information about the normal upper winds as well as their variability with respect to direction and speed are useful factors for aviators. Based on normal upper winds at pibal stations in India and neighbourhood, the steadiness factor and the standard vector deviation have been computed at selected levels for four typical months, January, April, July, and October. Charts depicting these parameters have been prepared and the results discussed. - Authors' abstract.

93. Krishna Rao, P.R. Thunderstorm studies in India. Indian Journal of Meteorology and Geophysics, 12 (1): 3-6. Delhi, January 1961. DAS M(05) I39i.

...Consists of information on thunderstorms, severe thunderstorms, collection of thunderstorm data by the India Meteorological Department, the installation of weather radars at six aerodromes (Calcutta, Delhi, Bombay, Nagpur, Madras, and Gauhati) by the India Meteorological Department, the different characteristics of thunderstorms in different parts of India, and the forecasting of thunderstorms.

94. Kulshrestha, S.M., and Gupta, R.G. Some interesting observations of high level wind maxima in the atmosphere. Indian Journal of Meteorology and Geophysics, 12 (4): 678-681, October 1961. DAS M(05) I39i.

...Analyzes the wind data of six high-level cosmic ray balloon flights conducted at Hyderabad during March 1960. Each of these flights revealed the presence of two wind maxima.

95. Mitra, H., and Kulshrestha, S.M. Radar observations of tropical dust-storms. Proceedings of the Ninth Weather Radar Conference, Kansas City, Missouri, October 23-26, 1961. DAS MO1.81 R12pr.

...The paper describes some of the characteristics of radar echoes from tropical **duststorms** which occur over Northwest India during the period from March to June. - Authors' abstract.

96. Pandey, Suresh. The hot weather season in Bihar. Geographical Review of India, XXIII (3): 41-46. Calcutta, September 1961. DLC G1 .C17.

...Describes the pressure and winds, temperature, relative humidity, and precipitation in Bihar during the hot season (March-May). There are also tabular monthly (March-May) summaries of mean temperature, relative humidity, and rainfall amount at 7-16 stations.

97. Pandey, Suresh. The rainy season in Bihar. Geographical Review of India, XXIII (1):34-44. Calcutta, March 1961. DLC G1 .C17.

...Describes the general features of weather conditions at the beginning of the rainy season in Bihar, the burst of monsoon, pressure and wind, temperature, distribution of rainfall, and the effect of the typhoons on weather in the rainy season. The tables present monthly (June-September) mean temperature (°C) and normal total rainfall for 12-15 stations in Bihar.

98. Parthasarathy, K. and Singh, Gurbachan. Rainfall intensity-duration-frequencies for India, for local drainage design. Indian Journal of Meteorology and Geophysics, 12 (2):231-242. Delhi, April 1961. DAS M(05) I39i.

...Gives the results of an analysis to derive the rainfall data for designs of local drainage works. This paper discusses the methods of approach, the method of analysis, the rainfall data, and the use of

Source No. 98 continued

charts to obtain the design rainfall for local drainage work and presents the theoretical relations between intensity, duration, and frequency of rainfall.

99. Rai Sircar, N.C.,and Patil, C.D. Horizontal distribution of temperature over India in May during years of early, normal and late SW monsoon. Indian Journal of Meteorology and Geophysics, 12 (2): 377-381. Delhi, April 1961. DAS M(05) I39i.

...Examines the prevailing thermal patterns during the premonsoon months during a year in which the arrival of the monsoon was normal (1955), during a year when the arrival of the monsoon was unusually early (1956), and during a year when the arrival of the monsoon was unusually late (1957). Distinctive features are less marked at lower levels than at higher levels.

100. Rai Sircar, N.C.; Natarajan, T.R.; Joshi, A.R. On the relationship between 5-day mean 700-mb contour anomalies and 5-day mean surface temperature anomalies over the Indian region. Indian Journal of Meteorology and Geophysics, 12 (2): 273-278. Delhi, April 1961. DAS M(05) I39i.

...In this note, a study has been made of the geographical distribution of the correlation coefficients between 5-day mean 700-mb contour anomalies and 5-day mean surface temperature anomalies over the sub-continent of India during the winter season. It is seen that the two elements are positively correlated all over the above area. The correlation coefficients steadily increase northwestwards, the region with maximum value being located in west Rajasthan, north Gujarat, and the neighbourhood. Regression curves have been drawn for the stations Ahmedabad and Jodhpur lying in the above areas, and an objective method of forecasting 5-day mean surface temperatures from 5-day mean 700-mb charts has been suggested for these two stations. - Authors' abstract.

101. Ramakrishnan, K.P. and Venkiteshwaran, S.P. Wind power resources of India with particular reference to wind distribution. India (Republic), National Aeronautical Laboratory, Technical Note No. TN-WP-1-61. 15 pp. Bangalore, June 1961. DAS M(055) I39tec.

...Includes information on wind data from non-recording anemometers and from recording anemographs at meteorological observatories and stations, spells of low wind at individual stations, and highest gust speed at different stations in India. The summaries include tabular annual mean number of spells of low wind (≤ 8 kph) of

Source No. 101 continued

duration of 5-hour intervals from 1 to > 50 hours and annual duration of longest spell of low wind in hours at 12 stations in India based on data for 3-4 years; tabular annual maximum gust speed at 9 stations based on data up to the end of 1952; annual velocity-duration curves of 8 selected stations based on 3 years of data.

102. Raman, P.K., and Raghavan, K. Diurnal variation of thunderstorms in India during different seasons. Indian Journal of Meteorology and Geophysics, 12 (1): 115-130. Delhi, January 1961. DAS M(05) I39i.

...Studies the diurnal variation of thunderstorm occurrences over the Indian continent. There are descriptions of data, method of isoceraunic maps, the annual and seasonal distribution of thunderstorms, and general features of the area. The tables present seasonal (winter, hot weather, southwest monsoon, and post-monsoon) and annual total number of occurrences of thunderstorms, percentage frequency of occurrence of thunderstorms, and percentage probabilities of occurrence of thunderstorms for each 6-hourly period (0300-0900, 0900-1500, 1500-2100, and 2100-0300 IST) at 47 stations in India.

103. Ramana Murthy, Bh.V., and Biswas, K.R. Vertical growth and decay of convective cloud cells and associated precipitation rates at different levels. Indian Journal of Meteorology and Geophysics, 12 (1): 87-92. Delhi, January 1961. DAS M(05) I39i.

...Study, using radar, has been made of history of growth and decay, in the vertical, of convective rain cells around Delhi, and of associated variations in liquid water concentration or rate of precipitation release at different heights as judged from echo intensity measurements. Data relating to three such situations, typifying respectively rain from (a) warm, (b) moderately cold, and (c) very tall and highly supercooled (as in a severe thunderstorm) convective cloud are presented in this paper. One common feature noticed, namely, that the rise or fall in precipitation rate at each level follows closely a similar trend in variation of height of radar cloud top, needs to be given detailed consideration on the basis of suitable model of distribution of vertical currents within such a cell. Some tentative considerations have been given to this aspect of the problem. - Authors' abstract.

104. Ramdas, L.A. Crops and weather in India. 127 pp. New Delhi, 1961. DAS M:63 R169cr.

...Discusses the weather in relation to long-term as well as short-term planning of agriculture, weather risks, the new weather service for the farmer, the climate of the air layers near the ground, and the

Source No. 104 continued

coordinated crop weather scheme. The tables present seasonal and annual normal rainfall for 30 sub-divisions of India and Pakistan; date of establishment of the SW monsoon in 4 areas (Travancore-Cochin, S. Kanara, Ratnagiri, and Kolaba) along the west coast of India for each year (1891-1945) and over the period; normal rainfall for season (June-September) and number of abnormalities (floods and droughts) in 100 years in India; normal rainfall week by week during the year in 31 areas in India and Pakistan; normal maximum and minimum temperatures and relative humidity at 0800 at 5-day intervals in 30 sub-divisions of India and Pakistan; monthly mean radiation from the sun and sun-lit sky and duration of bright sunshine at Poona based on data for the period 1935-1942; monthly and annual average values of the actual number of hours of bright sunshine at 10 stations in India and 3 in Pakistan; monthly mean evaporation in 29 sub-divisions of Pakistan and India.

105. Rao, K.N., and Raman, P.K. Frequency of days of thunder in India. Indian Journal of Meteorology and Geophysics, 12 (1): 103-108. Delhi, January 1961. DAS M(05) I39i.

...The monthly and annual frequency of days of thunder in India are presented in the form of charts with brief descriptions. The most thundery areas in the country are Assam (extreme northeastern Assam with the highest annual frequency exceeding 100 days), Bengal, Orissa and the adjoining areas of Bihar. The least frequency (less than 10) occurs in western Saurashtra and Kutch. Kendrew's remarks on the frequency of thunder in India have been discussed. - Authors' abstract.

106. Roy, A.K.; Ramana Murthy, Bh.V.; Srivastava, R.C.; Khemani, L.T. Cloud seeding trials at Delhi during monsoon months, July to September (1957-59). Indian Journal of Meteorology and Geophysics, 12 (3): 401-412. Delhi, July 1961. DAS M(05) I39i.

...A programme of rainmaking trials during monsoon months (July to September), using the technique of dispersal in air of salt seeds of appropriate sizes from ground-based generators has been in operation at Delhi since 1957. The note presents the design and programme of the seeding trial, and the results obtained and experience gained in the course of the first three years of experimentation. -Authors' abstract.

107. Sen, S.N., and Basu, S.C. Premonsoon thunderstorms in Assam and synoptic conditions favourable for their occurrence. Indian Journal of Meteorology and Geophysics, 12 (1): 15-20. Delhi, January 1961. DAS M(05) I39i.

Source No. 107 continued

...Based on the weather charts for April and May during the period 1955-1959, the author attempts to determine the synoptic features favourable for the occurrence of premonsoon thunderstorms over Assam and to point out special characteristics of these thunderstorms in the Assam area. The table contains the number of occasions (<3, 3-6, 7-10, and >10) of premonsoon thunderstorms with different durations in the forenoon (0600-1200 IST), afternoon (1200-1800 IST), night (1800-2400 IST), and early morning (2400-0600 IST) of April and May during the period 1955-1959 at Mohanbari, North Lakhimpur, Jorhat, Tezpur, Gauhati, Rupsi, Agartala, Kumbhigram, and Imphal in Assam.

108. Srinivasan, V. Some cases of clear air turbulence. Indian Journal of Meteorology and Geophysics, 12 (2): 279-282. Delhi, April 1961. DAS M(05) I39i.

...Presents a few cases of turbulence in the clear air which were reported to the Meteorological Office at Dum Dum (Calcutta). These reports are described because of the synoptic situations associated with them and because such turbulence reports are received only occasionally.

109. Subbaramayya, Indugula. Studies on the Indian southwest monsoon. Thesis submitted to the Andhra University for the award of the degree of Doctor of Philosophy. 147 pp. December 1961. DAS MF2369.

...Part I on the study of the southwest monsoon circulation describes the general winds in the tropics from the surface to the stratosphere; explains the meaning of monsoons; reviews the monsoon theories; contains the methods of analyses followed for the study of the circulation in the lower troposphere during the monsoon period, presents the findings, and discusses the results; deals with the study of the circulation in the upper troposphere, the changes during the premonsoon period and the relations between the changes and the onset and advance of the monsoon in India; gives a general picture of the proposed meridional circulation in the South Asian regions; presents the merit of this proposed meridional circulation over the theory of Koteswaram. Part II on the Bay cyclones reviews briefly the results of important studies on tropical cyclones round the world; presents and discusses theories of cyclones and their motion; critically examines previous studies on Bay cyclones; gives the methods of analyses adopted for the study of the structure of the Bay depressions, and discusses the results and explains the associated weather in terms of three-dimensional circulation in the depression. Tables include (1) mean zonal and meridional components of wind at levels of 0.6, 1.5, 3.0, 4.5, 6.0 and 9.0 km. at 73 stations in India, Afghanistan, Pakistan,

Source No. 109 continued

Burma, and Ceylon and (2) radiosonde data for specific days during depressions for Madras, Visakhapatnam, Calcutta, and Chittagong.

110. Subramaniam, A.R. Some studies of aridity and droughts in the dry climatic zones of India. 178 pp. Thesis submitted to the Andhra University. December 1961. DAS MF2334.

...The discussion includes information on moisture factors in climatic studies, method of study and results of analysis of arid zones, semiarid zones, and dry subhumid zones. The appendix presents a climatic study of droughts in Peninsular India, climatic features of Andhra Pradesh, and climates and natural vegetation of Mysore State.

111. Williams, S.D. Frequency of thunderstorms in South India. Indian Journal of Meteorology and Geophysics, 12 (1): 131-133. Delhi, January 1961. DAS (05) I39i.

... In this paper the average frequency of thunderstorm days in the different states of South India, based on data for the yrs 1946-1956 has been discussed. Kerala State has the highest annual frequency of 57 while Madras has 37 and Mysore and Andhra Pradesh 29 each. In Madras State, there is a marked decrease of thunderstorm frequency along the coastal regions compared to the interior and this is very pronounced as one goes south. - Author's abstract.

1962

112. Banerji, S.K. Progress of meteorology in India. Science and Culture, 28(5): 197-204. Calcutta, May 1962. DLC QH1 .S35.

...Describes briefly the India Meteorological Department and its function, the observational network in India, Kodaikanal Observatory, Colaba and Alibag Magnetic Observatories, the Central Seismological Observatory at Shillong, administration of the India Meteorological Department, communication systems, the meteorological forecasts, research and publications, and meteorology in space research.

113. Basu, Amal. A stability index for thunderstorm forecasting over India. Indian Journal of Meteorology and Geophysics, 13 (1): 63-66. Delhi, January 1962. DAS M(05) I39i.

...Based on two radiosonde ascents per day computes the stability index by Showalter's method to determine to what extent this method could be applied successfully in forecasting thunderstorms over Delhi in the premonsoon months (April-June).

114. Chiplonkar, M.W.,& Karekar, R.N. Radio-meteorological thunderstorm formation. Journal of Scientific & Industrial Research, 21B (6): 273-275. New Delhi, June 1962. DNAL 475 J82.

...Statistical analyses of records of radio-meteorological thunderstorms on four selected frequency bands observed at Poona have been presented and discussed. The analysis has disclosed a new phenomenon, the radio-meteorological 'thunderstorm formation'. Twenty-seven of such thunderstorm formations have been observed at Poona during the period August 1956-December 1958 on the 85, 125, 175, and 455 kc/s bands. The results indicate (i) there is a significant difference in the characteristics of the formations observed during pre-July and post-July seasons; (ii) the order of magnitude of atmospherics activity with the frequency band, observed at this station and reported earlier, is the same as that for the start of the formation, and (iii) the duration of the formation increases practically linearly with the maximum activity, on all the frequencies. - Authors' abstract.

115. Dayal, E. The variation of Koppen's BW/BS boundary in N.W. India. The Indian Geographical Journal, XXXVII (3): 83-86, July-September 1962. Madras. DLC DS401 .I36.

...Examines the position of the arid zone boundary over a period of ten years (1950-1959) using Koppen's technique based on data for twenty-five stations and identifies the zone of variation over which the BW/BS boundary in northwest India fluctuates. The author's main purpose is to examine the spatial variation of arid conditions and not the individual climatic element separately. The conclusions reached from the analysis of the data are that the BW/BS boundary in northwest India fluctuates over a considerable area from year to year, the east-west variation is much more than the north-south and the yearly lines of the BW area in India show no trend in any particular direction. A table presents annual values for each year, 1950-1959, of total annual rainfall and critical rainfall for 25 Indian stations.

116. Dhar, N.C., and Mitra, H. Diurnal variation of upper air temperatures. Symposium on Meteorology in Relation to High-level Aviation over India and Surrounding Areas Held at Meterological Office, New Delhi, 7 December 1957, pp. 93-98. Delhi, 1962. DAS M:629.13 S989sy.

...The analysis made from a number of soundings taken at different hours of the day indicates that during April and May the upper air at New Delhi is generally warm during morning and cools down gradually reaching a minimum during noon and warms up again towards the afternoon. - Authors' abstract.

117. Gupta, I.P., and Tikka, R.N. The characteristics and frequency of weather types in the evenings and mornings of Uttar Pradesh. The National Geographical Journal of India, VIII (3-4): 215-227. September-December 1962. DAS M82.2/54 G977ch.

...In the present paper an attempt has been made to study the characteristics and frequency of weather types in the evenings and mornings of Uttar Pradesh. Gorakhpur, Allahabad, Agra, Roorkee, and Mussoorie have been selected and studied for this purpose. The results obtained and the analysis of the climatic comfort conditions have been presented. Instead of monthly means of the elements of weather, a long record at certain instants of time has been utilized. This way helpful in giving actual frequencies of various types of weather that occurred at a place at certain hours of the day. A scale for classification of weather types has been suggested. A record of 10 years was taken from Monthly Meteorological Registers of Meteorological Department of India for temperature, humidity, wind speed, and sunshine. The weather types have been prepared by finding out the class of each element at 8.00 A.M. & 5.00 P.M. from the suggested scale. It has been found that the frequent weather types in the plains and the hills in the rainy season are not comfortable in the mornings and evenings. The weather types of hills are more comfortable than those of plains, and the weather types of morning are more comfortable than those of evenings. Also the frequencies of bad weather types increase from western U.P. to Eastern U.P. Finally a brief account has been given of the air masses and their effect on weather types. - Authors' summary.

118. Gupta, S.L. Mohindergarh District in need of a centre for rain-making experiments. The Indian Geographical Journal, XXXVII (3): 87-90, July-September 1962. Madras. DLC DS401 .I36.

...Mohindergarh, Gurgaon, and Hissar Districts in India receive an annual average of about 12" of rainfall. The author describes the essential conditions for producing artificial rainfall and suggests the creation of a rain-making centre at Narnaul.

119. India. Central Statistical Organization. Statistical abstract, India. New Series, No. 1-12, 1949-1962. DLC HA1713 .A732.

...Contains summaries for each year of monthly (1948-1950, 1952-1962) and annual (1940-1962) total rainfall amount in 27-29 subdivisions of India; monthly and annual mean temperature for 27-54 subdivisions in India (1947, 1949-1962) and Pakistan (1947); monthly (1948-1950, 1952-1955) and annual (1946-1955) frequency in days of bright sunshine within limits (nil or trace, 0.1-3, 3.1-6, 6.1-9, and >9 hours), total

Source No. 119 continued

hours of sunshine, per cent of possible sunshine, maximum and minimum duration of sunshine with dates of occurrence at 11-18 stations in India and Kashmir; monthly maximum and minimum temperatures (1949, 1950, 1952-1962) at 37 stations; monthly mean relative humidity at 0830 and 1730 in 28-30 subdivisions of India.

120. India. Meteorological Department. Adverse weather conditions at airfields. Parts I and II. New Delhi, 1961 and 1962. DAS M:629.13 I39ad.

...Is a study of the simultaneous occurrence of adverse weather conditions at 45 airfields in India and Nepal and their alternates to determine the most suitable alternates to these airfields. This study was based primarily on five years of data for 1955-1959. The statistical data include monthly and annual summaries for the period (3-5 years within the period 1955-1960) and annual year by year summaries of poor visibility (visibility ≤ 3.2 km), low cloud (base $\leq$ 300 m., and amount >4 oktas), other phenomena (accompanied with poor visibility and/or low cloud ceiling), frequencies of occasions of adverse weather phenomena not associated with poor visibility or low cloud, and frequencies of occasions of all types of adverse weather phenomena at each main airfield as well as at alternate airfields.

121. India. Meteorological Department. Monthly and annual normals of rainfall and of rainy days based on records from 1901 to 1950. Memoirs of the India Meteorological Department, XXXI (3): 1-208. Delhi, 1962. DAS M(055) I39m.

...Contains monthly and annual rainfall normals and number of rainy days for 2693 raingauge stations which were in existence by the end of 1950, based on available data for the period 1901-1950.

122. India. Meteorological Department. Weather and the Indian farmer. Second edition. 39 pp. Poona, 1962. DAS M86:63. I39w 1962.

...Discusses the growth of weather science, weather lore in India, climate in relation to crop growth and yield, rainfall of India during the southwest monsoon, liability of India to floods and droughts, cyclonic storms and depressions, thunderstorms, hailstorms, duststorms, cold waves and frost hazard in India, heat waves, excessive or defective insolation, high winds, insurance against weather risks, the crop weather calendar, weather service for agriculture, phenology, and pests and diseases affecting crops in India and their relation to meteorological factors. A table presents seasonal and annual rainfall amounts in mm and % for 15 meteorological divisions and 31 meteorological sub-divisions in India.

123. Koteswaram, P. Jet streams over India and neighbourhood. Symposium on Meteorology in Relation to High-level Aviation over India and Surrounding Areas Held at Meteorological Office, New Delhi, 7 December 1957, pp. 101-108. Delhi, 1962. DAS M:629.13 S989sy.

...India is traversed by a westerly jet stream in the dry months (October to May) and an easterly jet stream during the southwest monsoon season (June-September). The mean location of these jet streams, their spatial extent, thermal and dynamical properties are indicated. The role of jet streams in the formation of local disturbances over the Indian area and the weather associated are briefly discussed. - Author's abstract.

124. Krishnan, A. Heights of base of low clouds over India. Indian Journal of Meteorology & Geophysics, 13 (Spl. No.): 31-38. Delhi, March 1962. DAS M(05) I39i. Special No.

...This paper, presented at the Symposium on Physics of Cloud and Rain in the Tropics held at Meteorological Office at Poona on 29 October-1 November 1960, contains tabular monthly percentage frequency of occurrence of low clouds during morning and afternoon and frequency of occurrence of low clouds covering 6-8 oktas during the morning and afternoon over 25 important aerodrome stations in India based on data collected during pibal ascents from 1937-1955. A table also gives variance ratios of heights of base of low clouds as estimated and as observed during the pilot balloom ascents along with number of observations under each category during morning and afternoon in July and August at 18 stations.

125. Mani, Anna; Swaminathan, M.S.; Venkiteshwaran, S.P. Distribution of sunshine and solar radiation over the Indian Peninsula. Indian Journal of Meteorology and Geophysics, 13 (2): 195-212. Delhi, April 1962. DAS M(05) I39i.

...Discusses the distribution of sunshine over the Indian subcontinent and the distribution of total solar radiation in India. The tables contain monthly and annual mean duration of bright sunshine per day, % of possible hours of bright sunshine and frequency of occurrence of bright sunshine of specified duration (0.1-3, 3.1-6, 6.1-9, and > 9 hours) at 15 stations in India and Kashmir for 6-8 years within the period 1948-1955.

126. Mani, Anna; Chacko, O.; Venkiteshwaran, S.P. Measurements of the total radiation from sun and sky in India during the IGY. Indian Journal of Meteorology and Geophysics, 13 (3): 337-366. Delhi, July 1962. DAS M(05) I39i.

Source No. 126 continued

...Summarizes the radiation data recorded during the IGY at Poona, Delhi, Calcutta, and Madras. This study contains a description of the instruments and exposure, discusses the standardization of the instruments and gives an analysis of the results. The tables present monthly (July 1957-December 1958) and annual (1958) summaries for Poona, New Delhi, Calcutta, and Madras of hours of possible sunshine, hours of actual sunshine per day, and % of possible sunshine; mean values of total radiation of sun and sky on a horizontal surface on all days and on clear, cloudy, and over cast days; mean values of total radiation from sun, sky, and ground on a spherical surface on all days and on clear, cloudy, and overcast days; % frequency distribution of daily values of total radiation for each month; mean hourly values of total radiation from sun and sky on a horizontal surface.

127. Mattimore, Norine Marie. Climatic regions of the subcontinent of India, a modified Köppen classification. Thesis (M.A.). Clark University, Worcester, Mass. 1962. DAS SF 1178.

...The object of this thesis is to construct a climatic map of the subcontinent of India using a modified Köppen classification system. The subcontinent includes India, Pakistan, and Ceylon. The first step in the construction of the map required a classification of a large number of stations according to the modified Köppen system. Then the generalized controls of the climate are discussed and the various climatic regions according to the modified system are described.

128. Natarajan, K.K. Horizontal convergence as a factor for forecasting fog or stratus. Indian Journal of Meteorology and Geophysics, 13 (3): 367-370. Delhi, July 1962. DAS M(05) I39i.

...Influence of horizontal convergence in the surface layers bounded by thermal inversion on formation of radiation fog at Palam, Santacruz, and Begumpet during the winter 1960-61 is studied in this note. - Author's abstract.

129. Nedungadi, T.M.K. Weather and circulation over India, February to April 1961. Chagnon, C.W. (ed.), Joint Indo-United States balloon flight program, 1961, pp. 105-117. December 1962. DAS MO7.321.2 C433jo.

...Briefly describes the climatic conditions over the Indian subcontinent with special reference to the area south of Latitude 25° N and the actual prevailing meteorological conditions during the period of these flights. Seasonal trends in weather, progress of weather during the period February-April 1961, normal circulation, flow features in February-April 1961, and subtropical jet stream are discussed.

130. Panchang, G.M., and Narayanan, R. Adequate numbers of raingauges for accurate estimation of mean depths. Journal of Central Board of Irrigation and Power, 19 (2): 94-107. New Delhi, February 1962. DAS P.

...For fixing the requisite number of raingauges in any river basin for the purpose of its hydrological study it is the usual practice, apart from topographical considerations, to compute the mean precipitation depths of the existing numbers of raingauges for the relevant period of interest. Such means are computed separately for a number of years and their stability or year-to-year variational extents studied.

Since the standard deviation has come into vogue as a measure of stability, its highest observed value from all the recorded numbers of years is picked out and set against the desired control magnitude for determining the increased number of raingauges necessary. In other words the relative magnitudes of all the other lower yearly observed values of the standard deviation are not assigned any useful role.

The paper outlines the use of the frequency analysis method of all the standard deviation values or the coefficient of variation (standard deviation/mean) values as better appropriate. The requisite estimates so derived are also shown to be relatively better consistent irrespective of the lengths of the data availed for the purpose, against the large inconsistencies obtaining of the estimates otherwise. This consistency aspect obtaining particularly from the use of the frequency analysis method thus immediately warrants greater confidence in the fair accuracy of the estimates as well as of the procedure. - Authors' abstract.

131. Pisharoty, P.R.; Asnani, G.C.; Pacheco, J.A. Horizontal wind shear and consequent instability associated with jet streams over India. Symposium on Meteorology in Relation to High-level Aviation over India and Surrounding Areas Held at Meteorological Office, New Delhi, 7 December 1957, pp. 117-126. Delhi, 1962. DAS M:629.13 S989sy.

...Analyzes the characteristics of wind maxima observed over India with the aid of actual winds on some consecutive days. The examination of the observed winds from the point of horizontal and vertical shears includes information on the source of data, the selection of the area, selection of the dates, times of observations, horizontal velocity, more detailed analysis for four days in each season, wind shear along the vertical, and geostrophic velocity. The authors also present the results of the study and the limitation of these results.

132. Raman, C.R.V. A tentative method of forecasting runway temperature for purpose of take-off of jet aircraft. Symposium on Meteorology in Relation to High-level Aviation over India and Surrounding Areas Held at Meteorological Office, New Delhi, 7 December 1957, pp. 23-30. Delhi, 1962. DAS M:629.13 S989sy.

...A study of the usefulness of the Stevenson Screen temperature under normal conditions of exposure for the estimation of runway temperature at engine height has been made by analysing the data for one year at Santacruz (Bombay) airfield of temperatures over taxi-tracks at different heights within and outside enclosures. Graphs showing mean monthly differences of temperature as well as mean seasonal differences have been presented. The results show that the former temperatures in all the seasons and at all times of the day be generally within 2°F of the Stevenson Screen enclosure temperatures. Under the influence of exceptional meteorological factors, the contrast has been found to be within 5°F (2.5°C). The usefulness of contrast graphs such as those presented in this paper for issue of engine level runway temperature forecasts with high degree of confidence to Jet pilots at different airfields is discussed. - Author's abstract.

133. Ramaswamy, C. Breaks in the Indian summer monsoon as a phenomenon of interaction between the easterly and the sub-tropical westerly jet streams. Tellus, 14 (3): 337-349. Uppsala, August 1962. DAS M(05) T277.

...The present paper contains the results of the study of a synoptic situation over India during a period of 8 days in which normal monsoon conditions were followed by a break and were further followed by a return to normal monsoon. This study has shown that during breaks in the monsoon, a trough in the middle latitude westerlies with a jet embedded in it increases considerably in its amplitude and gets retarded as it moves into the Tibetan Plateau on account of its entering a region of weaker basic current. The large-amplitude trough weakens or destroys completely the Tibetan high at the 500-mb level and appreciably weakens the easterlies at the higher levels to the south of the Himalayas. Protruding into India and Pakistan, the large amplitude trough contributes to the development of heavy rainfall along and near the foot of the Himalayas which is characteristic of the break conditions. The southward protrusion of the trough, and its subsequent movement eastward, is also indirectly responsible for a corresponding shift of the high over Iran and Arabia, which, in its turn, seems to lead to the formation of a secondary jet core in the easterlies west of 80°E between 20°N and 25°N. Consequent on the above developments, the westerly jet which had retreated to the north of the Himalayas at the time of the onset of the monsoon reenters the

Source No. 133 continued

Indo- Pakistan sub-continent during the breaks. Thus we see during break conditions the remarkable spectacle of two jets of entirely different types - the easterly and the sub-tropical westerly - within a short latitudinal distance of each other and dynamically interacting with each other.

The above detailed study, supplemented by a general examination of the monthly mean 700-mb charts for the northern hemisphere for a period of 10 years, suggests that active monsoon over India is closely associated with high index circulation in middle latitudes over Asia and neighbourhood, while weak monsoon is closely associated with low index circulation over the same region. - Author's abstract.

134. Rao, Y.P. Meridional circulation associated with the monsoons of India. Indian Journal of Meteorology and Geophysics, Delhi, 13 (2): 157-166, April 1962. DAS M(05) I39i.

...Meridional components in January and July at twelve Indian Rawin stations and Colombo, Nairobi, Aden, Bahrein, and Tashkent based on three years' data are presented. The centres of direct and indirect cells are located at higher elevations, probably to overcome the obstruction to meridional exchange from high mountain ranges running east to west. At Bahrein and Aden the upper southerlies of the direct cell are absent in winter. The direct cell retreats northward to near 30°N in July, and a 'monsoon cell' with lower southerlies and upper northerlies occupies the Indian area from 26 to 13°N. Northerlies at Colombo and Trivandrum in the lower troposphere in July suggest that the feed across the equator into the Arabian Sea branch of the monsoon may be extremely limited. - Author's abstract.

135. Roy, A.K. Rain stimulation experiments by present contemplated techniques of cloud nucleation. Indian Journal of Meteorology & Geophysics, 13 (Spl.No.): 219-225. Delhi, March 1962. DAS M(05) I39i Special No.

...Orientation suitably of microphysical condition of a cloud, with a view to accelerating the process of accretional or coalescence growth of cloud droplets to sizeable precipitation elements is the aim of present-day experiments on artificial rainmaking by techniques of cloud nucleation. How far the method employed may succeed in effecting significant quantitative results depends, amongst others, on two important factors governing cloud life (i) aerosol content of air determining concentration and size distribution of cloud droplets, and (ii) nature of air motion controlling build up of cloud. Large variability of both these parameters in different cloud situations make quantitative determination of results of seeding experiments difficult and uncertain. The points as above are discussed with reference to some of the reported results of seeding experiments

conducted in different countries, including those carried out at the National Physical Laboratory, New Delhi.

Certain alternative scientific methods of rain stimulation in clouds proposed in recent years are discussed briefly. - Author's abstract.

136. Sreenivasaiah, B.N., and Ramakrishnan, K.P. Upper air climatology of India in relation to high-level flying. Symposium on Meteorology in Relation to High-level Aviation over India and Surrounding Areas Held at Meteorological Office, New Delhi, 7 December 1957, pp. 75-92. Delhi, 1962. DAS M:629.13 S989sy.

...The paper presents and discusses: (i) The normal distribution of temperature at levels of 300 and 200 mb (30,000 and 40,000 ft) in four representative months, January, April, July, and October over India and neighbourhood, (ii) The variability of temperature at 300 and 200 mb in the four representative months at selected stations, (iii) The normal distribution of wind, based on pilot balloon and available radar/rawin data at the heights of 10 and 12 km, which nearly correspond to the pressure levels of 300 and 200 mb, (iv) Day-to day winds obtained from rawin ascents in winter months in Delhi and Calcutta and during the monsoon months in Bombay and Madras, and (v) The general pattern of the freezing level. - Authors' abstract.

137. Subba Rao, B., and Subrahmanyam, V.P. A climatic study of arid zones in the central Deccan. Proceedings of the National Institute of Sciences of India, 28 A (4): 568-572. New Delhi, July 1962. DGS S(640) N2lip.

...Identification of arid and semi-arid regions on a climatic basis is the first essential step in any project of land reclamation for agricultural and other purposes. In the delineation of climatic zones and the delimitation of their boundaries, schemes of de Martonne, Köppen, and Thornthwaite found wide application and, in particular, Thornthwaite's method of 1948 has been recognized to be a standard for the classification of climates, both regional and global. His modified scheme of 1955 placed a very powerful tool in the hands of the climatologist for such analytical studies, and the present paper is an attempt at understanding the arid conditions of the central Deccan according to this scheme.

Available data of temperature and precipitation for a large number of stations were used for this study, and the water-needs of stations for which precipitations alone were available were carefully determined by the graphical techniques proposed by Carter. Cartographic analysis of the water-balances of the region showed, beyond doubt, existence of absolute arid conditions in the central portion of peninsular

Source No. 137 continued

India, and this feature is also supported by the ecological studies on the distribution of natural vegetation.

Investigation according to de Martonne's scheme, too, confirmed the conclusions from the above analysis. Coincidences between the climatic indices of Thornthwaite and of de Martonne for the arid zone of the Deccan seem to lend strong support to Bhatia's results of study in the Rajasthan region. - Authors' abstract.

138. Subrahmanyam, V.P., and Subramaniam, A.R. Climatic features of Andhra Pradesh. Journal of the Indian Society of Soil Science, 10 (2): 129-153. June 1962. DGS S(640) In27j.

...Discusses the general climatic features, winds, air masses, rainfall, temperature, climates, and water balance of Andhra Pradesh. A table presents annual water need (cm.), water surplus, water deficiency, moisture index, moisture climatic type and subtype, summer concentration, and thermal climatic type and subtype at 16 stations.

139. Visvanathan, T.R., and Faria, F.J. A climatological study of thunderstorms at Bombay Airport. Indian Journal of Meteorology and Geophysics, 13 (3): 377-382. Delhi, July 1962. DAS M(05) I39i.

...A study has been made of thunderstorms and the occurrence of Cb clouds over Bombay (Santacruz) Airport for the decade 1950 to 1959. Statistics have been collected giving the monthly frequency of days of occurrence of thunderstorms in each of the years 1950 to 1959 and also of thunderstorms and thundery conditions (i.e., occurrence of Cb) for the same period. The diurnal distribution of thunderstorm activity, i.e., thundery conditions and of thunderstorms of each of the months has been discussed, and the duration of such activity in each month has been classified. The diurnal distribution of the time of commencement of thunderstorms for each month has been tabulated. The synoptic situations connected with typical cases of thunderstorms have been referred to. - Authors' abstract.

140. World Meteorological Organization. Climatological normals (CLINO) for climat and climat ship stations for the period 1931-1960. WMO - No. 117 TP 52. Geneva, 1962. DAS M(06) W927p.

...Records monthly and annual summaries over specified periods (vary by station and element but within the period 1931-1960) at 40-44 stations in India of mean pressure, mean temperature, mean relative humidity, mean total amount of precipitation, and precipitation frequency.

141. Ananthakrishnan, R., and Rangarajan, S. Inversions and stable layers in the free atmosphere over India-Part I. Indian Journal of Meteorology and Geophysics, 14 (2): 173-189. Delhi, April 1963. DAS M(05) I39i.

...Is a study of the incidence of inversions and stable lapse rates in the free atmosphere over India based on data during the 5-year period 1956-1960 at 5 stations (Trivandrum, Port Blair, Madras, Visakhapatam, and Bombay) south of latitude 20°N. The authors describe the data used, the method of analysis, and the results. The tables present monthly summaries over the period (1956-1960) of percentage frequencies of bases of stable layers at 0000 and 1200 Z and frequencies of stable layers of various thicknesses for the 5 stations.

142. Anjaneyulu, T.S.S, and Sikka, D.R. Equatorward extension of troughs in the upper westerlies and the relation of upper tropospheric flow to onset of monsoon rains over India. U.S. National Science Foundation, India Meteorological Department and U.S. Information Service, Preliminary Results and Future Plans of the International Indian Ocean Expedition Meteorology Programme, Proceedings of a Seminar held in Bombay on 1 August 1963. pp. 68-79. October 1963. DAS M:551.46 U585pre.

...Daily 200-mb streamline charts for the months of March through May occasionally show large equatorward extension of troughs in upper westerlies. The possible effects of the troughs on surface weather during their eastward passage are briefly discussed.

The difference between mean circulation over India and neighbourhood during April and May 1963 and the normal April and May circulation is discussed. Mean 200-mb level winds during May 1963 have been studied more critically to show the suddenness of changes in upper tropospheric circulation pattern during the second half of the month. Mean zonal and meridional components of winds at 200 mb over India and neighbourhood have been studied to determine possible relationships between the perturbations in the westerlies at that level in the transition season and the onset of summer monsoon over India. - Authors' abstract.

143. Chakravorty, K.C., and Das Gupta, Brij Ratan. "Interesting meteorological features of Varanasi." The Journal of Scientific Research of the Banaras Hindu University, XIII (2): 267-282. June 1963. DGS S(640) J823 v.13, no. 2.

...Discusses the rainfall, temperatures, relative humidity and vapor pressure, clouds, wind direction and speed, pressure, and important

Source No. 143 continued

weather phenomena. Tables present monthly prevailing wind direction at Varanasi for morning and for afternoon and monthly and annual number of days with thunder, hail, dust storms, and fog in the Varanasi area.

144. Gangopadhyaya, M.; Sreenivasan, P.S.; Venkataraman, R. Some characteristics of the average monsoon rainfall along the coasts of India and Burma. Australian Meteorological Magazine, 41:23-41. Melbourne, June 1963. DAS M(05) A938.

...The rainfall during the southwest monsoon season of India and its neighbourhood is not uniformly distributed over the various stations along the coasts nor uniform throughout the season. With a view to study whether the pulsatory character is reflected on the average, a detailed study of the five-day normal rainfall is made for stations located on the east and west coasts of India and the Burma coast.

From a preliminary study of the rainfall intensity and distribution, it is found that the stations can be classified broadly into six groups with sub-groups in some of them. The groups and sub-groups are:

1 (i) Tenasserim Coast, (ii) Arakan Coast; 2 (i) Deltaic Burma Coast, (ii) Bengal and East Pakistan Coast; 3 Orissa Coast; 4 (i) East Coast (North), (ii) East Coast (South); 5 (i) West Coast (South), (ii) West Coast (North); 6 Kathiwar and West Pakistan Coast.

The characteristics of the rainfall at representative stations of these groups, as brought out by fitting orthogonal polynomials of the fifth degree, are discussed in the light of average synoptic climatology and topography. - Authors' abstract.

145. India. Meteorological Department. Annual report on agricultural meteorology..., 1935/1937-1939/1940, 1943/1944-1945/1946, 1948/1949-1962/1963. Title varies. Poona. DNAL 346 In2.

...Reviews the chief features of the work of the Agricultural Meteorology Division of the India Meteorological Department, the experimental work at the Central Agricultural Observatory at Poona, and the coordinated crop-weather stations for each agricultural year; analyzes past meteorological statistics with its bearing on agricultural problems; lists publications prepared by staff for each agricultural year. The tables contain summaries of rainfall, grass minimum temperature, air and soil temperatures, sunshine duration, global radiation, evaporation, and dew. Most of the summaries are for Poona. Periods of record vary by element.

146. Jagannathan, P., and Ramamurthi, K.M. Contingency technique applied to medium range forecasting of rainfall during the monsoon season in India. Australian Meteorological Magazine, no. 41, pp. 42-61. Melbourne, June 1963. DAS M(05) A938.

...In India daily weather forecasts for the use of farmers are being issued since 1945. The utility of these forecasts will be considerably enhanced if dependable forecasts can be issued 5 to 7 days ahead. Investigations have been initiated for the development of a technique for medium-range forecasting of rainfall.

The paper reports the pilot study made for predicting the rainfall during during the "standard pentads" of the southwest monsoon months.

Contingency tables have been prepared with 5-day rainfalls over Bombay classed as "Normal," "Abnormal," or "Subnormal" against similarly classified "antecedent weather factors" one or two pentads prior to the pentad to which the rainfall relates. The factors were chosen on the basis of the flow patterns revealed in composite 5-day mean charts relating to the pentad 5 or 10 days prior to the regime of abnormal or subnormal rainfall. This technique provides a method of selecting significant factors without making a search for them indiscriminately and also suggests some physical meaning. Further, composite charts for different levels (850, 700, 500, and 400 mb) when prepared provide a ready method of checking for comparative suitability of the different levels for forecasting purposes.

The contingency technique developed has been tested on independant data and "skill scores" calculated on the basis of marks alloted to "correct forecasts,""forecasts wrong by one stage", and "forecasts wrong by two stages."

5-day mean composite charts corresponding to the period of onset of the southwest monsoon over Bombay have revealed certain interesting changes in circulation patterns, and these are also discussed. - Authors' abstract.

147. Jagannathan, P., and Khambete, N.N. Seasonal oscillation of the diurnal range of temperature in India and neighbourhood. Indian Journal of Meteorology and Geophysics, 14 (4): 389-402. Delhi, October 1963. DAS M(05) I39i.

...Considers the diurnal range of temperature and the factors affecting the range in India and neighborhood. This paper presents information on the scope of the study and data, graduation of the seasonal march, mean daily range, and annual range of daily range of temperature. The table includes mean diurnal range of temperature, the amplitudes and phase angles of the annual and half-yearly oscillations together with

Source No. 147 continued

the percentage of seasonal variation left unaccounted after the first two harmonics have been fitted for 166 stations in India and Pakistan and for Kathmandu in Nepal.

148. Koteswaram, P., and Bhaskara Rao, N.S. Formation and structure of Indian summer monsoon depressions. Australian Meteorological Magazine, no. 41, pp. 62-75. Melbourne, June 1963. DAS M(05) A938.

...Tropical depressions forming in the monsoon trough over India have characteristics somewhat different from their counterparts over the other tropical oceanic areas and have long been believed to be similar in structure to extratropical cyclones. The formation and structure of some monsoon depressions that have been examined generally agree with the pattern suggested earlier by Koteswaram and George (1958, 1960). They form in the monsoon trough over the north Bay of Bengal, under the influence of divergence aloft associated with a perturbation in the upper easterlies over this area. Along with condensation heat released in the monsoon trough, thermal advection seems to take a part in the maintenance and movement of the depression as well as in the asymmetrical distribution of heavy rainfall which is confined to the south-west sector. It is concluded that the mechanism of the monsoon depression is similar to its extratropical counterpart, though no fronts or strong air mass contrasts exist. The circulation derives energy from the thermal gradient due to the differential heating of land and sea areas and is then maintained even during its long trek over land till it breaks up over the Himalayan mountains or the deserts of northwest India and west Pakistan. - Authors' abstract.

149. Nedungadi, T.M.K. Heavy rain spells during the strong monsoon of 1961. India (Republic). Institute of Tropical Meteorology, Technical Paper No. TP-5-64. 7 pp. Poona, November 1963. DAS M(055) I391te TP-5-64.

...The total water that fell over India during the southwest monsoon season in each of the years 1957 to 1963 is computed, and the years are arranged in decreasing order of monsoon strength as 1961, 1959, 1958, 1963, 1960, 1962, and 1957. The volume of water that fell over the country in each year from June to September varied between 2.7×10^{12} and 2.1×10^{12} cubic metres in this period. The mean daily precipitation in respect of the strongest monsoon year 1961 has been worked out for each meteorological division for the period May to October and represented on a diagram along with all the flood reports. Such diagrams afford a convenient way of seeing at a glance the time and space distribution of intensity and length of all heavy rain spells that contributed to these floods. - Author's abstract.

150. Padhye, S.S. Climate of the Deccan trap regions of Vidarbha. The Indian Geographical Journal, XXXVIII (3&4): 79-89, July-September and October-December 1963. Madras. DLC DS401 .I36.

...Discusses the diurnal, monthly, seasonal, annual, and cyclic variation of climate and the regional differentiation of climate both in time and space in the trap region of Vidarbha, which lies between 19°26'N and 21°47'N and 75°56'E and 79°28'E.

151. Pant, P.S., and Vernekar, A.D. A study of the onset of monsoon over India. Proceedings of IGY Symposium, February 13-16, 1961, New Delhi, 2:20-41. New Delhi, 1963. DAS 551 I61pro.

...The onset of the monsoon during the years 1957-1959 has been examined. Meteorological data relating to 850 mb. level have been mainly considered, as this level is high enough to be free from local effects and low enough to be in the monsoon air, when it is just setting in and is not too deep. All the normally measured meteorological elements, namely temperature, humidity, wind speed and direction, and a few derived qualities, like lapse-rate, wet bulb potential temperature, have been examined.

The study broadly indicates that in the south the onset of monsoon does not result in a conspicuous change in the temperature and humidity of the air mass. The only characteristic change that comes over is the setting in of westerlies which are extremely steady and which can normally be separated from the winds existing earlier. Further north, especially at the interior stations, there is a conspicuous change in the thermal properties accompanied by rise in humidity.

Detailed discussion of onset of monsoon at some stations is presented. - Authors' abstract.

152. Pant, P.S. Upper tropospheric circulation over India. Proceedings of IGY Symposium, February 13-16, 1961, New Delhi, 2: 7-19. New Delhi, 1963. DAS 551 I61pro.

...Meridional sections along 80° E depicting the month-to-month variation during 1958 of winds and temperatures have been prepared for the levels 9, 10.5, 12, 14, and 16 km. Charts showing streamlines and isotachs for the same levels and for the months January, April, July, and October (representative of the four seasons) have been drawn. Corresponding sections and charts based on normal upper winds and temperatures have also been prepared.

On the basis of these charts the upper tropospheric circulation has been discussed with special reference to the onset and withdrawal of strong westerly and easterly winds of jet magnitude. The position

of region of strongest winds, the horizontal and vertical shears associated with these winds, and the characteristics of the tropopause have been examined. A few case studies during IGY period have also been presented. - Author's abstract.

153. Rai Sircar, N.C., and Datar, S.V. Cold waves in northwest India. Indian Journal of Meteorology & Geophysics, 14 (3): 315-319. Delhi, July 1963. DAS M(05) I39i.

...During the winter months, northwest India experiences cold waves after the passage of western disturbances across the same area. These cold waves may be broadly classified under two categories, viz., (1) dry cold waves and (2) moist cold waves. When the area is in the grip of a dry cold wave, there is no deterioration in the morning visibility and the aviation activity is not affected in any way. On the other hand, widespread fog occurs in the area when it experiences moist cold wave and this dislocates air traffic very badly. In the note, the conditions favourable for occurrence of dry fog as well as moist fog have been discussed and illustrated. The typical instances included in the note will be found useful to forecaster in predicting for occurrences of widespread fog of persisting type in NW India. - Authors' abstract.

154. Rai Sircar, N.C., and Varghese, K.P. A study of high level clear air turbulence reports received from aircraft. Indian Journal of Meteorology and Geophysics, 14 (4): 433-440. Delhi, October 1963. DAS M(05) I39i.

...In this paper, a study has been made of the high level clear air turbulence reports received from jet aircraft in relation to the wind field at the cruising levels. It is seen that such turbulence is mainly experienced near trough lines and in areas having large east-west wind gradient. Charts showing the various types of situations leading to the generation of the clear air turbulence have been presented and discussed in some detail. The illustrations may be of use to forecasters in indicating this hazard in weather forecasts supplied for the operations of jet aircraft on the international routes passing over Bombay. - Authors' abstract.

155. Rangarajan, S., and Sikka, D.R. Diurnal variation of upper air temperatures over India. Indian Journal of Meteorology and Geophysics, 14 (3): 261-269. Delhi, July 1963. DAS M(05) I39i.

...A statistical study of the diurnal variation of upper air temperatures over India is made utilising radiosonde data of four stations for four standard hours of the day and covering four representative months.

Source No. 155 continued

A marked difference in the pattern of diurnal variation is found between a continental station like New Delhi and the three coastal stations - Bombay, Calcutta, and Madras. Significant diurnal variations are found over New Delhi up to 1 to 3 km depending on the season, the mean daily range being about 1 to 2°C in most cases. On the other hand, diurnal variations at the coastal stations extend higher up to 4-6 km, the amplitudes being of the same order. Apparent diurnal variations found at still higher levels are probably due to inadequacy of radiation corrections. Nocturnal cooling of the atmosphere between 600-and 400-mb levels is found to be in the range of 0.1 to 0.15° per hour. - Authors' abstract.

156. Rao, K.N., and Jagannathan, P. Climatic changes in India. Proceedings of the Rome Symposium Organized by Unesco and WMO, Changes of Climate, pp. 49-66. Paris, 1963. DAS M83 R763ch.

...In the first section Rao describes the methods for the study of climatic changes and trends in Madras rainfall, and in the second part Rao and Jagannathan discuss the rainfall of the Rajasthan, Gujarat State, Hyderabad State, and of the Tamilnad and at individual stations. Tables with mean rainfall amounts, coefficients of variation, standard deviations, and greatest and least amounts of rainfall are included for 33-56 stations in India.

157. Rao, K.V. A study of the Indian northeast monsoon season. Indian Journal of Meteorology and Geophysics, 14 (2): 143-155. Delhi, April 1963. DAS M(05) I39i.

...Is a study to ascertain whether there are any distingushing features in the large-scale flow pattern over the entire northern hemisphere at the 500-mb surface, which characterize good and weak northeast monsoon seasons. This is based on the Hovmöller diagram for a year (1946) with good northeast monsoon rains and a year (1949) representing defective monsoon rains. The discussion includes information on the preparation of Hovmöller diagrams, northeast monsoon in relation to 500-mb pattern outside the Indian region, northeast monsoon in relation to the 500-mb pattern over India, some theoretical considerations, and conclusions.

158. Singh, M.S. Upper air circulation associated with a western disturbance. Indian Journal of Meteorology and Geophysics, Delhi, 14 (2): 156-172, April 1963. DAS M(05) I39i.

...Upper tropospheric circulation associated with the development of a western disturbance which was active over India and Pakistan from 28 to 31 December 1960 has been studied with the help of the Asian charts. It was observed that between 26th and 28th a meridional type

Source No. 158 continued

circulation developed at 300-mb level in the Middle-East and the South-Russian Region. As a result, the upper air trough in the westerlies extended deep into the north Arabian Sea and a strong north-westerly jet developed upstream of this trough by the 28th. It was on this day that a feeble western disturbance along Makran coast intensified. On the 29th the meridional circulation at 300-mb level was destroyed. Probable causes of these developments in the upper air as well as at the surface have been discussed. - Author's abstract.

159. Srinivasan, V., and Mathur, M.B. Central Indian and peninsula thunderstorms during the premonsoon season. U.S. National Science Foundation, India Meteorological Department and U.S. Information Service, Preliminary Results and Future Plans of the International Indian Ocean Expedition Meteorology Programme, Proceedings of a Seminar Held in Bombay on 1 August 1963. pp. 42-56. October 1963. DAS M:551.46 U585pre.

...Part I consists of a discussion on the thunderstorms over the south Indian Peninsula from March to May by V. Srinivasan. Table I presents conditions accompanying good and weak thunderstorm activity over the Indian Peninsula.

Part II is a study by M.B. Mathur on premonsoon thunderstorms over central India. The author's abstract is, as follow: "The positions of the axes of jet maxima affect weather over central India in the premonsoon season. This region is the seat of good thunderstorm activity, when jet maxima and the subtropical anticyclone lie south of their normal positions. Activity of westerly waves is also enhanced in such cases."

160. Subrahmanyam, V.P. Continentality trends over India and the neighbourhood. Indian Journal of Meteorology and Geophysics, 14 (3): 334-338. Delhi, July 1963. DAS M(05) I39i.

...Studies the geographical distribution of the continentality factor K* (ratio of the actual to expected summer concentration of thermal efficiency in %) as also its altitudinal variation. This study is based on data for about 250 stations in India, Pakistan, Burma, and Ceylon.

161. Tikka, R.N. The delimitation of the climatic regions of Uttar Pradesh. The Geographical Review of India, XXV (2): 73-83. Calcutta, June 1963. DLC G1 .C17.

...Summarizes the earlier works in the classification of climate, applies Thornthwaite's method for the classification of climate to Uttar Pradesh, gives the results obtained by Thornthwaite's method, and describes the

determination of finer subregions in Uttar Pradesh. A table contains computed climatic types at representative stations based on Thornthwaite's 1955 method.

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162. Ananthakrishnan, R., and Rao, K.V. Diurnal variation of low level circulation over India. Proceedings of the Symposium on Tropical Meteorology, Rotorua, New Zealand, 5-13 November 1963, pp. 89-95. Wellington, 1964. DAS M15.5 S89pr.

...Discusses the seasonal changes in circulation, diurnal changes in circulation, and sea-level pressure and wind patterns over India.

163. Ananthakrishnan, R., and Rajagopalachari, P.J. Pattern of monsoon rainfall distribution over India and neighbourhood. Proceedings of the Symposium on Tropical Meteorology, Rotorua, New Zealand, 5-13 November 1963, pp. 192-206. Wellington, N.Z., 1964. DAS M15.5 S89pr.

...The five-day normal rainfalls of 60 selected stations for the 50-year period 1901 to 1950 have been utilised for the study of the pattern of monsoon rainfall over the area between 8°N to 35°N and 67° E to 95° E. Beginning from the end of May a rising trend is shown by the rainfall curves of most of the stations. In respect of the stations on the west coast of peninsular India the rise is extremely steep and the peak is attained by about the middle of June. The slope of the rainfall curve is much less and the maximum very flat in respect of stations in North-East India. Stations in the central and northern parts of India experience the peak of rainfall activity by the middle of August. There is thus an interval of two months between the attainment of the peak rainfall at stations on the west coast of South India and those over the plains in North India. These facts are considered in relation to the onset and advance of the south-west monsoon. The rainfall patterns of two island stations, Minicoy and Port Blair, the first of which lies in the path of Arabian Sea branch of the monsoon current and the second in the Bay of Bengal branch of the monsoon current are presented and discussed. - Authors' abstract.

164. Ananthakrishnan, R., and Ramakrishnan, A.R. Perturbations of the general circulation over India and neighbourhood. Proceedings of the Symposium on Tropical Meteorology, Rotorua, New Zealand, 5-13 November 1963, pp. 144-159. Wellington, 1964. DAS M15.5 S89pr.

...The general upper air circulation over India and neighbourhood consists of a summer circulation from end of May to the beginning of October and a winter circulation during the period from October to May. The transition from the winter to the summer circulation which takes place rather abruptly in the second half of May ushers in the

southwest monsoon over the country; the onset of the winter circulation brings about the withdrawal of the monsoon from North India and the central parts of the country. Large-scale perturbations in the normal flow patterns occur in both the winter and summer months. The nature of these perturbations and the dynamical and thermodynamical features associated with them are discussed on the basis of case studies. - Authors' abstract.

165. Ananthakrishnan, R., and Rangarajan, S. Some features of the thermal structure of the atmosphere over India and neighbourhood. Proceedings of the Symposium on Tropical Meteorology, Rotorua, New Zealand, 5-13 November 1963, pp. 62-71. Wellington, 1964. DAS M15.5 S89pr.

...Deals with the contrasting features of the mean thermal structure of the troposphere and lower stratosphere over India and adjacent areas during the winter and summer seasons, the characteristics of the tropopause over the area, and the incidence of inversions and layers of stable lapse rate in the lower troposphere and their relationship with the meridional component of the general circulation over the Indian region.

166. Ananthakrishnan, R., and Ramakrishnan, A.R. Vertical variation of the constancy of upper winds over India. Indian Journal of Meteorology & Geophysics, Delhi, 15(3): 359-374, July 1964. DAS M(05) I39i.

...Examines the variability of upper winds at 12 rawin stations in India, describes the features of individual stations in the order of increasing latitude, and presents tabular summaries of resultant wind speed (knots), resultant wind direction in degrees, and the wind constancy (%) at levels of 6.0, 7.2, 9.0, 10.5, 12.0, 14.1, 16.2, and 18.0 km for January and July at the 12 rawin stations based on data for 4-10 years during the period 1951-1960.

167. Asnani, G.C., and Umamaheswara Rao, A. Seasonal changes in the circulation pattern over India and neighbourhood. Proceedings of the Symposium on Tropical Meteorology, Rotorua, New Zealand, 5-13 November 1963, pp. 207-215. Wellington, N.Z., 1964. DAS M15.5 S89pr.

...Based on monthly means of observations during the IGY year 1958, time-sections are presented for the four meridians 20°E, 80°E, 180°, and 80°W extending from latitude 60°S to 60°N. Important differences in these sections, apparently due to land and sea contrasts, are highlighted. The Indian radiosonde data, averaged for two different months January and July, are used to calculate various measures of vertical stability. The Indian pibal and rawin data for January are used to evaluate horizontal and vertical wind shears. It is found that

Source No. 167 continued

the ratio of the relative vorticity to the coriolis parameter is constant for a given level on the anticyclonic side of the westerly wind maximum. Brief reference is made to the applicability of geostrophic assumption to the mean January flow over India south of 20°N. - Authors' abstract.

168. Bryson, Reid A.; Wilson, Clayton W., III; Kuhn, Peter M. Some preliminary results from radiation sonde ascents over India. Proceedings of the Symposium on Tropical Meteorology, Rotorua, New Zealand, 5-13 November 1963, pp. 507-516. Wellington, N.Z., 1964. DAS M15.5 S89pr.

...A programme of radiation sounding of the Indian atmosphere was initiated in April 1963 as a joint effort of the University of Wisconsin and the Indian Meteorological Department. Results to date contribute to the elucidation of two problems, both concerned with non-gaseous radiators. (1) Over a very large area of south Asia during at least the pre-monsoon season there exists a deep, dense layer of haze. Visual observations indicate that it may be in excess of 30,000 feet deep. The Suomi-Kuhn radiation-sonde observations suggest that the emission from the dust is comparable in importance to that of carbon dioxide and a significant fraction of that due to water vapour. (2) Scattered observations over the past two decades suggest a high frequency of occurrence of a tenuous Cirrus layer near the tropopause over large parts of the tropics. Rather clear evidence of this Cirrus sheet was obtained on some soundings. - Authors' abstract.

169. Deshpande, D.V. Heights of Cb clouds over India during the southwest monsoon season. Indian Journal of Meteorology & Geophysics, 15(1): 47-54. Delhi, January 1964. DAS M(05) I39i.

...Is a study on the development of Cb clouds over India during the southwest monsoon (June-September). These clouds constitute a hazard to flying. The author discusses the data used in this study, analyzes the data, presents 3 typical synoptic situations and gives conclusions. The tables present frequencies of heights of Cb tops over India during the monsoon season and for each month (June-September) summarized over the period 1957-1962; comparative percentage frequency distribution of heights of Cb tops during June-September summarized from aircraft reports (South Asia) during 1952-53, radar study (North India) during 1958-59, and aircraft reports (India) during 1957-1962; frequency distribution of Cb tops over India at different periods of the day (0000-0600, 0600-1200, 1200-1800, and 1800-2400Z); percentage frequency of Cb heights for southern India (south of 20°N), central India (20°-25°N), and northern India (north of 25°N).

170. Flohn, Hermann. Investigations on the tropical easterly wave (Untersuchungen über die tropische Ost-Strahlströmung). Bonner Meteorologishe Abhandlungen, Heft 4 (1964). 83 pp. Bonn. DAS M(055) B716bon Heft 4.

...Discusses the upper wind climatology of south Asia, meridional temperature cross sections, dynamics of the tropical easterly jet, the role of the tropical easterly jet in the general atmospheric circulation, and the synoptic behavior of the tropical easterly jet above India. The tables contain for 1-12 stations in India summaries for specified periods of July-August average temperatures at levels of 850, 700, 500, 300, 200, and 100 mb ; July-August resultant winds at levels of 200, 150, and 100 mb ; July-August zonal temperature cross-sections along 25°N at 850, 700, 500, 300, and 200-mb. levels; July-August temperature distribution along the thermal equator at 850, 700, 500, 300, 200, and 100-mb levels; July and August statistical wind parameters (direction and velocity of resultant wind).

171. France, Myrtle D. Climatological density data for forty Eurasian stations. U.S. Naval Weapons Laboratory, Dahlgren, Virginia, Report No. 1909. March 23, 1964. DAS M(055) U586re.

...Includes seasonal air density means and standard deviations in kilograms per cubic meter by geometric heights in meters with correlation between heights at New Delhi, Jodhpur, and Calcutta.

172. Kulshrestha, S.M., and Gupta, M.G. Satellite study of an inland monsoon depression. Indian Journal of Meteorology & Geophysics, 15 (2): 175-182. Delhi, April 1964. DAS M(05) I39i.

...This study describes and discusses an inland deep depression of the Indian southwest monsoon season with special reference to the associated cloud structure and rainfall pattern on 20 September 1962 and the considerations which governed the recurvature which was most pronounced on that date. In addition to the conventional synoptic data, use has been made of the observations obtained from TIROS VI satellite cameras. This is the first satellite study of an inland depression over India. - Authors' abstract.

173. Kulshrestha, Shashi M. A preliminary study of the surface distribution of absolute humidity over the Indian Sub-continent. U.S. National Bureau of Standards, Report, NBS Report 8463. 15 pp. Boulder, Colorado, October 1964. DAS 600 U585re.

Source No. 173 continued

...Is a study on the surface-distribution of absolute humidity and its climatic variation over the Indian subcontinent (India, Pakistan, and Burma). This report presents mean absolute humidities (gm/m^3) and maximum range of variation of absolute humidities based on 5 years (1959-1963) of data for January, May, August, and November for 13 stations in Pakistan, 36 stations in India, and 4 stations in Burma.

174. Pant, P.S. Forecasting winter precipitation over north India 3-7 days ahead - The synoptic approach. Indian Journal of Meteorology & Geophysics, 15 (3): 347-358. Delhi, July 1964. DAS M(05) I39i.

...A brief review of some important synoptic methods of Medium Range Forecasting is presented, and the line of approach adopted in the present investigation is indicated.

An examination of the mean charts for the winter seasons of the six-year period (1956-61) has revealed the large-scale pressure systems which have an influence on winter precipitation over north India for periods of 5-days or more. Some of the interesting and useful relations found between pressure pattern and the corresponding precipitation are presented. The influence of the large-scale pressure systems on the fast moving daily disturbances is examined. - Author's abstract.

175. Pant, P.S. Onset of monsoon over India. Indian Journal of Meteorology & Geophysics, 15(3): 375-380. Delhi, July 1964. DAS M(05) I39i.

...The large-scale changes in the 5-day mean 700-mb contour pattern associated with the onset of monsoon rains over different parts of the country are located with the help of charts for the period 1957-1962.

The onset of monsoon over India and adjoining seas south of 15°N is associated with the disappearance of the premonsoon 'high' over central parts of the country and the formation of the monsoon trough near 90°E at the 700-mb level. The formation of the monsoon low with the major axis in an east-west direction near about 20°N heralds the establishment of the monsoon over the entire country. Simultaneously the Pacific 'High' shifts northwards.

It is also noticed that the extension of rains over central parts of the country is associated with the disappearance of the anticyclonic curvature in the 700-mb contour pattern over the region. In those years in which the monsoon gradually extends westwards over north India, such an extension is associated with the gradual shift westwards of the monsoon trough. - Author's abstract.

176. Raghavan, K. Influence of the Western Ghats on the monsoon rainfall at the coastal boundary of the Peninsular India. Indian Journal of Meteorology & Geophysics, 15 (4): 617-620. Delhi, October 1964. DAS M(05) I39i.

...Along the west coast of the Indian Peninsula, north of lat. 9°N, rainfall during the monsoon season usually increases from the coastal boundary towards the Western Ghats. Monthly normal rainfalls (for July) of the different stations along the coastal belt, plotted against their distance from the sea coast, show a significant correlation (-0.6) with the distance of the 150-metre contour from the coast and appear to be uncorrelated with the distances of the 600m and 900m contours from the coast. Apparently the gradient between the sea level and the 150-metre contour determines the magnitude of the coastal convergence, and the consequential vertical motion responsible for the rain. - Author's abstract.

177. Raghavan, K. Rainfall associated with double tropical storms in India. Weather, XIX (4):106-112. London, April 1964. DAS M(05) R888w.

...Is a study of selected synoptic situations which feature the rainfall distribution under the influence of two storms at one time in India. The author describes and illustrates on maps the influence of two tropical storms occurring on the same day for June 26, 1956; July 11, 1962; September 13, 1961; October 20, 1935.

178. Rai Sircar, N.C.,and Sikdar, D.N. Pre-monsoon jet streams over the Indian sub-continent and the associated vertical motions. Indian Journal of Meteorology and Geophysics, Delhi, 15 (1): 95-98, January 1964. DAS M(05) I39i.

...Examines a few cases of premonsoon jet streams to study how far the conclusions of Koteswaram (1954) can be applied to day-to-day situations. According to Koteswaram, the confluence of two currents, (1) the southwesterlies to westerlies over the Bay of Bengal and the Peninsula and (2) the continental westerlies to northwesterlies from higher latitudes, causes the premonsoon jet stream and the jet stream during the dry months. He also shows by his charts that there is a southward transport of air across the jet stream both above and below it. Diagrams and text seem to disprove Koteswaram's conclusions.

179. Roy, A.K.; Ramana Murthy, Bh. V.; Biswas, K.R.; Khemani, L.T. Cloud seeding experiment around Delhi using aircraft. Journal of Scientific & Industrial Research, 23 (8): 326-333. New Delhi, August 1964. DAS P.

Source No. 179 continued

...Describes the experiments conducted and the results obtained in a series of aircraft seeding experiments at Delhi during the monsoon season (July-September) of 1962.

180. Srinivasan, T.R. Rainfall persistence in India during May-October. Indian Journal of Meteorology and Geophysics, 15 (2): 163-174. Delhi, April 1964. DAS M(05) I39i.

...Examines the daily rainfall for the summer (May-October) for 93 representative stations in India for the purpose of studying the persistency pattern of the occurrence of rainfall based on data for the period 1951-1960. The table presents the frequency of spells of rainy days of specified lengths (1,2,3,4,5,6,7,8,9,10, and >10 days) for these stations.

181. Subbaramayya, I., and Rao, N. Jaganmohana. The frequency distribution of rainfall of different intensities. Journal of the Meteorological Society of Japan, Tokyo, Ser. II, 42 (5): 277-284, October 1964. DAS M(05) M589sj.

...Gives the results of an investigation to determine how the rainfall frequency is distributed in different intensities in different parts of India. The method of analysis and the frequency distributions are described. A table presents computed and observed percentage frequencies of rainfall at 11 stations in India and at Jacobabad in West Pakistan.

182. Upadhye, M.K. The weather and climatic conditions at Amravati. Bombay Geographical Magazine, XII (1): 49-62. Bombay, December 1964. DLC.

...Discusses the weather and climatic conditions of Amravati, which is considered a fairly representative station of the four districts of Berar - namely, Amravati, Akola, Buldana, and Yeotmal. The climatic elements described in this study are temperature, precipitation, number of rainy days, cloud amount, thunder, hail, dust storms and fog, and wind. The author summarizes the precipitation effectiveness index, the index of aridity, the annual probability of rainfall, the coefficient of continentality, and the thermohumid ratio and range. The study also presents tabular monthly mean rainfall intensity at Amravati.

183. Venkiteshwaran, S.P. Observations in India of turbulence in the upper air from sounding balloon ascents. India (Republic), National Aeronautical Laboratory, Technical Note No. TN-AE-23-64. Bangalore, March 1964. DAS M(055) I39tn.

Source No. 183 continued

...The paper describes the special features of the F-type radiosonde in distingushing from the rotation of the fan whether the downward movement of the radiosonde balloon is due to a strong vertical downward current or due to the accumulation of snow. It shows how the rate of the rotation of the fan can be used to identify regions of turbulence in the atmosphere. The observations of the turbulence with the F-type radiosonde are compared with the inferences drawn by turbasondes in the U.S.A. and the Dines meteorograph records in India. The regions where turbulence may be observed in India have been indicated. The existence of severe turbulence in the upper troposphere and in the stratosphere has been emphasised. - Author's abstract.

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184. Ananthakrishnan, R.; Selvam, M. Mary; Chellappa, R. Seasonal variation of precipitable water vapour in the atmosphere over India. Indian Journal of Meteorology & Geophysics, 16 (3): 371-384. Delhi, July 1965. DAS M(05) I39i.

...Is a study of the precipitable water vapor in the atmosphere over India based on radiosonde data for 12 stations for 6 years (1956-1961). The method of calculation of data, evaluation of data and results are presented. The tables contain summaries over the period (1956-1961) for 12 stations in India of monthly mean precipitable water (gms), mean total rainfall amount (cm), diurnal variation of precipitable water, and mean precipitable water (gm) for isobaric layers (surface-900, 900-800, 800-700, 700-600, 600-500, 500-400, 400-300, 300-200) at 0000 and 1200Z.

185. Ananthakrishnan, R., and Ramakrishnan, A.R. Upper tropospheric zonal circulation over India and neighbourhood in relation to the south west monsoon. Proceedings of the Symposium on Meteorological Results of the Indian Ocean Expedition, Bombay, India, 22-26 July 1965. pp. 415-422. DAS M:551.46 S989pr.

...A study has been made of the zonal wind changes at the 200-mb level at the rawin stations in India and at the Middle-East stations of Aden and Bahrein, accompanying the onset and withdrawal of the southwest monsoon. The changes in question are the reversal of the westerly circulation to the easterly at the time of onset and the opposite change at the time of withdrawal. Although these changes at some of the stations give prior indication of the onset and withdrawal, they have little forecasting value. - Authors' abstract.

186. Chacko, O.,and Desikan, V. Atmospheric turbidity measurements over India. Indian Journal of Meteorology & Geophysics, 16 (4): 649-660. Delhi, October 1965. DAS M(05) I39i.

...From daily measurements of direct solar radiation for selected spectral regions and for the whole spectrum, coefficients of atmospheric turbidity and transmissivity have been calculated for different months for two representative stations in north and central India. Attenuation of direct solar radiation and atmospheric turbidity are maximum at both stations, during the hot, dry, dusty summer months and a minimum during the monsoon months and after, when the atmosphere has been cleansed of its dust content by precipitation. The turbidity over Delhi is two to five times that over Poona throughout the year, as a result of its proximity to the arid zones to the west. The variations from year to year are also much more pronounced at Delhi. The sudden fall in turbidity during June as well as the turbidity values during June to September at both stations are related to the times of onset of the monsoon in the two areas and the amount of rainfall during these months. - Authors' abstract.

187. Despande, D.V. Cirriform clouds over India - heights and temperatures. Indian Journal of Meteorology & Geophysics, 16 (4): 635-644. Delhi, October 1965. DAS M(05) I39i.

...Aviators and meteorologists alike have now-a-days become increasingly concerned with cirriform clouds. Information regarding the characteristics of cirriform clouds over tropical countries is very meagre. All available data of these clouds obtained by high-altitude aircraft flights over India during the last seven years have been analysed. These include reports of the meteorological reconnaissance flights by the I.A.F. aircraft and Met. reports by civil jet-aircraft. The mean heights of cirriform clouds, their extremes, thickness and amounts have been computed. The diurnal, regional,and seasonal variations are also discussed. Other parameters investigated include turbulence, winds, icing,and visibility in and near these clouds. A typical synoptic situation giving rise to extensive cirriform clouds is also presented. - Author's abstract.

188. Dixit, C.M.,and Jones, D.R. A kinematic and dynamical study of active and weak monsoon conditions over India during June and July 1964. International Meteorological Centre, Bombay, India. 26 pp. April 1965. DAS M53.21 D619ki.

...Two synoptic situations are discussed which epitomize the active monsoon regime, with attendant heavy rainfall over certain regions of India, and its counterpart, the "break" wherein precipitation amounts are considerably reduced over these same regions. Kinematic analyses of several standard levels, covering an area from 10° S to 40° N

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and 40°E to 150° E, are presented to illustrate the marked difference in the flow patterns between these two synoptic periods.

Of particular significance in this presentation is the analysis of the two cyclonic cells in the monsoon trough with respect to their differing dynamic and thermal structures. Of equal interest is the analysis of anticyclonic conditions in the mid-troposphere over central India leading to sustained "breaks" in precipitation. Based on both kinematic and vorticity considerations, the existence of a subequatorial ridge distinct from the subtropical ridge is postulated. The differences in the characteristics of the two ridges are illustrated.

Finally, a monsoon synoptic model is suggested for the active and weak monsoon regimes and a qualitative forecast scheme is presented for commencement of "breaks" and re-establishment of active monsoon conditions. - Authors' abstract.

189. Gokhale, G.S.; Menon, G.K.; Re..ar, R.T. Zonal winds in the 10-35 km region of the subtropical atmosphere over India. Journal of the Atmospheric Sciences, Boston, 22 (2): 116-119, March 1965. DAS M(05) A512j.

...High-altitude balloon ascents made from Bombay (19N, 73E) and Hyderabad (17.6N, 78.5E) indicate that during the period from September to May through December, in the subtropical atmosphere over India, the stratospheric winds above 22 km are mostly easterlies. These are found to build up in strength with increasing altitude. Also, with the advent of summer the stratospheric easterly stream strengthens at all altitudes whilst the westerlies characteristic of the upper troposphere weaken. Between April 1957 and May 1964, there were two periods 1959 (March-May) and 1961 (February-April), when at the highest altitudes attained by the balloons, at or above 30 km, stratospheric westerlies were observed; during 1963 (October-December) some flights showed westerlies and others easterlies at these altitudes. These westerlies could be an extension to lower altitudes of the winter westerly regime observed by rocket-sondes in the Northern Hemisphere. The easterly to westerly change-over observed by us at high altitudes is also discussed in terms of the quasi-biennial wind cycle in the tropical stratosphere. - Authors' abstract.

190. India. Meteorological Department. A brochure on the Institute of Tropical Meteorology, Poona. 8 pp. Poona, March 1965. DAS M(06) I38br.

...Discusses the history of the meteorological research in India, the formation of the Institute of Tropical Meteorology, the location and organization of the Institute, the Scientific Advisory Board set up for the Institute, scope of work, and the International Meteorological Center of this Institute.

191. India. Meteorological Department. India weather review. 1891-... (June 1965). DAS M06.1/54 I39i.

...Presents descriptive monthly and annual summaries of weather in India for individual years, monthly mean constant pressure charts, typhoon and depression tracks, information on western disturbances and local storms, description of storms and depressions, summary of snowfall reports from the mountain regions, and monthly and annual summaries of climatic data. The climatic summaries include divisional and subdivisional mean rainfall amount, maximum and minimum temperatures, and means at specified hours of vapor pressure, relative humidity and cloud amount; monthly mean wind speed, resultant mean wind velocity and resultant mean wind direction at surface and specified heights at specified hours (1-4 per station) for pilot balloon and rawin stations; monthly mean dynamic height, mean temperature, maximum and minimum temperatures, and mean dew point temperature at specified hours at surface and specified millibar surfaces for radiosonde stations; monthly and annual summaries at fixed hours (1-8 per station) of (1) frequencies of wind speed and wind direction and (2) mean sea-level and station-level pressures, dry bulb and wet bulb temperatures, dew point temperature, vapor pressure, relative humidity, cloud amount and wind speed; monthly and annual maximum and minimum pressures and temperatures with dates of occurrence, mean maximum and minimum temperatures, total rainfall amount, maximum rainfall amount in 24 hours with date of occurrence, number of rainy days, mean wind speed, sunshine duration, sunshine duration frequency, maximum and minimum sunshine duration, minimum and mean minimum nocturnal radiation temperatures, mean hourly wind speed, days with weather phenomena (precipitation, snow or sleet, hail, thunder heard, fog, dust storms, ground fog, gales, squalls, and line squalls), wind speed frequency by direction at surface and specified heights, low cloud height frequency and visibility frequency. Various computed values and departures from normal are recorded for some elements. Summaries are recorded for about 13-400 stations. Period of record varies by station and element.

192. Mani, A.; Chacko, O.; Iyer, N.V. Studies of terrestrial radiation fluxes at the ground in India. Indian Journal of Meteorology & Geophysics, 16 (3): 445-452. Delhi, July 1965. DAS M(05) I39i.

...Discusses the results of observations at the ground of longwave effective outgoing radiation and atmospheric radiation at 8 stations in India from 1958-1962. The tables present mean monthly and annual values of the net outgoing longwave radiation and downward longwave radiation fluxes on clear nights at Delhi, Poona, Calcutta, Madras, Trivandrum, Nagpur, Jodhpur, and Visakhapatnam.

193. Mathur, L.S. Weather radar studies in India. Lecture delivered during the Scientific Discussions following the 4th Session of the WMO Commission for Instruments and Methods of Observation (Tokyo:October 20, 1965). 34 pp. DAS M08.85 M432w.

...The article is divided into two parts. The Part I gives the history of radar weather studies in India and describes the present stage of progress both in operational and research fields.

Part II deals with the classification and interpretation of radar weather echoes in India by taking into account the observations so far made in various regions of the country in different seasons of the year. - Author's abstract.

194. Portugal. Serviço Meteorológico Nacional. O clima de Portugal. Fascículo XI. Estado da Índia. (The climate of Portugal. Fascicule XI. State of India). 57 pp. (In Portuguese). Lisboa, 1965. DAS M82.1/469 P853c.

...Describes the meteorological conditions, meteorological phenomena, climatic conditions, climatic factors, the territory of Portuguese India, meteorological activities in Portuguese India, climatological values of Portuguese India, meteorological stations in Portuguese India, synoptic and dynamic climatology in Portuguese India, and the Meteorological Services of Portugal. The tables contain monthly and annual summaries over the period (1931-1960) of mean station and sea level pressures, mean temperature, mean maximum and minimum temperatures, absolute maximum and minimum temperatures, total hours of sunshine, percent of possible sunshine, total evaporation, mean total amount of precipitation, maximum amount of precipitation in 24 hours, mean wind speed and wind direction frequency; mean temperature, relative humidity and cloud amount at 1-3 specified hours (0900, 1400 or 1500, and 2000 or 2100); mean number of days with maximum temperature $> 25.0°$, minimum temperature $< 0.0°$ and $> 20.0°$, wind speed ≥ 36 kph and ≥ 55 kph, cloud amount ≥ 8 and ≤ 2, precipitation ≥ 0.1 mm and ≥ 1.0 mm, precipitation ≥ 10.0 mm, snow, hail, thunderstorms, fog, dew, rime, and snow cover. The above summaries are for 1-16 stations in Portuguese India.

195. Raghavan, K. Some aspects of severe cold waves in India. Current Science, 34 (13): 401-403, July 5, 1965. Bangalore. DNAL 475 Sci23.

...Briefly discusses the broad features of cold waves that are considered to be severe with a drop (departure) in night mimimum temperature of the order of $\geq 8°$ C. below its daily normal based on data for the period 1911-1961. The author gives information on (1) the frequency, persistency, and intensity of severe cold waves in

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India excluding the hill stations except those in Jammu-Kashmir, (2) the lowest minimum temperatures and local variations of severe cold waves. A table presents total number, maximum intensity, and maximum duration in days of severe cold waves for 27 subdivisions of India.

196. Raghavan, K., and Nagarkar, N.D. Water temperature in evaporation pans in India. Indian Journal of Meteorology & Geophysics, 16 (1): 128-133. Delhi, January 1965. DAS M(05) I39i.

...Discusses briefly the general characteristics of water temperature based on measurements in evaporation tanks for 5 years at 20 stations distributed throughout India. The tabular data for these stations consist of mean water temperature (°C) at 0830 and 1730 IST.

197. Ramamurthi, K.M.; Keshavamurty, R.N.; Jambunathan, R. Some distinguishing features of strong and weak monsoon regimes over India and neighbourhood. Proceedings of the Symposium on Meteorological Results of the International Indian Ocean Expedition, Bombay, India, 22-26 July 1965. pp. 350-361. DAS M:551.46 S989pr.

...Two periods, each of two weeks' duration, one of a strong monsoon and the other of weak monsoon (during 1963), were chosen, and the mean resultant winds were computed for each period. Streamline-isotach analyses for the standard levels were made. Thickness charts between standard levels were analysed using all thermal winds. Also, mean meridional sections of vorticity and of zonal and meridional components of wind were prepared for longitudes 75° E and 85° E.

The wind fields at 700 mb show the greatest contrast between the two regimes. The weather over central and north India and along the west coast during the strong monsoon and along and near the foothills of the Himalayas during weak monsoon can be explained on the basis of vertical circulations caused by advection discontinuities. The thickness charts show that the main monsoon trough over the Gangetic plains is warm-cored; but the midtropospheric vortex during strong monsoon over Gujarat is cold-cored at 700 mb. The vorticity sections and the charts show the more northward position of the monsoon trough, the more southward position of the upper tropospheric subtropical ridgeline, during weak monsoon, and also the presence of an upper tropospheric westerly trough over West Pakistan during weak monsoon. The upper tropospheric easterlies build up more between 200 and 100 mb during the strong monsoon and between 300 and 200 mb during weak monsoon. The sections of meridional component of wind show that the monsoon or reverse cell is more prominent during strong monsoon and the Hadley cell is more prominent during weak monsoon. - Authors' abstract.

198. Ranganathan, C.,and Soundararajan, K. A study of a typical case of interaction of an easterly wave with a westerly trough during the post monsoon period. Indian Journal of Meteorology & Geophysics, Delhi, 16 (4): 607-616, October 1965. DAS M(05) I39i.

...A spell of heavy rain which first occurred over south India and later gradually spread northwards in the course of about three days during the first week of December 1962 has been studied. An easterly wave which had been affecting south India on 1 December moved out into the Arabian Sea and interacted with a trough in the westerlies which was moving across Rajasthan and northern plains of India in association with a western disturbance. The result of the interaction on 2 December and on subsequent days, which was facilitated by the presence of an induced low in between them, was the formation of an extended trough in the low-level easterlies. The northern part of the extended trough in which was embedded the induced low, then moved eastward and got fractured. The fracture of the waves was accompanied by the weakening of the trough systems, as well as the induced low. Unprecedented heavy rains for the month occurred in Madhya Pradesh and Vidarbha and broke the all-time record for the month at a number of stations during and after the formation of the extended trough. - Authors' abstract.

199. Rao, K.N. Seasonal forecasting - India. world Meteorological Organization, WMO-No. 162, TP. 79, Technical Note No. 66, WMO-IUGG Symposium on Research and Development Aspects of Long-range Forecasting, Boulder, Colorado, 1964. pp. 17-30. Geneva, 1965. DAS M(06) W927p no. 162.

...Reference is made to the main seasonal rainfall features, the selection of factors, inter-correlations among subdivisions, Walker's Formulae, new factors to improve the forecasting formulae, seasonal forecast memoranda issued by the India Meteorological Department, verification forecasts, and memorandum regarding the probable amount of monsoon rainfall in 1964.

200. Rao, M.S.V.,and Sikdar, D.N. Methods of measuring winds and temperatures in the upper atmosphere with small rockets. Indian Journal of Meteorology & Geophysics, Delhi, 16 (4): 661-670, October 1965. DAS M(05) I39i.

...The Indian Meteorological Rocket Launching Programme was initiated at Thumba on 14 July 1964. During the following six months, seven Judi-Dart rockets and eleven test rockets were fired. The chaff payload released from the Judi-Dart rockets were tracked by an MPS-19 radar system. The data thus collected were reduced following a method which is a simple adaptation of India Meteorological Department graphical technique.

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This paper includes a description of the Judi-Dart and test rockets as well as the radar system. The method of data reduction employed at Thumba is explained with an actual example. A comparison is drawn between this method and the one employed in the U.S.A. (Wallops station).

A few remarks are added on the present International ROCOB Code in the light of the experience gained at Thumba.

A brief survey is also included of techniques of measuring winds and temperatures with small meteorological rockets which are currently in use in other countries and some which may be adopted at Thumba in future. - Authors' abstract.

201. Sikka, D.R. On some aspects of the fluctuations of the sub-tropical westerly jet stream over India during winter. Proceedings of the Symposium on Meteorological Results of the International Indian Ocean Expedition, Bombay, India, 22-26 July 1965. pp. 178-189. DAS M:551.46 S989pr.

...The analysis of the 200-mb charts shows that there are local variations in the intensity of the jet but on many occasions, it is very difficult to trace any regular west to east propagation of the jet maxima and minima; although on some occasions, it may be possible to trace west-to-east propagations in association with well-marked troughs and ridges moving across NW India.

It is suggested that many of these variations in the intensity of the jet occur under the influence of perturbations in the lower tropospheric equatorial chart and of the extra-tropical middle and upper tropospheric westerly belt. Possibility of variations in the meridional circulation along longitudinal belt 70-75° E and its effect on the intensity of the jet stream over that region for short periods averaging about 5 days is also examined. - Author's abstract.

202. Sivaramakrishnan, M.V. Structure of tropical cyclones as revealed by TIROS cloud pictures taken over the Indian region. Proceedings of the Symposium on the Meteorological Results of the International Indian Ocean Expedition, Bombay, India, 22-26 July 1965, pp. 285-294. DAS M:551.46 S989pr.

...A comparative study of TIROS VII and VIII cloud pictures taken over the Indian region with conventional synoptic weather analysis during the formation, development, and movement of a number of storms in the Bay of Bengal and the Arabian Sea during 1963, 1964 has been made. During the beginning stage of a storm, considerable asymmetry is noticed in the TIROS cloud pattern with considerably larger activity

in the rear sector as observed by previous workers. In the mature stage the degree of maturity is shown by the increasing concentricity of the spiral bands and by the decreasing width of the clear air channel between them. In the dissipating stage of the storm there is a decrease in cloud cover and increase in space between bands. In some tropical storms at sometime during their development TIROS cloud pictures show a relatively clear annular zone of subsidence around the rim of the high cirrus cloud shield above the storm. Thus the TIROS cloud pictures by themselves provide a wealth of analytical data to be used in conjunction with proper tropical synoptic charts to understand the formation, intensification, and dissipation of tropical storms. Examples of a few storms taken for study show clearly the spiralling cloud pattern, the eye of the storm surrounded by a closed circle of cloud. A case study of the Rameswaram cyclone showing the 'double eye' has also been made. - Author's abstract.

203. Subrahmanyam, V.P., and Subramaniam, A.R. Some characteristics and frequencies of occurrence of droughts in the dry climatic zones of India. Bulletin of the International Association of Scientific Hydrology, Xe Année, No. 3. pp. 31-37. September 1965. DAS M(06) I611gb.

...The paper describes some results of a climatic study of the characteristics and decennial frequencies of droughts at a few selected stations in the three dry climatic zones - arid, semi-arid, and dry sub-humid - of India. The classification of the climates was done according to the 1955 water balance scheme of Thornthwaite, after a careful mapping of the moisture indices for all the climatological observatories in India. Four stations in the arid, six from the semi-arid and from the dry sub-humid were selected for the analytical study of droughts.

The aridity index of Thornthwaite, viz., ratio of annual water deficiency to the total annual water need, expressed as a percentage, was found to be a useful parameter for the purpose. The values of this parameter were computed for each year of a 65-year period of record for all the selected stations, using the well-known book-keeping procedure of Thornthwaite. From the yearly trends of the index it could be ascertained whether a station was becoming drier, less dry, or remaining steady. Taking the amplitude of departure of the index from the normal as a measure of severity of a drought situation, an arbitrary yet practical scheme employing the standard deviation, σ, was adopted for the classification of droughts of different degrees of severity, viz., moderate ($< 1/2\,\sigma$), large ($1/2\,\sigma$ to σ), severe (σ to 2σ), and disastrous ($>2\,\sigma$).

Decennial frequencies (number of drought-years in successive decade intervals) of the above four categories of droughts were worked out for each of the stations and illustrated by means of block-diagrams.

By plotting the moisture indices rather than aridity indices against successive years, the climatic shifts at individual stations could also be studied. Considerable shifts in moisture regime, say from arid to first humid at Delhi (normally semi-arid) and from almost arid to second humid at Cuddalore (normally dry sub-humid), were observed signifying that at any station large fluctuations in yearly water balances are quite a common occurrence. Such a study in the generally humid climates may provide important clues to the origin and nature of the so-called contingent droughts and thus enable a national planning of agricultural and hydrologic projects. - Authors' abstract.

204. Yadav, B.R. Total solar radiation in relation to duration of sunshine. Indian Journal of Meteorology & Geophysics, 16 (2): 261-266. Delhi, April 1965. DAS M(05) I39i.

...An attempt has been made to establish a relation between the total radiation from sun and sky and the duration of bright sunshine based on the formula, $Q/Q_A = a + b(n/N)$, Q and Q_A being the radiation amounts on one square centimeter of horizontal surface at the surface of the earth and at the top of the atmosphere respectively and n and N being the actual and the maximum possible hours of bright sunshine respectively. The values of the regression constants a and b have been computed for daily, weekly, and monthly data. Data from daily observations have been grouped for the dry and the monsoon seasons, and the constants a and b calculated and compared with those obtained by others.

Mean monthly total radiation at a few places in north India having the same cloud regime as at Delhi has also been computed and discussed. - Author's abstract.

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205. Alvi, S.M.A., and Punjabi, K.G. Diurnal and seasonal variations of squalls in India. Indian Journal of Meteorology & Geophysics, 17 (2): 207-216, April 1966. DAS M(05) I39i.

...Presents the climatological studies of the squalls which occurred over India during the 15-year period, 1948-1962, based on the anemograph records of 22 stations. The discussion includes information on the data utilized in this study, monthly and annual frequency of squalls, diurnal variation of squalls, direction of squalls, squall frequencies with respect to maximum wind speed reached, squall frequencies with respect to their duration, and comparison of squalls and thunderstorm frequency. The results and conclusions are given. There is a table with monthly and annual summaries over 5-15 years during the period 1943-1962 of mean frequency of squalls for 22 stations. Graphs present the diurnal variation of squalls for the same stations.

206. Banerjee, A.K., and Sharma, K.K. Seasonal oscillations of daily mean maximum temperature in India and neighbourhood. Indian Journal of Meteorology & Geophysics, 17 (3): 443-450. Delhi, July 1966. DAS M(05) I39i.

...The mean daily maximum temperatures of 124 selected observatories have been subjected to harmonic analysis. The annual oscillations are observed to predominate over the other harmonic oscillations. The amplitudes of annual oscillation are highest in northwest of India and least over the west coast. Half-yearly oscillation amplitudes are highest over central India more towards northern latitudes. The close proximity of the dates of onset of SW monsoon and amplitude maxima of the annual oscillations over a major part in northwest India and adjoining area is striking.

The regression coefficients of the first and second harmonic amplitude with latitude, longitude, and elevation have been worked out and discussed. - Authors' abstract.

207. Bhattacharyya, P., and De, A.C. Study of the heights of radar cloud tops in the Gangetic valley of West Bengal. Indian Journal of Meteorology & Geophysics, 17 (4): 591-596. Delhi, October 1966. DAS M(05) I39i.

...Results of a study of the heights of radar cloud tops in the Gangetic valley of West Bengal based on hourly radar observations for the premonsoon and monsoon seasons of 1959 to 1962 are reported. Percentage frequency distributions at different height intervals and also during different periods of the day for two seasons under study and on a ten-day period basis have been computed. - Authors' abstract.

208. Chatterjee, S.P. Progress in climatology in India. Tokyo Journal of Climatology, 3 (1): 30-35. December 1966. DAS M(05) T646to.

...Decribes the progress in surface climatology, upper air climatology, weather and climate, climatic types, rainfall and runoff, and climatic changes in India. There is a list of some of the important references in the field of Indian climatology.

209. Great Britain. Meteorological Office. Tables of temperature, relative humidity and precipitation for the world. Part V. Asia. Second edition. 126 pp. London, 1966. DAS M82.2 G786ta.

...Presents monthly and annual summaries over specified periods (vary by station and element) for 45 stations in India of mean maximum and minimum temperatures, mean of the highest and mean of the lowest

Source No. 209 continued

temperatures and absolute maximum and minimum temperatures in °F; mean relative humidity at approximately 0800 and 1600; mean total precipitation amount and maximum amount in 24 hours in inches; mean number of days with precipitation ≥ 1" for 43 stations and ≥ 0.04" at Bangalore and Jubbulpore. Identical data are also found in the first edition (1958).

210. Gupta, B.R.D. Frequency of wet and dry spells at five stations in Rajasthan. Indian Journal of Meteorology & Geophysics, 17 (3): 451-456. Delhi, July 1966. DAS M(05) I39i.

...Frequencies of wet and dry spells at five stations in Rajasthan (Bikaner, Jodhpur, Ajmer, Jaipur, and Udaipur) for the southwest monsoon period are studied. The study is based on the daily rainfall data of these stations from 1891 to 1919. It is seen that frequencies of rain spells of less than 5 days are common and those greater than 10 days are extremely rare. Frequencies of dry spells of less than 5 days are common for all the five stations. Frequencies of dry spells greater than 15 days are also common at Bikaner, Jodhpur, and Ajmer but are less frequent (20 per cent of the total days) at Jaipur and Udaipur. Intercorrelation coefficients among the stations for all dry spells of two days and more are found to be significant for Bikaner-Jodhpur, Bikaner-Ajmer and Jodhpur-Ajmer, and Jaipur-Udaipur. - Author's abstract.

The tables contain (1) monthly (June-September) and SW monsoon season summaries over the period (1891-1919) of mean amount and maximum and minimum amounts of rainfall in inches and mean number and maximum and minimum number of rainy days (days with rainfall ≥ 0.01" in 24 hours) and (2) summaries for the SW monsoon season of frequencies of wet spells and dry spells based on data for the period 1891-1919 at Bikaner, Jodhpur, Ajmer, Jaipur, and Udaipur.

211. Gupta, M.G. An estimate of solar radiation over India in the pre-monsoon season. Indian Journal of Meteorology and Geophysics, 17 (1): 101-108. Delhi, January 1966. DAS M(05) I39i.

...The computations of diabatic heating over India in the pre-monsoon season, with the help of a simple formula due to Mintz (1958), indicate the gradual build up of a zone of diabatic heating over central India from March to May. These results have been checked against estimates of net radiation over India during March, April, and May. For this purpose the outgoing long wave radiation was computed with the help of Elsasser's radiation diagram, the results of which agree fairly well with the measurements of long-wave radiation by Tiros IV. For incoming solar radiation, mean values based on 2-6 years' data of pyrheliometer observations have been utilised. By subtracting the

the outgoing radiation from the sum of (a) the radiation observed at the surface of the earth and (b) the radiation absorbed by the atmosphere, an estimate of the net radiation for diabatic heating has been obtained. The values thus obtained are generally higher than the values given by Mintz's formula. But there is a fairly good agreement on the order of magnitude. - Author's abstract.

212. Gupta, R.G. A study of winds up to 32 km over Hyderabad Deccan. Indian Journal of Meteorology & Geophysics, Delhi, 17 (2): 199-206, April 1966. DAS M(05) I39i.

...Rawin observations of eleven high-altitude ascents at Hyderabad Deccan (India) during the months of February 1960 and April to May 1959 have been analysed. An abrupt change in direction of winds at an altitude of about 19 km during summer months, depth of westerlies and easterlies, and the occurrence of two maxima and at least one minima of velocities and the relationship between their altitudes have been described. Also, vector average winds throughout the observed channel of atmosphere (0-32 km) and their relationship with the maxima have been determined and described. It was also found that the upper winds were quite steady. The steadiness factor has been calculated for each altitude for the month of March 1960. - Author's abstract.

213. Joseph, P.V., and Raman, P.L. Existence of low level westerly jet stream over peninsular India during July. Indian Journal of Meteorology & Geophysics, Delhi, 17 (3): 407-410, July 1966. DAS M(05) I39i.

...From an analysis of July rawin and pilot data over peninsular India it is shown that a low-level jet stream (as defined by Reiter) exists over peninsular India on a large number of days, with level of wind speed maximum near 1.5 km asl and with core speeds ranging from 40 to 60 kts. High vertical wind shear is observed below the jet core. - Authors' abstract.

214. Joseph, P.V., and Singh, Ranjit. Nomograms for evaluating Richardson Number for forecasting clear air turbulence. Indian Journal of Meteorology & Geophysics, 17 (3): 411-414. Delhi, July 1966. DAS M(05) I39i.

...Research in the last decade has shown that one of the meteorological parameters which is associated with clear air turbulence (CAT) is Richardson's Number. To make Richardson number R_i useful for forecasting the location and intensity of CAT, we made a study under Indian conditions of the association between CAT and different ranges in the value of R_i. In this paper a set of nomograms is presented by

which R_i may be estimated without elaborate calculations and with a fair degree of accuracy for the layer between 300 and 200 mb. Similar nomograms can be prepared for other isobaric levels for the use of different types of aircraft in operation in India. If a singularity, like a wind maximum, is found between 300 and 200 mb, R_i may be also computed separately for the layer between 300mb and the level of maximum wind and for the layer between the level of maximum wind and 200 mb. - Authors' abstract.

215. Krishna Rao, P. A study of the onset of the monsoon over India during 1962 using TIROS IV radiation data. Indian Journal of Meteorology & Geophysics, 17 (3): 347-356. Delhi, July 1966. DAS M(05) I39i.

...Infrared radiation data collected from the TIROS IV satellite during the months of April, May, and the early part of June 1962 have been used to study the onset and advance of the monsoon over India. The data show the northward migration of the intertropical convergence zone with time. A sudden shift of the convergence zone near the equator to the southern tip of India occurs early in May. This apparently corresponds to the "burst of monsoon" over India; this conclusion is supported by other meteorological data. The TIROS IV radiation data also show that the intertropical convergence zone over Africa during the same period shifted northward, but in a more uniform fashion than the convergence zone over the Indian Ocean area. - Author's abstract.

216. Mallik, A.K. Arid-zone agrometeorology in India. Agricultural Meteorology, 3 (1/2): 3-34. Amsterdam, February 1966. DAS M(05) A278agr.

...Describes the geography, rainfall, temperature, sunshine, radiation, evaporation, wind, thunderstorms, duststorms, hailstorms, and agricultural patterns in the arid zone of India. This arid region includes 17 districts of India within the limits of 24°N-32°N and 68°E-78°E. In addition to the descriptive climatic data the author discusses the climatic interaction between the region and its surrounding area; presents methods of protection against wind raising sand and dust and frost; surveys the agro-meteorological tasks lying ahead. The tables contain monthly and annual summaries of normal rainfall (mm) amount and number of rainy days (days with rainfall ≥ 2.5 mm) in the 17 arid districts of India based on data for the period 1901-1950; weekly (June-September) normal rainfall amounts (mm), and standard deviations for 9 districts in Western Rajasthan. Graphs present monthly values of mean daily maximum and minimum temperatures, normal mean rainfall amount (mm) with numerical number of rainy days, global radiation, hours of bright sunshine, mean daily evaporation amount (mm), and mean daily wind speed (kph) for 3-5 stations (New Delhi, Bikaner, Jodhpur, Ahmedabad, and Jamnagar) in India.

217. Mallik, A.K. Dry periods during the southwest monsoon season in Rajasthan west. Indian Journal of Meteorology and Geophysics, 17 (3): 357-366. Delhi, July 1966. DAS M(05) I39i.

...Based on data for the period 1901-1950, the incidence of spells of 'no rainfall' in Rajasthan West, during the southwest monsoon season (June to September), has been studied, with week as the unit period of time and district as the unit of area. It has been shown that (i) the number of dry weeks shows a loose negative relationship with total rainfall and the number of rainy days, (ii) there is a pulsating character in the rainfall during the southwest monsoon season, (iii) years with too many or too few rainless weeks are experienced by many districts simultaneously, (iv) prolonged spells of rainless period are common at the commencement and cessation of the season; the second week of August is also a critical period for the setting in of prolonged dry spells. During the period 1901-1950, in the extreme case, in Jaisalmer district in 1918, the whole of the southwest monsoon season was rainless except for 34 mm of rain in the second half of July, (v) Rajasthan West can be divided into three zones, viz., Zone 'A' consisting of Churu, Nagore, and Pali districts with least number of dry spells, Zone 'B' consisting of Ganganagar, Jodhpur, and Bikaner districts with the number of dry spells increasing and Zone 'C' consisting of Jalore, Barmer, and Jaisalmer districts with maximum number of dry spells, (vi) on the basis of the duration of dry spells and their number, an index of "Extreme drought" has been worked out and the districts of southwest Rajasthan has been graded accordingly. - Author's abstract.

218. Mathur, L.S., and Kulshrestha, S.M. Classification and interpretation of radar weather echoes in India. Indian Journal of Meteorology & Geophysics, 17 (1): 1-16. Delhi, January 1966. DAS M(05) I39i.

...In the paper, a classification of various types of radar-weather echoes in tropics has been attempted. The different types of precipitation echoes have been categorised under the heads - (1) Feature type, (2) Synoptic type, and (3) Seasonal type. In order to be able to distingush the real precipitation echoes from those due to super-refraction etc, the various types of non-precipitation echoes have been described in the second part of the paper. Classification of radar echoes has been attempted with a view to provide guidance material to meteorologists in India in the identification and interpretation of radar-weather echoes. It is based on the data so far collected in India and is likely to be changed or modified as more experience is gained. - Authors' abstract.

219. Nandy, J., and Mukherjee, A.K. A tornado over northwest Assam and adjoining west Bengal on 19 April 1963. Indian Journal of Meteorology & Geophysics, 17 (3): 421-426. Delhi, July 1966. DAS M(05) I39i.

Source No. 219 continued

...On the evening of 19 April 1963, a tornado passed over a few places in Cooch Behar district of North Bengal and adjoining Goalpara district of North Assam. Details of the tornado as far as could be gathered from on-the-spot enquiries have been presented in the paper. The area is frequented with severe thundersqualls and hailstorms, but this one caused the biggest havoc in living memory. The tornado had a track of 36 km. The diameter of the funnel of the tornado where it touched the ground was 100-130 m. The rotation was anticlockwise. At three places, the funnel itself showed spiralling motion. There was practically no rain in and around the area affected by the tornado. Hailstones as large as 14 cm in diameter could be observed. The meteorological conditions showed high probability of occurrence of severe thunderstorm over North Assam with possibilities of large hail. - Authors' abstract.

220. Raghavan, K. A climatological study of severe heat waves in India. Indian Journal of Meteorology & Geophysics, 17 (4): 581-586. Delhi, October 1966. DAS M(05) I39i.

...Results of a climatological study of severe heat waves in India based on observations extending over a period of 51 years are presented. Their period of occurrence, frequency, intensity, persistency, extent, development, and decay are discussed with the help of 4 diagrams and 7 tables. - Author's abstract.

221. Raman, P.K., and Mukerji, T.K. Estimation of probable maximum point rainfall by log-probability method. Proceedings of the Symposium on Hydrometeorology of India with Special Reference to Flood Forecasting and Warning Held at Meteorological Office, New Delhi on 23-24 March 1964, Indian Journal of Meteorology and Geophysics, 17 (Spl.No.): 9-14. Delhi, April 1966. DAS M(05) I39i.

...A statistical method of investigating the distribution of maximum 24-hour rainfall for finding reliable estimates of maximum probable rainfall for different return periods at a station on the assumption of log-normal distribution has been proposed by Van Te Chow. This method of calculation of 24-hr. maximum possible point rainfall with definite confidence limits has been applied to the 50 years of annual maximum 24-hr. rainfall data of 5 stations in India to test its applicability to Indian rainfall data. - Authors' abstract.

222. Ramaswamy, C. The problems of fronts in the Indian atmosphere. Indian Journal of Meteorology & Geophysics, 17 (2): 151-170. Delhi, April 1966. DAS M(05) I39i.

Source No. 222 continued

...The present paper contains the results of a detailed synoptic investigation of a western disturbance in the typical month of January. This disturbance moved across West Pakistan and northern India and was prima facie associated with fronts. The investigation has, however, shown that there were no well-organized sloping surfaces in association with the western disturbance. The slopes were found to be very variable and did not extend above 3.0 km. The potential pseudo-wet bulb temperature curves did not also show any significant air mass contrasts in the vertical, during the movement of the discontinuity surfaces across the stations. The times of commencement and cessation of precipitation had no relationship to the time at which the discontinuity at sea level moved across the synoptic stations. On the basis of these observational facts, the conclusion is drawn that, even in mid-winter, when there is a maximum probability of formation of fronts in the Indian atmosphere, discontinuity surfaces which may form due to juxtaposition of different air masses, probably get disorganized on most occasions leaving merely a broad "indeterminate" type of partition which moves with the western disturbance and causes temperature and other associated changes. The available evidence also suggests that such partitions are of little consequence in the development of hydrometeors and, therefore, would be of little value in forecasting the hydrometeors. - Author's abstract.

223. Rangarajan, S., and Mokashi, R.Y. Some aspects of the statistical distribution of upper winds over India. Indian Journal of Meteorology & Geophysics, Delhi, 17 (1): 25-38, January 1966. DAS M(05) I39i.

...For a quantitative evaluation of the probabilities of occurrence of upper wind speed and direction, a number of standard statistical parameters like standard deviations of the zonal and meridional components of the wind and the correlation coefficients between them are required. Utilising all radio-wind observations of the 5-year period, 1959-1963, these statistical parameters have been computed for the standard geometrical heights 1.5, 3.0, 6.0, 9.0, 12.0, 14.1, and 16.2 km a.s.l. for all the twelve months of the year for three representative stations in India, viz., New Delhi, Nagpur, and Trivandrum. The brief theory underlying the use of statistical parameters and the method of constructing the distribution ellipses are outlined. The verification of the procedure has been illustrated by four actual cases of wind distribution. The main features of the distribution of winds in the different seasons have been discussed. In general, there is a tendency for the upper wind distribution to be elliptical rather than circular. - Authors' abstract.

224. Sastry, P.S.N., and Narasimham, A.L. Some characteristics of tropopause over India. Indian Journal of Meteorology & Geophysics, 17 (4): 567-572. Delhi, October 1966. DAS M(05) I39i.

Source No. 224 continued

...Variations of the height and temperature of tropopause over India have been discussed in this paper. Seasonal and latitudinal variations over India have been compared with those over neighbouring stations. Smith (1963) suggested that increase in moisture contributes to the lowering of the tropopause, but a comparison of the mixing ratios with tropopause heights over India does not seem to bear this out. - Authors' abstract.

225. Sharma, K.K. A study of annual oscillations of tropopause over India. Indian Journal of Meteorology & Geophysics, 17 (3): 479-480. Delhi, July 1966. DAS M(05) I39i.

...This study, based on data from 13 radiosonde stations in India, presents information on the seasonal and annual variations of pressure, height, and temperature at the level of the upper tropopause over India.

226. Siromani, P. Incidence of low clouds at Bombay airport (Santacruz) with reference to jet landings with the help of the Instrument Landing System (ILS). Indian Journal of Meteorology & Geophysics, 17 (3): 433-442. Delhi, July 1966. DAS M(05) I39i.

...Santacruz airport constitutes a high traffic density area, with a substantial number of jet aircraft movements. Aviation hazards at this airport get particularly accentuated during the monsoon season on account of the occurrence of very low clouds, strong gusty winds, and poor visibility conditions in mist or haze, or showers. There are a few important hill features around the airport, not far from the landing area.

The airport is equipped with standard radio navigational aids, namely, very high frequency omnidirectional range (VOR), Instrument Landing System (ILS), the Aerodrome Surveillance Radar (ASR). A precision approach radar (PAR) will become operational at this airport shortly. On the ILS the glide path angle has recently been reduced from 4 degrees to 3.3 degrees above the horizon, necessitating the approach of the aircraft generally at a lower altitude, the altitude above the middle marker being of the order of 561 ft only. The distance of the middle marker from ARP is 2972 m (1.6 n.m.). Fig. 1 is the instrument approach chart for the Bombay airport.

The aviation hazards that may be encountered by the jet aircraft especially in the monsoon season, on the phase of the final approach, have been discussed in this note with reference to climatological statistics and the synoptic climatology of this airport. It is hoped that the result arrived at will be of some practical value to pilots operating jet aircraft and to air traffic controllers. - Author's abstract.

227. Yegnanarayanan, Sumathi. Vector mean wind and standard vector deviations for selected Rawin stations in India. Indian Journal of Meteorology & Geophysics, 17 (2): 179-186. Delhi, April 1966. DAS M(05) I39i.

...A statistical investigation of all available Rawin data at 3.0, 6.0, 9.0, 12.0, 14.1, and 16.2 km above sea level, for five Indian stations, covering the years 1961 and 1962 is reported in this paper. The stations are Bombay, Calcutta, Madras, New Delhi, and Trivandrum. The tables showing the mean meridional and zonal components together with the standard vector deviations for the two seasons December-February and July-August are included. The vector mean winds and the standard vector deviations for each station are given. The distribution of winds at the different levels mentioned above are tested for circularity and found to be mostly noncircular for the stations south of Lat. 20° N and mostly circular for stations north of it. - Author's abstract.

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228. Alvi, S.M.A. Squalls over east Uttar Pradesh. Indian Journal of Meteorology & Geophysics, 18 (2): 233-246. Delhi, April 1967. DAS M(05) I39i.

...A statistical study of squalls over east Uttar Pradesh is presented in this paper. A comparison of squalls occurring over east Uttar Pradesh with those occurring over Jodhpur station in west Rajasthan has been made, and salient features have been brought out. - Author's abstract.

The tables contain monthly and annual frequencies of squall duration (≤ 10, 11-20, 21-30, and >30 minutes) for 3-hourly periods (0000-0300, 0300-0600, ... 2100-2400); monthly and annual frequencies of maximum speeds (≤ 30, 31-40, 41-60, 61-80, and >80 knots) for 3-hourly periods (0000-0300, 0300-0600, ... 2100-2400); monthly and annual squall direction (16 pts and calm) frequencies; date, time of commencement, duration, maximum speed, and direction of squalls when two or more occur in 1 day. The above data are for 2-3 stations (Allahabad, Lucknow, and Jodhpur) in India.

229. Banerjee, A.K., and Sharma, K.K. A study of the seasonal oscillations in the upper air temperatures over India. Indian Journal of Meteorology and Geophysics, 18 (1): 69-74. Delhi, January 1967. DAS M(05) I39i.

...The results of the harmonic analysis of the mean monthly upper air temperature of 13 radiosonde stations in India have been presented in this paper. Diagrams showing the spatial distributions of the amplitudes and phase angles of the first two harmonics over the different parts of the country are presented and discussed. Broadly, two

maxima of temperature amplitudes are found, viz., one from ground up to about 850 mb and the other higher up in the troposphere between 600-and 150-mb levels. The existence of these two distinct regimes seem to indicate two different types of physical processes operating the seasonal temperature changes. - Authors' abstract.

230. Banerji, S.; Rao, D.V.L.N.; Julka, M.L.; Anand, C.M. Some further results of investigations on quantitative precipitation forecasting over selected area in north India. Indian Journal of Meteorology and Geophysics, 18 (4): 465-472. Delhi, October 1967. DAS M(05) I39i.

...The present paper gives results on Quantitative Precipitation Forecasting involving application of the forecasting model to each of the days of two monsoon months, viz., July and September 1962. Further in order to simplify these computations and reduce the computational time, partial divergence tables have been prepared for the triangular grid comprising of Allahabad, Calcutta,and Gauhati, which covers the area under investigation. In addition a nomogram has been prepared to facilitate further reduction in computational time in estimating precipitation rates from a knowledge of vertical velocities and moisture content in the vertical. The computation of rainfall made at intervals of twelve-hour period for the two months has then been compared with the actuals which have been evaluated as the arithmetic mean of rainfall recorded by a representative number of raingauges within this grid.

The results of this comparison show that the computed amounts are,in general, an over estimate over the observed amounts. Although it has not been possible to assess the reasons for such variation, to be of any theoretical importance, the computed values have shown that they account for almost all the actual heavy rainfall situations, this in itself forming an interesting result of the investigations. - Authors' abstract.

231. Bedi, H.S.,and Parthasarathy, B. Cold waves over northeast India and neighbourhood. Indian Journal of Meteorology & Geophysics, 18 (3): 371-378. Delhi, July 1967. DAS M(05) I39i.

...Based on 50 years (1915-16 to 1964-65) daily minimum temperature anomalies of meteorological stations in Indo-Pakistan sub-continent north of 22 1/2° N and west of 82 1/2°E, a statistical study of duration, intensity, and movement of cold waves in this region has been made. Duration of cold wave occasionally exceeds 10 days in Baluchistan, Kashmir, and northwest Rajasthan whereas in east Uttar Pradesh, it lasts only for about 2-4 days. Maximum intensity of cold wave is also in Baluschistan, Kashmir, and northwest Rajasthan. In the plains, Gujarat also experiences comparatively intense cold waves. The cold waves are comparatively mild in east Uttar Pradesh.

Source No. 231 continued

Probable duration of cold waves likely to be exceeded once in 5, 10, 25, 50, and 100 years has also been calculated, and duration distribution charts prepared. - Authors' abstract.

232. Biswas, K.R.; Kapoor, R.K. ; Kanuga, K.K.; Ramana Murty, Bh. V. Cloud seeding experiment using common salt. Journal of Applied Meteorology, Boston, 6 (5): 914-923, October 1967. DAS M(05) J86joa.

...An experiment on artificial stimulation of rain using a warm cloud seeding technique was undertaken in three nearby climatologically similar regions, Delhi, Agra, and Jaipur in northwest India. Analysis of the data from 18 experiment-seasons has suggested a positive trend of the result, which is found significant by statistical tests. - Authors' abstract.

233. Bryson, Reid A., and Baerreis, David A. Possibilities of major climatic modification and their implications: Northwest India, a case study. Bulletin of the American Meteorological Society, 48 (3): 136-142, March 1967. DAS M(05) A512b.

...On the basis of field observations and theoretical studies it is believed that the dense pall of local dust over northwestern India and West Pakistan is a significant factor in the development of subsidence over the desert. Archeological evidence derived from the northern portion of the desert within India suggests a pattern of intermittent occupation with the role of man being important in making the desert. As man has made the desert, so through surface stabilization can he reduce the dust and consequently modify the subsidence and precipitation patterns in the region. The social consequences of such climatic modification are briefly considered. - Authors' abstract.

234. Chang, Jen-hu. The Indian summer monsoon. The Geographical Review, 57 (3): 373-396. New York, July 1967. DAS P.

...Qualifies and amplifies the monsoon theory formulated by Halley in 1686 and discusses the Indian monsoon during the summer season when the circulation patterns are unique and most complicated. The discussion presents information on the premonsoon circulation, the burst of the monsoon, the monsoon cell, the monsoon rains, monsoon depressions, breaks in the monsoon, the Thar Desert, and the retreating monsoon.

235. Das Gupta, D.N. Study of heavy rainfall associated with low pressure microcells over northeast India. Indian Journal of Meteorology & Geophysics, 18 (1): 101-104. Delhi, January 1967. DAS M(05) I39i.

Source No. 235 continued

...Low-pressure vortices of small extent or microcells of low pressure are sometimes embedded in the large-scale circulation of the lower levels of the atmosphere. These can be located on the surface isobaric charts plotted on a large scale map by drawing isobars at intervals of 1.0 or 0.5 mb. It is seen that location and movement of these vortices sometimes influence distribution of rainfall over small areas. The spots of heavier rainfall tend to move near to the microcells of low pressure. A meso-scale network of observing stations is necessary for precise location of these cells and for study of their movements and influence on rainfall distribution. Results of studies with available observations on some typical days of the monsoon season in 1961 are presented in this paper. - Author's abstract.

236. Desai, B.N. Circulation over India and neighbourhood during the south-west monsoon season. Indian Journal of Meteorology and Geophysics, 18 (4): 459-464. Delhi, October 1967. DAS M(05) I39i.

...A survey has been made of circulation over India and neighbourhood as represented by streamlines analysis by different authors for July and of the theories put forward by different workers about the south-west monsoon taking into consideration the IIOE observations over the Arabian Sea and facts of weather, climatology, and orographic features of the country. It is shown that the claims of the exponents of streamlines analysis regarding its utility in day-to-day forecasting have to be treated with considerable reserve as the same does not give adequate importance to topographical features which play a vital role in the (a) production of rainfall besides convergence and upglide action, (b) modification of the properties of the air masses involved, and (c) deflection of the air streams which contributes significantly in making the Indian southwest monsoon a selfsustaining system in the lower levels of the atmosphere. The significant layers would appear to be from the surface up to about 500 mb; the position of the partition at 9 and 12 km between the middle latitude westerlies and the easterlies to their south remains about the same in the July "mean" and in "active" and "break" monsoon conditions. - Author's abstract.

237. India. Meteorological Department. Magnetic, meteorological and atmospheric electric observations made at the government observatories at Bombay and Alibag... 1845- ... (1967). Record not complete prior to 1879. Beginning in 1945 issued in 2 parts; only Part II relevant to this bibliography. Issuing office and title vary. DAS M06.1/54 I39m.

...The following data are presented for Colaba, Bombay, for 1945-1967 (earlier years not surveyed) of hourly observations with monthly summaries for each hour of pressure, temperature, and relative humidity;

Source No. 237 continued

daily and monthly means of pressure, temperature, relative humidity, vapor pressure, and wind direction and speed; daily maximum and minimum with time of occurrence of pressure, temperature, relative humidity, and wind speed; hourly rainfall amounts (total for 60 minutes) with monthly totals for each hour; daily and monthly total rainfall amount; daily maximum rainfall amount in one hour with time of occurrence; hourly (averages for 60 minutes) wind speed and direction with monthly means for each hour; monthly mean vapor pressure for each hour; observations at 3-6 hours per day of cloud forms with amount for each form, total cloud amount, and visibility; daily weather remarks; monthly total cloud amount at 5-6 specified hours.

238. India. Meteorological Department. Statement of actual rainfall in the monsoon season, June to September. 1927-1935, 1937-1940, 1946, 1950-1953, 1955-1961, 1966-1967. DAS M06.1/54 I39sa.

...Contains tabular summaries during each year (1927-1935, 1937-1940, 1946, 1950-1953, 1955-1961, 1966-1967) of actual rainfall amount with departure from normal and percentage departure from normal for two periods, (1) June to September and (2) August and September for each sub-division and forecast division of India. There are also comparisons of the forecast for each period with the actual rainfall.

239. Joseph, P.V. A case of very low latitude occurrence of the subtropical jet stream over the Indian region. Indian Journal of Meteorology & Geophysics, Delhi, 18 (2): 217-226, April 1967. DAS M(05) I39i.

...This paper is a case study of an unusual excursion of the subtropical jet stream into very low latitudes. From 18 December 1963, the subtropical jet stream began moving south from its normal position, roughly Bahrain to Delhi, consequent to the formation of a deep trough in the upper tropospheric westerlies, near Bahrain longitude. At 0000 GMT on 24 December 1963, the subtropical jet is located along Aden-Visakhapatnam, with Aden recording a maximum of 120 kts westerly, which is quite unusual. The vertical cross-section along 80° E for 0000 GMT of 24 December 1963 shows clearly two jet streams, the subtropical jet stream core near Visakhapatnam, below the tropical tropopause and close to a break in the tropopause and another jet stream core, over Delhi, in the angle formed by the tropopause and an inclined front which does not extend below 500 mb. - Author's abstract.

240. Joseph, P.V. A study of maximum wind surface in the easterly jet stream over India during July 1966. Indian Journal of Meteorology & Geophysics, 18 (2): 213-216. Delhi, April 1967. DAS M(05) I39i.

Source No. 240 continued

...In this paper a study is made of the level of maximum wind of the easterly jet stream over India using July 1966 upper wind data. It is found that, in general during the month, the level of maximum wind increases in height from about 13-15 km near Trivandrum latitude to about 16-18 km at about 15-20 degrees North latitude and towards further north decreases to at times as low a height as 12-13 km near Allahabad-Delhi latitudes. Many of the 200-mb charts of July 1966 show two distinct jet axes 10-15 degrees latitude apart, the northern jet axis being of very limited longitudinal extent. The author finds that double jets occur on 200-mb charts due to the inverted V-shaped nature of the north-south vertical profile of the level of maximum wind. A tentative schematic diagram of a typical north-south vertical section of the easterly wind field of July 1966 is presented in the paper. - Author's abstract.

241. Parthasarathy, B. Seasonal oscillation of bright sunshine in India and neighbourhood. Indian Journal of Meteorology & Geophysics, 18 (2): 263-266. Delhi, April 1967. DAS M(05) I39i.

... Calculated bright sunshine values are available in India. A study of its seasonal variation has been taken up. The amplitude of the annual and semi-annual variations of bright sunshine are largest in the west central part of the country. - Author's abstract.

242. Raghavan, K. A climatological study of severe cold waves in India. Indian Journal of Meteorology & Geophysics, 18 (1): 91-96. Delhi, January 1967. DAS M(05) I39i.

...Results of a climatological study of severe cold waves in India based on observations extending over a period of 51 years are presented. The main aspects considered are the period of occurrence, frequency, intensity, persistency, extent, development, and decay. - Author's abstract.

243. Ramachandran, G. Rainfall distribution in India in relation to latitude, longitude and elevation. Indian Journal of Meteorology & Geophysics, 18 (2): 227-232. Delhi, April 1967. DAS M(05) I39i.

...An analysis of the normal rainfall of 167 observatory stations distributed over India and the neighbourhood has been made using regression equations representing monthly and annual rainfall as a linear function of latitude, longitude, and elevation above sea level. The multiple CCs are high, being 0.8 to 0.9 except in some months.

The anomalies after eliminating the systematic variations have also been studied. These bring to light other factors which influence rainfall, viz., the orographic effects and the effect of lee-side of mountains. - Author's abstract.

244. Sen, A.K. Enhancement of atmospherics in relation to pre-monsoon and monsoon thunderstorms. Indian Journal of Meteorology and Geophysics, 18 (4): 447-458. Delhi, October 1967. DAS M(05) I39i.

...Enhancements of atmospherics associated with local thunderstorms occurring in a tropical station, Calcutta, were studied on 30 kc/s. The various stages of an enhancement were correlated with the different stages of development of thunderclouds occurring in the rainy seasons. The results show an association of a sudden increase and sudden decrease of atmospherics in the pre-monsoon and the monsoon seasons respectively, with precipitation. Atmospherics activity noticed early in the process of development of clouds before any precipitation occurs and even before the cloud has, perhaps, developed up to the ice-forming level, is indicated. The potential meteorological importance of the enhancements, in forecasting the thunderstorms and also in providing with a new insight into the mechanism of charge separation in thunderclouds, is discussed. The studies also indicate the significance of cloud discharges as a source of atmospheric radio noise. - Author's abstract.

245. U.S. Air Weather Service. U.S. Naval weather Service world-wide airfield summaries. Vol. II.Parts I and II. Middle East. October 1967. DAS M06.3 U5815u.

...Presents tabular monthly and annual summaries over specified periods (vary by airfield and element) of absolute and mean maximum and minimum temperatures (°F), mean number of days with maximum temperature ≥ 90°F, mean number of days with minimum temperatures ≤ 32°F and ≤ 0°F, mean dew point temperature (°F), mean relative humidity, mean pressure altitude (ft), mean precipitation amount (in), mean snowfall amount (in), mean number of days with precipitation ≥ 0.1", mean number of days with snowfall ≥ 1.5", and mean number of days with thunderstorms at Car Nicobar Airfield, 1-5 airfields (Gilgit, Srinagar, Dras, Leh, and Jammu) in Jammu and Kashmir, and 80-116 airfields in India; mean number of days with visibility $< 1/2$ mi, percent frequency of wind speed ≥ 17 knots and ≥ 28 knots, and percent frequency of ceiling < 5000 ft and/or visibility < 5 miles for 64-97 airfields in India; percent frequency of ceiling < 1500 ft (< 300 ft) and/or visibility < 3 mi (< 1 mi) for specified 3-hourly periods during the day at 5 airfields in Jammu and Kashmir and 107 airfields in India; mean number days with ceiling ≥ 1000 ft and visibility ≥ 3 mi, ceiling ≥ 2000 ft and visibility ≥ 3 mi with surface winds < 10 knots, surface wind ≥ 17 knots and no precipitation, surface wind 4-10 knots and temperature 33°-89°F with no precipitation, sky cover < 3 tenths and visibility ≥ 3 mi, ceiling ≥ 2500 ft and visibility ≥ 3 mi, ceiling ≥ 6000 ft and visibility ≥ 3 mi, and ceiling $\geq 10,000$ ft and visibility ≥ 3 mi at 1-4 specified hours for 5 airfields areas in Jammu and Kashmir, the climatic area of Jammu

Source No. 245 continued

and Kashmir, 106 airfield areas in India, and 6 climatic areas of India; mean maximum and minimum temperatures (°F) and largest and smallest mean total precipitation amounts for the Andaman/Nicobar Islands area, climatic area of Jammu and Kashmir, and 6 climatic areas of India.

246. U.S. Naval Oceanographic Office. Sailing directions for the west coast of India; includes Ceylon and Maldive and Laccadive Islands. H.O. Pub. 63. Fifth edition. 359 pp. 1967. DAS M82/267 U58sd 1967.

...Discusses general weather conditions, pressure, extratropical and tropical cyclones, winds, monsoons, autumn transition period, land and sea breezes, temperature, precipitation, thunderstorms, cloudiness and visibility for the south and west coasts of India, Ceylon, eastern coast of West Pakistan and the Arabian Sea on pages 14-30 and 287. The tables present seasonal sea and swell frequencies and monthly and annual summaries of mean sea-level pressure (mb), mean temperature (°F), mean daily maximum and minimum temperatures(°F), absolute maximum and minimum temperatures (°F), mean relative humidity at 0800 and 1600 or 1700, mean cloud amount (tenths) at 0800, mean total amount of precipitation (inches), greatest and least amounts of precipitation (inches), maximum amount of precipitation in 24 hours in inches, mean number of days with precipitation ≥ 0.01", mean cloud amount (tenths), mean number of days with cloud amount $< 3/10$ and $> 7/10$ of the average amount, wind direction (8 points and calm) frequency at two specified hours (hours vary by station), mean wind speed in knots, mean number of days with wind speed ≥ 34 knots, mean wind speed at two specified hours in knots and mean number of days with visibility < 1100 yds. at 1-13 stations in India. Periods of record vary by station and element.

247. U.S. weather Bureau. 0-3/10 cloud cover information for selected sites around the world. June 1967. DAS M76.2 U587ze.

...Includes tabular monthly and annual summaries of % of days with 0-3/10 cloud cover and monthly per cent of possible sunshine for 7-9 stations in India based on specified periods of records. Data are recorded for Fukche, Ambala, Khali Kundah, Calcutta, Madras, Bareilly, Siliguri, Patna, and Dibrugarh.

248. Venkataraman, S., and Krishnamurthy, V. The radiation climate over India. Indian Journal of Meteorology & Geophysics, 18 (1): 39-44. Delhi, January 1967. DAS M(05) I39i.

...As solar radiation data for India available at present are not extensive enough to meet the increasing demands for the climatological

Source No. 248 continued

information of this parameter, use of data of bright hours of sunshine to estimate the radiation receipt is examined. Monthly normal radiation maps based on the estimated solar radiation values for 52 stations are presented and discussed. - Authors' abstract.

249. Venkiteshwaran, S.P., and Swaminathan, M.S. An estimate of thermal comfort at some stations in India. Indian Journal of Meteorology & Geophysics, 18 (1): 27-38. Delhi, January 1967. DAS M(05) I39i.

...The paper describes briefly how the thermal aspect influences comfort. Since comfort depends not only on the temperature of the air, but also on the relative humidity and air movement, no simple formula to obtain an index involving all the factors is available. In this paper Thom's simple empirical formula for a Discomfort Index $= 0.4 \times (t_d + t_w) + 15$, where t_d is air temperature and t_w is the wet bulb temperature, is used and the mean hourly values of discomfort index are calculated for different months for the 5 stations, New Delhi, Calcutta, Poona, Madras, and Trivandrum. According to Thom people in the U.S.A., feel discomfort as the index rises above 70 and everyone is uncomfortable by the time the index reaches 79. When the index becomes 86 or higher, in Washington metropolitan area, mass dismissal of employees is permitted. The analysis of Indian data shows that in general, the prevailing DI for India is in the range 76-80 or less, except in the summer months, April-May to September, when it exceeds this value. Poona has the largest number of hour days with DI = or < 75. In the range DI = 76-80, Poona and Trivandrum have the largest and almost similar values, viz., 8224 and 8343 hour-days, respectively, but a possible total of 8760 during the year. DI = 86-90 is experienced in the premonsoon months only in New Delhi (368 hour-days), Calcutta (183), and Madras (239). It is generally observed that the indices can be adopted for the tropical Indian conditions also. They will, therefore, be of value to visitors from abroad and to the Indians. They will also be useful to plan air conditioning units for Indian use. - Authors' abstract.

250. Viswanadham, Y., and Ramanadham, R. Studies on night radiation at some Indian stations. Pure and Applied Geophysics, 68 (1967/III): 214-228. Basel and Stuttgart, 1967. DAS P.

...The present paper contains studies of the nocturnal radiation at some Indian Stations (Madras, Waltair, Nagpur, New Delhi, and Poona) with the help of the Ångström compensation Pyrgeometer. The technique of measurement is also described briefly. A study of the mean monthly variation of sky radiation during clear as well as all nights has been discussed. A comparative study of mean monthly values of sky and other nocturnal radiation components at these stations is also presented. - From the authors' abstract.

251. Williams, S.D. Thermal structure of the troposphere over Bangalore. Indian Journal of Meteorology & Geophysics, 18 (3): 379-382. Delhi, July 1967. DAS M(05) I39i.

...The paper presents monthly mean values of upper air temperatures over Bangalore at 5000, 10,000, ..., 50,000 ft a.s.l. based on the 00 Z radiosonde data for the period 1961-1965. The diurnal variation of temperature at these levels on the basis of 00 and 12 Z data is found to be generally less than 1°C, the evening temperatures being higher. Lapse rates are higher in the evenings below 10,000 ft but show little variation aloft. - Author's abstract.

252. Wright, P.B. Changes in 200 mb circulation patterns related to the development of the Indian south-west monsoon. Meteorological Magazine, 96 (1143): 302-315. London, October 1967. DAS M(05) G786m.

...The upper tropospheric circulation pattern over India from April to June is discussed, and it is shown that sudden changes occur. The advance of the south-west monsoon up to the west coast of India is shown to be closely related to these changes and also to the strength of the lower tropospheric westerly flow over the Indian Ocean.

A mechanism is suggested to explain the observed changes in the upper flow and how they influence the progress of the south-west monsoon. - Author's abstract.

1968

253. Chacko, O. ; Krishnamurthy, V.; Desikan, V. Global solar radiation flux measurements over India during the IQSY. Indian Journal of Meteorology & Geophysics, Delhi, 19 (1): 89-92, January 1968. DAS M(05) I39i.

...Results of measurements of global solar radiation made at a network of 14 stations including 2 island stations in India during the IQSY have been studied. The radiation climate of India relating to global radiation and the monthly and seasonal variation of global radiation over India are discussed. - Authors' abstract.

254. Chacko, O.; Thomas, C.T.; Mani, A. Surface radiation balance measurements in India during the IQSY. Indian Journal of Meteorology & Geophysics, Delhi, 19 (1): 93-98, January 1968. DAS M(05) I39i.

...Results of surface radiation balance measurements at Poona, Calcutta, and Delhi during the IQSY are presented. The diurnal, seasonal, and spatial variations of net radiation are discussed, with reference to solar elevation, cloudiness albedo, and surface moisture and temperature.

Source No. 254 continued

Net radiation during day is a maximum during the clear summer months and least during cloudy monsoon and winter months. At night net radiation is negative and generally very small or zero. Marked differences are present in the magnitude and the distribution of net radiation at Poona, Calcutta, and Delhi. - Authors' abstract.

255. Desikan, V.; Swaminathan, M.S.; Chacko, O. Distribution of sunshine and global solar radiation over the arid and semi-arid regions in the Indian sub-continent. Indian Journal of Meteorology & Geophysics, Delhi, 19 (2): 149-158, April 1968. DAS M(05) I39i.

...A study of the distribution of sunshine and global solar radiation over the arid and semi-arid zones of the Indian sub-continent has been made. Over these regions about 500 cal/cm^2 are received daily during the major part of a year. During monsoon and winter seasons, global radiation drops to about 300-400 cal/cm^2 per day. The article discusses in detail the distribution of the duration of sunshine and the daily and hourly distribution of global radiation over these areas. The effect of seasonal weather conditions are also pointed out. - Authors' abstract.

256. Domrös, Manfred. "Zur Frage der Niederschlagshäufigkeit auf dem Indisch-Pakistanischen Subkontinent nach Jahresabschnitten." (On the question of rain frequency on the Indo-Pakistan subcontinent according to annual periods.) Meteorologische Rundschau, 21 (2): 35-43, March-April 1968. (In German). DAS M(05) M587.

...Based on monthly means of rain frequency of 2912 raingauge stations on the Indo-Pakistan subcontinent the author has compiled maps of rain frequency (number of rainy days) for the periods: January-March (Winter monsoon), April-May (Hot period or pre-monsoon period), June-September (Summer monsoon), October-December (Post-monsoon period or retreat of the monsoon). The present paper offers a condensed review of the rain frequency maps and tries to explain local differences in rain frequency.

During what the author calls winter monsoon period the regime of the winter monsoon or NE-Passat results in a rather low rain frequency over the Indo-Pakistan subcontinent; during that time rainfall in the N of the subcontinent is caused by western disturbances. The map of rain frequency during pre-monsoon period clearly shows an increase of the rain frequency in South, East, and especially Northeast of the subcontinent; this is the result of a change of low-level wind flow conditions of the winter monsoon, based on the establishment of a heat low above the southern parts of the subcontinent. During summer monsoon period the SW monsoon is responsible for the maximum of rain frequency as well as for remarkable local differences. Abundant

Source No. 256 continued

precipitation is partly the result of the equatorial westerlies (SW monsoon) causing orographic rainfall in the W-Ghats and W-coast as well as in Assam/Bengal (in this area correlated with the quasi-stationary monsoon convergence above the Khasia-Hills), but also of travelling disturbances: monsoon depression along the monsoon trough are responsible for rainfall in the eastern parts of the Deccan Plateau. During postmonsoon period the subcontinent is marked by rather low rain frequency; rainfall is important only in SE India, caused by cyclonal disturbances. - English summary.

257. Harihara Ayyar, P.S., and Krishnamurthy, V. Net radiation climate of India. Indian Journal of Meteorology & Geophysics, 19 (2): 203-208, April 1968. DAS M(05) I39i.

...A formula has been derived for computing net radiation using (1) radiation received outside the earth's atmosphere, (2) actual duration of bright sunshine, and (3) maximum possible duration of bright sunshine. Computed values and actual recorded values are shown to be generally in good agreement for Poona and Calcutta, for which recorded values are available. Net radiation values are computed for 79 stations in India using the formula and maps are prepared showing the net radiation over India in each month. The main features of the monthly distribution of net radiation over the country are discussed. - Authors' abstract.

258. India. Meteorological Department. Statement of the rainfall and snowfall of Northwest India in January, February and March..., 1913-1941, 1948-1959, 1961-1962, 1968. Title varies prior to 1937. Simla (prior to 1928) and Poona. DAS C/ef AO-fr.

...Consists of brief notes on the actual rainfall and actual snowfall for January and February for each year prior to 1921; brief notes on the actual rainfall and actual snowfall for January, February, and March for each year from 1921 to date; comparisons of rainfall with forecast for each year prior to 1938; summaries of weather conditions and conclusions for each year from 1938 to date. The above-mentioned information is for subdivisions of prepartitioned Northwest India prior to 1949 and for Northwest India for 1950 to date. Northwest India currently consists of Uttar Pradesh, Haryana, the Punjab, Himachal Pradesh, Delhi, Chandigarh, Rajasthan, and Gujarat.

259. Jagannathan, P. Seasonal forecasting in India: a review. 69 pp. Poona, Meteorological Office, 1968. DAS A QC995 J3.

Source No. 259 continued

...Long-range weather forecasting has been attempted so far by three methods, viz., periodicity approach, correlation approach, and atmospheric circulation approach. The seasonal forecasting methods have progressed from the pre-instrumental period, when the nature of the monsoon rains was based on planetary considerations, to new regression formulae connecting the monsoon and winter rainfall over NW India. A review of the forecast formulae used in India, the limitations of the correlation approach, and suggestions for future work have been presented. The appendices list landmarks in seasonal forecasting in India, papers which have a bearing on long-range forecasting in India, factors utilized for forecasting seasonal rainfall in India, factors used in seasonal forecasts in recent years, and seasonal forecast formulae for 1908-1946.

260. Kolar Gold Field Observatory, Oorgaum, South India. "Summary of meteorological observations". 1909-1968. DAS M06.3/54 K81s.

...Presents monthly and annual summaries of mean pressure, mean maximum and minimum dry bulb and wet bulb temperatures with ranges, mean dry bulb and wet bulb temperatures, absolute maximum and minimum temperatures, wind movement, wind direction, mean vapor pressure, mean relative humidity, total rainfall amount, maximum rainfall amount in a day, number of rainy days, and mean cloud amount for each year (1926-1931, 1933-1956, 1958-1960, 1962-1968) and for accumulative periods (1909-1926, 1909-1927,... 1909-1968) at the Kolar Gold Field Observatory. There are also monthly frequencies of daily maximum and minimum dry bulb and wet bulb temperatures over some cumulative periods between 1909 and 1968; annual and seasonal (NE monsoon and SW monsoon) total rainfall amount for each year 1909-1968; monthly and annual mean maximum and mean minimum solar radiation temperatures based on data for the period (1915-1922).

261. Rana, Ratna Shumsher. The summer monsoon in India. Journal of Geography, LXVII (5): 293-300. May 1968. DAS P.

...Presents information on the classical approach to monsoon, temperature conditions during the period of the summer monsoon, summer circulation, the mechanism of the summer monsoon, the "burst" of the summer monsoon, the surges and the breaks of the summer monsoon and rainfall distribution over India during the period of summer monsoon.

262. Sajnani, P.P. Divergence, vorticity and vertical motion in the fields of winter and monsoon circulations over India. Indian Journal of Meteorology and Geophysics, Delhi, 19 (4): 391-394, October 1968. DAS M(05) I39i.

Source No. 262 continued

...Using upper wind data of 69 pilot balloon and rawin stations in India, Pakistan, Burma, and Ceylon, multi-level fields of divergence, vorticity, and vertical motion have been computed on five consecutive days in the months of January and July 1958 to study the winter and monsoon circulations over the Indian region. Computations have been made at 37 grid points 2.5 degrees apart, with the help of a digital computer. A filtering technique was used to smoothen the observed winds so as to filter out noise.

The study provides a convenient method of computing divergence directly from observed winds instead of doing so indirectly through the vorticity equation. The computed values of divergence and vorticity show that the two are of comparable magnitude. Examination of the divergence fields does not reveal narrow bands of convergence, characteristic of well-defined frontal systems. The distribution of vertical velocities in the monsoon field indicates the existence of a source region over the eastern half of India and a sink over the western half. - Author's abstract.

1969

263. Banerjee, A.K.; Sharma, K.K.; Chowdhury, A.B. Abnormal rise of surface temperature in association with thunderstorm downdrafts. Indian Journal of Meteorology & Geophysics, Delhi, 20 (1): 17-22, January 1969. DAS M(05) I39i.

...In association with downdrafts from thunderclouds, an abrupt and abnormal rise in surface temperature of the order of 5 to 6° C was recorded at Nagpur and Visakhapatnam on two different days during summer season, and with this abrupt rise the surface temperature touched once again the day's maximum temperature at these two places recorded earlier in the afternoon. These two cases are described in this paper, and a plausible explanation for the abrupt rise in temperature is also presented. - Authors' abstract.

264. Bedekar, V.C., and Banerjee, A.K. A study of climatological and other rainfall patterns over central India. Indian Journal of Meteorology & Geophysics, 20 (1): 23-30, January 1969. DAS M(05) I39i.

...The study is divided into three parts, viz., (a) The normal monthly rainfall charts during monsoon months for Madhya Pradesh and Vidarbha have been presented, and the results of the analysis discussed; (b) The spatial distribution of rainfall associated with monsoon depressions moving across Central India has been depicted and a method to forecast the same has been described; and (c) The character of rainfall at different places in and around a low-level convergence zone occurring over the above area has been brought out with the help of self-recording raingauge charts and its usefulness in local forecasting has been indicated. - Authors' abstract.

265. Bhargava, B.N., and Bansal, R.K. A quasi-biennial oscillation in precipitation at some Indian stations. Indian Journal of Meteorology & Geophysics, 20 (2): 127-128, April 1969. DAS M(05) I39i.

...A search has been made for quasi-biennal oscillation in precipitation from analysis of yearly rainfall data from seven Indian stations. Results indicate the presence of a significant oscillation at Bombay and of a weak oscillation at five of the six other stations. - Authors' abstract.

266. Desikan, V.; Iyer, N.V.; Rahalkar, C.G. Diffuse solar (sky) radiation measurements over India. Indian Journal of Meteorology & Geophysics, 20 (4): 389-394, October 1969. DAS M(05) I39i.

...The paper summarises the results of measurements of diffuse solar radiation made at a network of 10 stations in India since 1958. In highly polluted urban areas the ratio of diffuse to global radiation is almost twice that in non-industrial regions. The diffuse radiation has also shown a marked increase in urban areas during the last ten years. - Authors' abstract.

Tables present monthly, seasonal (Feb-May, Jun-Sep and Oct-Jan) and annual mean daily values of diffuse solar radiation (cal/cm^2/day) based on available data for the period 1958-1967 at Poona, Delhi, Madras, Dum Dum, Goa, Trivandrum, Shillong, Nagpur, Ahmedabad, and Visakhapatnam.

267. Garg, H.P., and Gupta, C.L. Design data for direct solar utilization devices. Part II.- Solar radiation data. Indian Journal of Meteorology & Geophysics, 20 (3): 221-226, July 1969. DAS M(05) I39i.

...This paper reports the computed values of conversion factor for obtaining the values of mean monthly daily total solar radiation received on tilted surfaces from the available records on horizontal surfaces for four widely separated Indian cities. The angles of tilt selected are normally used for flat plate collectors during various seasons of the year. Measured values of the ratio of diffused to solar radiation have been used for Delhi and Poona, and computed values for Calcutta and Madras. Liu and Jordan's formulae based on the assumption of an isotropic sky have been employed. - Authors' abstract.

268. Godbole, R.V., and Kelkar, R.R. Net terrestrial radiative heat fluxes over India during monsoon. Indian Journal of Meteorology & Geophysics, Delhi, 20 (1): 1-10, January 1969. DAS M(05) I39i.

...Infra-red radiative heat flux and instantaneous rate of temperature change have been computed for Indian sub-continent for monsoon season

Source No. 268 continued

by making use of the numerical method developed for the purpose. The effects of water vapour alone have been considered. It is found that the radiative heat loss near the surface is minimum over the Western Ghats. Over northeast and northwest India, the radiative heat loss is relatively high. Also, the radiative cooling integrated from the surface up to 300 mb indicates a large cooling over northeast and northwest India (>1°C per day) and relatively small cooling over the southern Peninsula (<0.25°C per day). Analyses of the day-to-day values of net flux and temperature suggest no cause-and-effect relationship. However, a good correspondence has been noticed between net flux, temperature, and total moisture content as far as surface level is concerned. The day-to-day values of net flux at higher levels follow very closely to those at surface. - Authors' abstract.

269. India. Meteorological Department. Aerological data of India. February 1968-March 1969 (excluding February 1969). New Delhi. DAS M06.7/54 I39ae.

...Consists of observations at 0000 and 1200 GMT with monthly summaries of pressure (surface), altitude of isobaric surface, temperature, dew point temperature, wind direction, and wind speed at surface and specified millibar levels; observations at 0000 and 1200 GMT of amount of low cloud (if no low cloud, then middle cloud amount), low clouds, height of base of lowest cloud, middle clouds, high clouds, present weather, and past weather; monthly summaries at 0000 and 1200 GMT of maximum and minimum temperatures, mean scalar wind and wind steadiness at surface and specified millibar levels; observations at 0000 and 1200 GMT of pressure, altitude and temperature at maximum height, freezing level and tropopause; observations at 1-4 hours (0000, 0600, 1200, and 1800 GMT) of wind speed and direction and monthly mean resultant wind direction and velocity, scalar wind and steadiness factor at surface and specified heights; daily altitude, direction, and speed of maximum of winds aloft at 0000, 0600, 1200, and 1800 GMT. Data for 64-71 stations are included, however, number of stations recording individual elements vary. See: Indian Daily Weather Report, India Weather Review and Indian Journal of Meteorology and Geophysics for upper air, upper wind, and ozone data prior to 1968.

270. Kulkarni, N.S., and Pant, M.B. The cumulative frequency distribution of rainfall of different intensities. Indian Journal of Meteorology & Geophysics, Delhi, 20 (2): 109-114, April 1969. DAS M(05) I39i.

...Presents a study on the cumulative frequency distribution of rainfall of different intensities for twenty stations in India. Information on method of analysis and the behavior of hypothetical frequency curves are presented. Tables contain observed and computed cumulative and actual frequencies of daily (24-hour) intensity of rainfall based on

data for 50 years (1901-1950) and observed and computed number of rainy days based on data for the same period for 10 selected stations in India.

1970

271. Ananthakrishnan, R. Reversal of pressure gradients and wind circulation across India and the southwest monsoon. Royal Meteorological Society, Quarterly Journal, 96 (409): 539-542, July 1970. DAS M(05) R888q.

...This paper describes some features of the climatology of the free atmosphere over India which are related to the onset and withdrawal of the monsoon. - Author's abstract.

272. Datta, R.K.; Chhabra, B.M.; Singh, B.V. An experiment in objective analysis for 500 mb. Indian Journal of Meteorology & Geophysics, 21 (3): 437-442, July 1970. DAS M(05) I39i.

...The present report gives the results of an experiment in objective analysis with Indian data. The technique is similar to Cressman's method, with an additional check for horizontal consistency of data.

The average of 5-day normals and the previous 24-hr forecast were used as the first-guess. The first-guess was then improved with the available current data by using suitable weighting factors.

The results of using successive scans of radius 5, 10, and 15 degrees (latitude/longitude) are reported in this report. - Authors' abstract.

273. De, A.C. Further studies on runway temperature and screen temperature observations made at Dum Dum Airport, Calcutta. Indian Journal of Meteorology and Geophysics, 21 (4): 577-582, October 1970. DAS M(05) I39i.

...Result of a study of runway and screen temperature observations made at Dum Dum airport, Calcutta at six synoptic hours (00, 03, 06, 09, 12, and 18 GMT) for a period of 21 months was reported earlier by the author. The same has now been extended for a further period of 24 months. The result of the study for the entire period of 45 months reveals that the runway temperature is generally higher than the screen temperature, the average value of difference of runway and screen temperature readings being generally less than 1° C. In extreme cases, the absolute value of the difference could be as high as ± 4 °C. The diurnal and seasonal variation of the difference has been discussed. The effect of surface wind, radiation, and other factors on the value of the difference has been also discussed. - Author's abstract.

274. De, U.S. Lee waves as evidenced by satellite cloud pictures. Indian Journal of Meteorology & Geophysics, 21 (4): 637-642, October 1970. DAS M(05) I39i.

...The paper presents the observational evidence of mountain waves in the Indian region with particular reference to the Assam and Burma hills with the help of satellite pictures. In all, sixteen cases have been studied,and the observed wavelengths vary between 17-34 km. In all the cases the conditions for formation of mountain waves were found favourable as evidenced by the wind profile and thermal stability of the atmosphere. - Author's abstract.

275. Flohn, H. Elements of a synoptic climatology of the Indo-Pakistan subcontinent. Bonner Meteorologische Abhandlungen, Heft 14, Investigations of the Indian Monsoon Climate, pp. 5-28. Bonn, 1970. DAS M(055) B716bon Heft 14.

...From synoptic and aerologic data - together with many pictures from meteorological satellites - the seasonal varying large-scale flow patterns above the Indo-Pakistan subcontinent are outlined, together with the rain frequency distribution. Special consideration is given to the development of summer monsoon winds and rainfall patterns and the differences between them and to the role of the Tibetan highlands in these processes.- Author's abstract.

276. Ganesan, H.R. Estimates of solar radiation over India. Indian Journal of Meteorology & Geophysics, 21 (4): 629-636, October 1970. DAS M(05) I39i.

...Some of the empirical relationships developed for the estimation of global solar radiation from sunshine and cloudiness data are discussed, and based on data for more than five years from a network of 10 principal radiation stations, a regression formula has been derived for the Indian area. This equation is then applied to sunshine and cloudiness data from 52 Indian stations to obtain estimated values of global solar radiation for four representative months January, May, July and October. May is considered, instead of April, as the values obtained in that month are higher than in April.

Global solar radiation is seen to be a maximum, exceeding 620 cal/cm^2/ day, in May over northwestern parts of the country and a minimum, less than 320 cal/cm^2/ day, in January over northern India.

Values of out-going longwave radiation have also been estimated, using Brunt's empirical formula and net radiation values calculated, assuming various values of albedo for various types of soil. It is seen that the distribution of outgoing radiation follows the general

Source No. 276 continued

climatic pattern as determined by the temperature and vapour pressure and net radiation does not vary appreciably over the whole country during the summer monsoon season. - Author's abstract.

277. Gangopadhyaya, M.; Datar, S.V.; George, C.J. On the global solar radiation climate and evapotranspiration estimates in India. Indian Journal of Meteorology & Geophysics, 21 (1):23-30, January 1970. DAS M(05) I39i.

...Discusses Penman's method; graphical coaxial technique developed by Kohler, Nordenson, and Fox; and McIlory method for estimating evapotranspiration. Each method requires a knowledge of global or net radiation. A table presents monthly mean values of actual and estimated pan evaporation using Penman's equation and Kohler's graphical technique.

278. George, C.A. Interaction between lower and upper tropical tropospheres during the southwest monsoon season over India. Indian Journal of Meteorology and Geophysics, Delhi, 21 (3): 401-414, July 1970. DAS M(05) I39i.

...Raman and Ramanathan's suggestion that latent heat released by "excessive cloudiness and copious precipitation" speeds up upper tropospheric winds over the west coast of India during the southwest monsoon is not borne out by observational evidence. Their proposition is shown to support rather than contradict Koteswaram's hypothesis regarding upper tropospheric easterlies and southwest monsoon activity along the west coast of India. The influence of these easterlies on the onset of monsoon over Kerala is illustrated for the years 1961-68. - Author's abstract.

279. India. Meteorological Department. Memorandum on the rainfall of June and July and the probable amount during August and September, 1916-1938, 1941, 1947-1954, 1956-1957, 1959-1961, 1968-... (1970). New Delhi. DAS C/ef AO-fm.

...Describes the weather in India for July and August, presents conditions having influence on the rain of August and September, and gives inferences from the information for each year. The tables contain (1) total rainfall amounts with departures from the normal for June and for July in the sub-divisions of India for each year (1916-1926) and (2) total rainfall amounts with departures from the normal for the period (June and July) in the subdivisions of India for each year (1916-1938, 1941, 1947-1954, 1956-1957, 1959-1961, 1968-1970).

280. India. Meteorological Department. Memorandum regarding the probable amount of monsoon rainfall in..., 1902-1937, 1939-1940, 1948, 1950-1954, 1956-1957, 1959-1961, 1969-... (1970). Title varies. DAS C/ef AO-f.

...Presents data over the world which seem to be important in affecting the monsoon rainfall of India, inferences from the information,and a summary of the forecast for each year from 1916 to date. Data prior to 1916 are not included in this abstract.

281. India. Meteorological Department. Silver Jubilee souvenir of the Regional Meteorological Centre and the Meteorological Communication Centre, Bombay, 1945-1970. various pagings. 1970. DAS M03 I39si.

...Presents an organization chart of India Meteorological Department, which includes the Regional Centres located at Bombay, Calcutta, Madras, Nagpur, and New Delhi. The activities, research papers published,and list of personnel are included for each Centre.

282. Leningrad. Glavnaia Geofizicheskaia Observatoriia. Solar radiation and radiation balance data (the world network). 1965-...(October 1970). DAS M21.12 L566so.

...Includes tabular daily and monthly sums and monthly means of total solar radiation in cal/cm^2 at 10-15 stations in India during the period January 1965-October 1970.

283. Mokashi, R.Y. A study of vertical wind profile of the tropical easterly jet stream over Madras. Indian Journal of Meteorology & Geophysics, Delhi, 21 (3): 415-420, July 1970. DAS M(05) I39i.

...Rawin observations for the months June to September during five consecutive years (1961-65) have been analysed to study the vertical wind profile of the tropical easterly jet stream over Madras, Visakhapatnam,and Trivandrum. The main finding is that the stronger the tropical easterly jet stream the higher is the altitude of maximum wind. This is just the opposite of the author's earlier finding in the case of sub-tropical westerly jet stream where the stronger the jet maximum the lower is its level of occurrence. It is also seen that the tropical easterly jet strengthens as one moves towards south from Visakhapatnam to Trivandrum while level of occurrence lowers. - Author's abstract.

284. Mooley, D.A.,and Rao, G. Appa. Statistical distribution of pentad rainfall over India during monsoon season. Indian Journal of Meteorology & Geophysics, 21 (2): 219-230, April 1970. DAS M(05) I39i.

Source No. 284 continued

...Statistical distribution of pentad rainfall during southwest and northeast monsoon seasons, at representative stations in India, has been studied. From the histograms it is seen that these distributions are right (positive) skewed. Gamma distribution function has been fitted to rainfall data, and the goodness of fit of the distribution to the rainfall data has been tested by Chi-square tests. These tests show that pentad rainfall may be described by Gamma distribution. Authors' abstract.

285. Padmanabhamurty, B., and Subba Reddy, E.V. A preliminary study of potential evapotranspiration by Penman's method. Indian Journal of Meteorology & Geophysics, Delhi, 21 (4): 607-612, October 1970. DAS M(05) I39i.

...Potential evapotranspiration was calculated by Penman's equation under different meteorological conditions obtained at diverse climatic stations, classified according to Thornthwaite. The relative importance of the aerodynamic and energy terms in the equation at different climatic stations was also discussed. Comparison of potential evapotranspiration values from Penman's as well as from Pan data also has been made, and the correction factors over the entire climatic spectrum have been worked out and discussed.- Authors' abstract.

286. Pant, P.S.; Abbi, S.D.S.; Gupta, D.K.; Chandra, Harish. A study of major rainstorms of Assam. Indian Journal of Meteorology & Geophysics, 21 (2): 169-181, April 1970. DAS M(05) I39i.

...More than 100 rainstorms of durations ranging from 2 to 7 days during the period 1901-1960 over the Brahmaputra catchment in Assam plains have been studied by the Isohyetal Method. Enveloping curves of maximum depths for various durations are presented and discussed in this paper. The synoptic situations associated with some of the heavy storms are also discussed. - Authors' abstract.

287. Prasad, B. Diurnal variation of rainfall in India. Indian Journal of Meteorology & Geophysics, Delhi, 21 (3): 443-450, July 1970. DAS M(05) I39i.

...The mean hourly rainfall for 15 selected stations having the data for the period 1948-1965 has been studied to find out the diurnal variation of rainfall in India. An attempt has been made to explain the different patterns observed on the basis of the models given by the previous workers. - Author's abstract.

288. Rao, Y.P., and Desai, B.N. The Indian summer monsoon. Symposium on Tropical Meteorology, June 2-11, 1970, University of Hawaii, Honolulu, Hawaii, Proceedings. pp. JV-1 to JV-6. August 1970. DAS M S989pr.

...Discusses important aspects of the Indian monsoon circulation and considers the causes responsible for its performance from the standpoint of rainfall over the Indian subcontinent. The flow of air across the equator under a heat-low influence is so affected by the topographical features that a monsoon circulation is set up in the atmosphere up to about 600 mb over the subcontinent. The monsoon circulation will not develop without the flow of air across the equator. There is no monsoon circulation in May when very little rain falls over the west coast of the Peninsula.

289. Ray, T.K. Use of stability charts in India as a forecasting tool. Indian Journal of Meteorology & Geophysics, 21 (1): 79-80, January 1970. DAS M(05) I39i.

...Showalter's Index has been used on a synoptic scale in charts called stability charts. Stability isopleths are drawn and analysed with distinct low and high stability values. - Author's abstract.

290. Sikka, D.R., and Ramanathan, Y. Some experiments in the objective analysis of the wind-field over India and neighbourhood. Indian Journal of Meteorology & Geophysics, 21 (2): 237-244, April 1970. DAS M(05) I39i.

...As a first step towards preparing input of wind observations for numerical weather prediction work in the Indian region, objective analysis of the wind-field has been made on a number of maps using a variation of Cressman's Scheme. The programme was executed on the CDC 3600 computer adopting a (15 x 17) grid in the region between 20° to 150° E and the equator to 40° N. The streamline patterns obtained by objective analysis for three maps are compared against conventional analyses. Vorticity patterns using the wind obtained from the objective analysis are presented. Root mean square error of the analysed winds with reference to the station observations is found to be about 8 kt. The stream function patterns, as well as 500-mb 24-hour forecast based on non-divergent barotropic model with the objective and the subjective wind analysis as inputs, do not show any synoptically significant differences. - Authors' abstract.

291. Sivaramakrishnan, M.V.; Mokashi, R.Y.; Parameswaran, N.V. Climatology of the tropopause over India. Symposium on Tropical Meteorology, June 2-11, 1970, University of Hawaii, Honolulu, Proceedings. pp. J IV-1 to J IV-6. Editorial Branch of the Hawaii Institute of Geophysics, August 1970. DAS M S989pr.

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...Defines tropopause according to the International Weather Code. The analysis of tropopause deals with types of tropopause, heights of tropopause with standard deviations, seasonal variations, and frequencies of tropopause heights. The tropopause and the level of maximum wind, the tropopause and ozone, and the tropopause and convective activity are also discussed. Tables present for 5-22 stations in India summaries for the period 1963-1967 of averages of heights, their standard deviations, and temperatures at tropopause levels for three-monthly periods (December-February, March-May, June-August, September-November); percentage frequency of heights of tropopause for 2 periods (December-February and June-August); monthly heights of tropopause, maximum wind direction and speed, level of maximum wind, and ozone amount.

292. Srinivasan, V., and Ramakrishnan, A.R. Location of the monsoon trough over India in the lower troposphere during July-August. Symposium on Tropical Meteorology, June 2-11, 1970, University of Hawaii, Honolulu, Proceedings. pp.F VI-1 to F VI-3. Editorial Branch of the Hawaii Institute of Geophysics, August 1970. DAS M S989pr.

...Discusses the daily variation of the location of the monsoon trough over India in the lower troposphere during July-August and the distribution of rainfall associated with it. Some conclusions of this study are: (1) the trough line is in the normal or near-normal position 30-47% of the time and it is north or south of the mean position 53-70% of the time based on data for July and August of the years 1961 to 1969 at 0000 and 1200 GMT, and (2) the monsoon trough is invariably associated with rainfall activity.

293. U.S. Environmental Data Service. Monthly climatic data for the world. 1948 - ... (December 1970). Issuing Office prior to 1966: U.S. Weather Bureau. Asheville, N.C. DAS M06.1 U587m.

... Presents tabular monthly summaries for each year at 8-43 stations in India of mean pressure, mean temperature with departure from the normal, mean relative humidity, total amount of precipitation with departure from normal, mean vapor pressure with departure from normal, total number of days with precipitation ≥ 1 mm, and sunshine duration. There are also monthly summaries of mean height, mean temperature, and mean dew point at specified millibar surfaces; mean height, mean temperature, dew point depression, mean vector wind (steadiness factor, direction and speed) at surface and specified levels; dynamic height, mean temperature, mean dew point, and resultant wind direction and speed at surface and specified millibar surfaces. Period of record varies by station and element.

294. Vittal Sarma, V. A simple method of evaluating vertical velocity over small areas for forecasting heavy rainfall. Indian Journal of Meteorology & Geophysics, 21 (1): 87-92, January 1970. DAS M(05) I39i.

...Vertical motion is an important parameter in any study of the atmospheric process. Evaluation of this parameter from derived values of divergence and vorticity involve elaborate calculations. A simple and quick method by adapting the vorticity equation in a simplified form has been attempted in the present study. The method has been applied to a small area formed by four pibal stations in Gujarat. Vertical velocity for six layers between surface and 700 mb were calculated. With these values, rainfall over the area was also computed and compared with actual observed rainfall. The results are compared and discussed. - Author's abstract.

295. Weather. Indian Journal of Meteorology & Geophysics, Vol. 1-21, 1950-... (October 1970). DAS M(05) I39i.

...Describes monthly and seasonal weather and seasonal upper air features in India for most years from October 1949-May 1970. Listings of disastrous weather events are included for 1968 and 1969.

1971

296. Daniel, C.E.J. Climate of Bombay. Vayu Mandal, 1 (2): 88-92, April-June 1971. DAS QC851.V3.

...Discusses weather conditions in Bombay during the four seasons, viz., cold weather (December-February), hot weather (March-May), southwest monsoon (June-September), and post monsoon (October-November). A table presents monthly summaries of mean daily maximum and minimum temperatures (°C), absolute maximum and minimum temperatures with dates of occurrence, mean relative humidity at 0830 and 1730 IST, mean total rainfall amount (mm), mean number of rainy days, total rainfall amount (mm) for wettest month and driest month with years of occurrence, maximum amount of rainfall (mm) in 24 hours with date of occurrence, and mean wind speed (kph) for two meteorological observatories (Colaba and Santacruz airport) in Bombay.

297. India. Meteorological Department. Memorandum on the probable amount of rain and snow in northwest India in January, February and March ..., 1947, 1950-1954, 1957, 1959-1961, 1971. DAS M82.1/54 I39me.

...Presents the factors which act as guides in forecasting the probable amount of precipitation, the area included in the forecast, the relevant data, and the conclusions for January-March for each year (1947, 1950-1954, 1957, 1959-1961, 1971).

298. India. Meteorological Department. Weekly weather report. July 1942- ... (March 1971). (Broken record). Poona. DAS M06.1/54 I39we.

...Gives for each week a descriptive summary of the weather in India and presents tabular weekly actual and normal rainfall amounts with departures for the different rainfall divisions in this country. For the years 1942-1945 data were included for undivided India (India and Pakistan).

299. Ramaswamy, C., and Kailasanathan, K. Prolonged spells of non-convective sand-storms in the Rajasthan Desert during the southwest monsoon period. Vayu Mandal, 1 (2): 78-83, April-June 1971. DAS QC851.V3.

...Discusses the sandstorms in July 1970, sea-level patterns associated with the sandstorms in July 1970, middle and upper tropospheric flow patterns associated with the sandstorms in July 1970, similar spells of sandstorms in the past 70 years in the month of July, types of sea level patterns associated with non-convective sandstorms in 1901-1970, middle and upper tropospheric flow patterns associated with non-convective sandstorms in 1901-1970, non-convective sandstorms in August, and forecasting of prolonged spells of sandstorms in the monsoon months. It has been concluded that (1) the severe sandstorms in the Rajasthan Desert in July 1970 were large-scale phenomena and were of the non-convective type, (2) similar sandstorms of duration and/or intensity have occurred at one or more stations in the desert in July in other years during the period 1901-1970, and (3) the non-convective sandstorms are associated with steep pressure gradients in the rear of a pronounced ridge at sea level.

300. Saha, Kshudiram. Tornadoes in India. Vayu Mandal, 1 (2): 84-87, 92, April-June 1971. DAS QC851.V3.

...Defines a tornado; discusses briefly the physical features and properties of a tornado, past tornadoes in India, meteorological conditions in which tornadoes may form, India's tornado belt, mechanism of formation of a tornado, forecasting of tornadoes, detection and warning of tornadoes, and how to guard against tornadoes. A table presents date, place, and remarks on some prominent tornadoes reported in India between 1838 and 1963.

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3 Cameroons (AD-670 029)
4 French Equatorial Africa (AD-670 030)
5 Peru (AD-670 031)
6 Rio Muni and Gulf of Guinea Island (AD-670 032)
7 British East Africa II (AD-670 033) (also No. 1)

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8 Angola (AD-669 410)
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