NOAA Technical Memorandum EDS BC-106

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

An Annotated Bibliography of Selected Sources on the Climate of Pakistan 1940-1970

ANNIE E. GRIMES

SILVER SPRING, MD.
August 1972

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

NOAA Technical Memorandum EDS BC-106

AN ANNOTATED BIBLIOGRAPHY OF SELECTED SOURCES ON THE CLIMATE OF PAKISTAN 1940 - 1970

Annie E. Grimes
Atmospheric Sciences Library
Libraries Division
Environmental Science Information Center

SILVER SPRING, MD.
August 1972

UDC 016:551.582(549)"1940/1970"

016	Subject bibliographies
551.5	Meteorology
.582	Climate of particular places
(549)	Pakistan
"1940/1970"	1940-1970

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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.

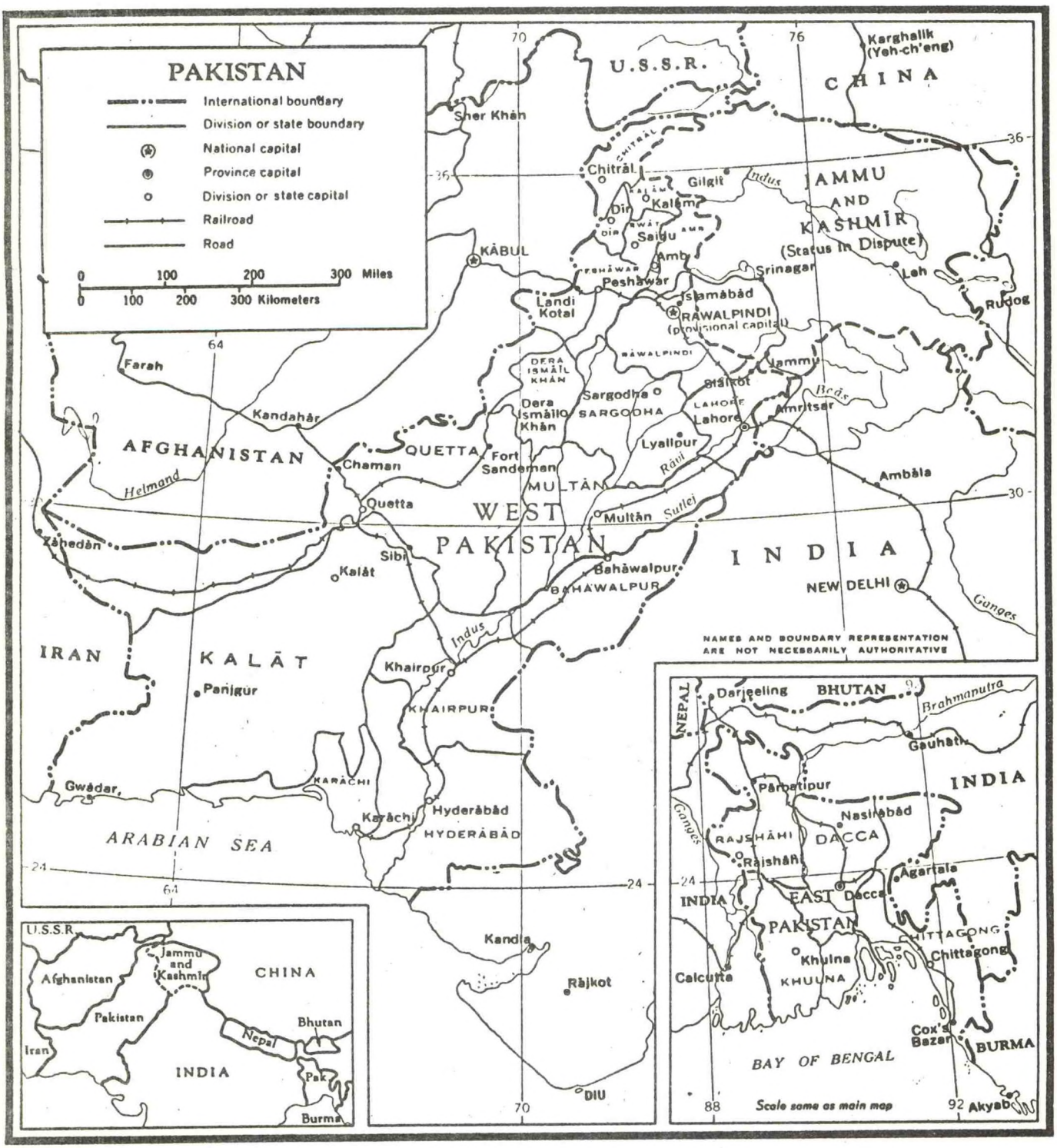
This bibliography on the climate of Pakistan has been compiled from selected sources in various libraries of the Washington Metropolitan Area. Some sources may be in more than one of these libraries; however, the call number is recorded in the abstract for only one of them in the preferential order listed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

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

The initials MGA or MAB appearing at the end of the abstract for some of the sources indicate that this abstract has been taken from the "Meteorological and Geoastrophysical Abstracts" (prior to 1960 title was "Meteorological Abstracts and Bibliography") of the American Meteorological Society.

Translation of foreign titles to English is recorded.


PAKISTAN
International boundary
Division or state boundary
National capital
Province capital
Division or state capital
Railroad
Road
0 100 200 300 Miles
0 100 200 300 Kilometers
U.S.S.R.
CHINA
Karghalik (Yeh-ch'eng)
Sher Khān
Chitrāl
Gilgit
Indus
JAMMU AND KASHMĪR (Status in Dispute)
Dir
Kalam
Saidu
KĀBUL
Amb
Srinagar
Leh
Peshāwar
Islāmābād
RAWALPINDI (provisional capital)
Rudog
Landi Kotal
Farah
Kandahār
Dera Ismāīl Khān
Sargodha
Jammu
Sialkot
Beās
Amritsar
Lahore
AFGHANISTAN
QUETTA
Fort Sandeman
Chaman
Lyallpur
Rāvi
Ambāla
Helmand
Quetta
WEST PAKISTAN
Multān
Sutlej
Zāhedān
Sibi
Kalāt
Bahāwalpur
BAHAWALPUR
NEW DELHI
INDIA
Ganges
NAMES AND BOUNDARY REPRESENTATION ARE NOT NECESSARILY AUTHORITATIVE
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KALĀT
Khairpur
Panjgur
KHAIRPUR
Gwādar
KARĀCHI
Karāchi
Hyderābād
HYDERĀBĀD
ARABIAN SEA
Kandla
Rājkot
DIU
Darjeeling
BHUTAN
Brahmanutra
NEPAL
Gauhati
Pārbatipur
INDIA
Nasirābād
RAJSHĀHI
DACCA
Rajshāhi
Agartala
EAST PAKISTAN
Dacca
Khulna
CHITTAGONG
Chittagong
Calcutta
KHULNA
Cox's Bazar
BURMA
BAY OF BENGAL
Scale same as main map
Akyab
U.S.S.R.
Afghanistan
Jammu and Kashmir
CHINA
Pakistan
Bhutan
Nepal
Iran
INDIA
Pak
Burma


SOUTH ASIA
AFGHANISTAN
PAKISTAN
IRAN
INDIA
CHINA
NEPAL
BHUTAN
BURMA
PAKISTAN
JAMMU AND KASHMIR
(STATUS IN DISPUTED)
ARABIAN SEA
BAY OF BENGAL
CEYLON
LACCADIVE ISLANDS (India)
MALDIVE ISLANDS (U.K.)
ANDAMAN ISLANDS (India)
NICOBAR ISLANDS (India)
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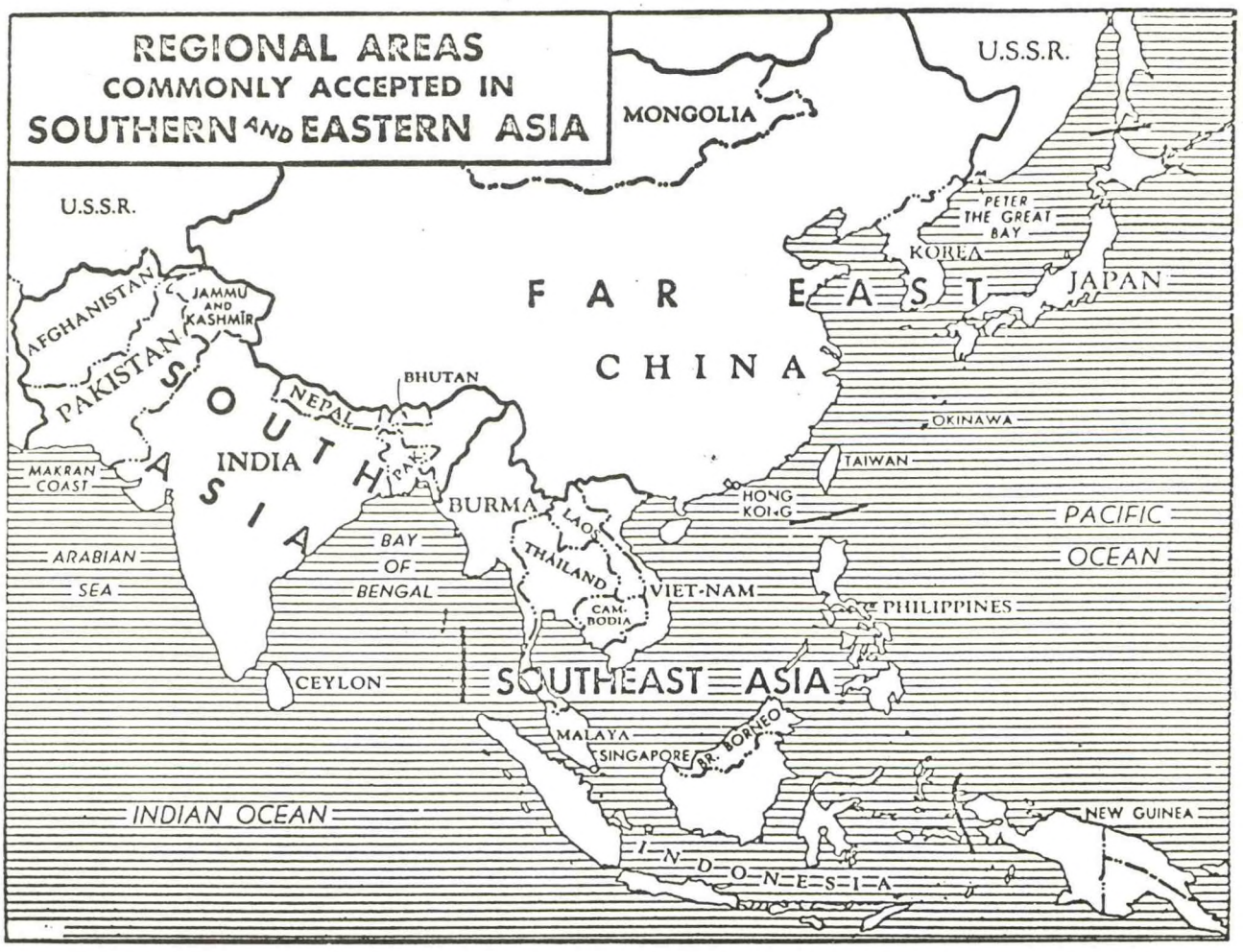
REGIONAL AREAS
COMMONLY ACCEPTED IN
SOUTHERN AND EASTERN ASIA
U.S.S.R.
MONGOLIA
U.S.S.R.
PETER THE GREAT BAY
KOREA
JAPAN
F A R E A S T
CHINA
AFGHANISTAN
JAMMU AND KASHMIR
PAKISTAN
SOUTH ASIA
INDIA
NEPAL
BHUTAN
OKINAWA
TAIWAN
MAKRAN COAST
BURMA
HONG KONG
PACIFIC OCEAN
ARABIAN SEA
BAY OF BENGAL
LAOS
THAILAND
VIET-NAM
CAMBODIA
PHILIPPINES
CEYLON
SOUTHEAST ASIA
MALAYA
SINGAPORE
BR. BORNEO
INDIAN OCEAN
NEW GUINEA
I N D O N E S I A

AN ANNOTATED BIBLIOGRAPHY OF SELECTED SOURCES ON THE CLIMATE OF PAKISTAN

1940 - 1970

Sources and Abstracts

1940

1. Desai, B. N. and Mal, S. A discussion of some aeroplane ascents at Drigh Road (Karachi) on days of duststorms, thunderstorms and dust-raising winds. India Meteorological Department, Scientific Notes, VIII(87): 31-45. Delhi, 1940. DAS M(055) I39s.

...Examines the information obtained from some aeroplane ascents prior to 1936 at Drigh Road on days with duststorms, thunderstorms, and strong dust-raising winds for the purpose of understanding their probable mechanism. The author discusses the duststorm and thunderstorm on November 27, 1928; thundery conditions on October 5, 1931; thunderstorm on March 24, 1932; thundery conditions and duststorm of March 29, 1932; thunderstorm on July 8, 1932; thunderstorm of July 12, 1932; dust-raising winds of January 2, 1932; dust-raising winds on June 13, 1932.

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 2, Part 7: The coast of Burma. 140pp. London, 1940. DAS M82/267 G786w.

...Describes the depressions and tropical cyclones, surface and upper winds, visibility, clouds, rain, hail, temperature, humidity, thunderstorms, sea and swell, waterspouts, mirages, and mud volcanoes for the coast of East Bengal, the west coast of Thailand 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. The tables present summaries over the period for Chittagong of monthly and annual total and low cloud amounts (1933-1937) at 0800 to 1800; monthly highest and lowest mean relative humidities (1876-1885) with times of occurrence and range; monthly and annual mean pressure with range, mean temperature, mean and absolute extreme temperatures, mean of the highest and mean of the lowest temperatures, mean total amount of rainfall, number of days with rain, maximum rainfall in 24 hours, number of days with thunder, mean wind speed, wind direction frequency at 0800 and 1800, number of days with visibility < 2 nautical miles at 0800 and 1800, mean cloud amount at 0800, mean relative humidity at 0800 and 1800 and mean wet-bulb temperature at 0800 and 1800 for specified periods (vary by element); monthly wind speed (3-13, 14-27, 28-40, and > 40 knots) frequency by direction (8 points

Source No. 2 continued.

and calm) at surface and heights of 1800, 3300, 6500, and 10,000 feet for the period November 1928 - December 1937; monthly and annual frequency of visibility (0-½, ½-2, 2-5, 5-10, and > 10) at 0800 and 1800 for the period 1933-1937; monthly cloud (0, Tr-3, 4-6, 7-9, and 10 tenths) frequency at 0800 and 1800 for the period 1933-1937; monthly state of sea frequency at 0800 and 1800 for the period 1933-1937. The source also includes surface and upper wind roses for Chittagong.

3. Ramdas, L. A. Cold waves and frost. Reprint from Indian Farming, 1(11): 531-533. Delhi, November 1940. DNAL 22 In283.

...Discusses the adverse effects of cold waves and frost on crops in prepartitioned India. The discussion contains information on nocturnal cooling, the definition of cold waves, winter temperatures over prepartitioned India, frost hazard, cold wave warnings, measures against frost hazard, heaters and wind breaks, and frequency of cold waves over India and Pakistan.

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, 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. 81pp. 1941. DAS M82/267 G786w.

...Discusses the depressions and tropical cyclones, surface and upper winds, visibility, clouds, rain, hail, temperature, humidity, thunderstorms, duststorms, sea and swell, turbulence and bumpiness for the Makran coast from Gwadar to Karachi and the west coast of India to latitude 20°N. The tables present for stations in Pakistan summaries over the period (varies by station and element) of monthly and annual mean wind direction and speed at specified hours (0000, 0400, 0800, 1200, 1600, and 2000) for Karachi, mean number of squalls at Karachi (Drigh Rd.), mean total and low cloud amounts (tenths) at approximately 0830 and 1630 for three stations (Pasni, Ormara and Karachi), frequency of sky cover 9 to 10 tenths with cloud below 8,000 feet for morning and afternoon at three stations (Gwadar, Karachi, and Ahmedabad), maximum and minimum rainfall amounts at Ormara and Karachi and mean number of duststorms at four stations (Gwadar, Pasni, Ormara, and Karachi); monthly (January, April, July, and November) percentage number of days on which balloons became invisible between definite limits of height for Karachi and Ahmedabad; monthly mean temperature and relative

Source No. 4 continued.

humidity at surface and specified heights (500, 1000, 2000, 4000, 6000, 8000, and 10,000 feet) at Karachi; monthly maximum and minimum relative humidities with time of occurrence and range at Karachi; monthly and annual mean pressure, mean temperature, mean and absolute extreme temperatures, mean of the highest and mean of the lowest temperatures, mean total rainfall amount, mean wind speed, maximum rainfall in 24 hours, and mean number of days with miscellaneous phenomena (rain, thunder and strong winds) for 2-3 stations (Pasni, Ormara and Karachi); monthly and annual mean number of days with visibility < 2 nautical miles, mean relative humidity, mean wet bulb temperature, and wind direction frequency at approximately 0830 and 1630 for 2-3 stations (Pasni, Ormara, and Karachi); monthly frequencies of wind force (calm, 1-3, 4-7, 8-12 Beaufort), visibility (0-½, ½-2, 2-5, 5-10, and > 10 nautical miles), cloud (0, Tr.-3, 4-6, 7-9, and 10 tenths) and state of sea (calm, moderate, rough, very rough, very high, and confused) at 0800 and 1600 for Pasni and Karachi; monthly wind speed (3-13, 14-27, 28-40, and > 40 knots) frequency by direction (8 points and calm) at surface and specified heights at Karachi (Drigh Road) and Ahmedabad.

5. Sen Gupta, Prabhat Kumar. Kalbaishakhis (thundersqualls) in Bengal. Science and Culture, VII(3): 134-139. Calcutta, September 1941. DLC QH1 .S35.

...Defines a Kalbaishakhi and discusses the characteristics, the source, season, and mechanism of the Kalbaishakhis in Bengal. A table shows the monthly (March - June) % frequency of the direction (N or NE, E, SE or S, SW or W, and NW) of thundersqualls in the northern parts, southwestern parts, and southeastern parts of Bengal based on data for the period 1936-1940.

1942

6. Ananthakrishnan, R. Discussion of upper air data obtained from aeroplane meteorological flights over Peshawar and Quetta during the years 1927-36. Memoirs of India Meteorological Department, 29(2): 55-88. Calcutta, 1942. DAS M(055) I39m.

...This paper contains an analysis of the temperature and humidity data collected by the aeroplane meteorological flights made by the R.A.F. over Peshawar and Quetta during the years 1927-36. Mean monthly values of the upper air temperatures and humidities up to the first 5 kms. above sea level over the two stations have been

Source No. 6 continued.

worked out for the individual years; from the monthly normals of the meteorological elements have been computed and the results briefly discussed. Mean monthly tephigrams, estegrams and depegrams for the two stations have been reproduced and some characteristic features shown by these curves are pointed out. The salient features revealed by a comparison of the temperatures and humidities over Peshawar and Quetta during the different months with those over Karachi, Agra and Poona are also discussed. While there exist many points of similarity between the upper air conditions over Peshawar and Agra, there are striking differences between Peshawar and Poona. Some remarks relating to ice accretion on air-craft over Northwest India are given at the end of the paper. - Author's abstract.

7. Bhatia, K. L. A comparison of Cherat surface observations of temperature and humidity at 0800 hrs. L. T. with aeroplane observations over the Peshawar plain at the same level. India Meteorological Department, Scientific Notes, X(116): 11-17. Delhi, 1942. DAS M(055) I39s.

...The paper deals with the comparison of dry-bulb and wet-bulb temperatures and the derived quantities, relative humidities, and vapour pressures recorded over a mountain station (Cherat) in the region of Peshawar with the free air values at the same level obtained from aeroplane flights in the neighbourhood. Mean monthly and annual differences have been given and it has been shown that the mountain is cooler than the free air, the mean annual difference being 2.7°F. The wet-bulb temperatures over mountain are higher during November to April and lower during May to October, the mean annual difference being 0.3°F. The relative and absolute humidities are generally higher over the mountain. An analysis of the dry-bulb differences according to season, cloudiness, wind direction and speed has also been given. The results may be useful in estimating free air conditions from mountain observations when aeroplane or balloon observations are not available. - Author's abstract.

8. Krishna Rao, P. R. Climate of Lahore. Punjab Geographical Review, 1(1): 2-8. 1942. DLC DS376 .P29.

...Deals with the chief features of the main climatic elements, viz., temperature, humidity, rainfall, wind, and weather of Lahore. A table presents monthly summaries (based on 63 years of data) of mean daily maximum and minimum temperatures, mean temperature, highest and lowest temperatures recorded, mean diurnal range, mean

Source No. 8 continued.

daily grass minimum temperatures, sunshine duration, and mean relative humidity. There are also monthly and annual summaries based on data up to 1920 of monthly mean total amount of rainfall, mean number of rainy days, maximum amount of rainfall in 24 hours, and greatest and least amounts of rainfall at Lahore.

9. Krishna Rao, P. R. and Sen, Sudhindra N. Dust-devil at Karachi on 28th February 1941. India Meteorological Department, Scientific Notes, VIII(100): 167-170. Delhi, 1942. DAS M(055) I39s.

...Five photographs of a well formed dust-devil at Karachi Air Port on the 28th February 1941 have been given with a short description of its important features. The meteorological conditions on that day have been discussed briefly, making use of the tephigram drawn from the data available from aeroplane met. flight made that morning. - Authors' abstract.

10. Lamoureux, C. E. and Fletcher, L. R. Air routes - Peshawar to Yarkand. U. S. Weather Bureau, S. R. No. 55. 7pp. July 1942. DAS M82.2 U587s.

...Consists of textual information on suggested air routes from Peshawar, Pakistan, to Yarkand, China, and weather conditions along the route; climatic maps and graphs; tabular climatic summaries for individual stations in U.S.S.R., India, Pakistan, and China. The tabular summaries include for 1-3 stations (Drosh, Chitral, and Peshawar) in Pakistan monthly frequency of low cloud heights based on data for 2 years; monthly mean temperature (^{o}F), mean total amount of precipitation (in.), number of days with precipitation, number of days with thunderstorms, mean relative humidity (%), mean cloud amount (0-10), and mean wind speed; seasonal extreme temperatures (^{o}F).

11. Lamoureux, C. E. and Fletcher, Lyle R. Flying conditions along Teheran, Meshed, Tashkent, Alma Ata, Lanchow-Chungking air route. U. S. Weather Bureau, P. R. 34. 84pp. 1942. DAS M82 U587p.

...Describes the general circulation, surface and upper winds, cyclonic storms, dust storms, thunderstorms, precipitation, cloudiness, visibility, and temperature for route from Peshawar to Yarkand. This report contains monthly summaries of mean temperature (^{o}F), mean total amount of precipitation (inches), number of days with precipitation, number of days with thunderstorms, mean relative humidity (%), mean cloud amount (0-10), prevailing wind direction, mean wind speed, and frequency of low cloud heights at 1-17 stations in Pakistan and India. There are also seasonal extreme temperatures for 11 of these stations and monthly upper wind roses for Peshawar.

12. Mal, S.; Desai, B. N.; Sircar, S. P. An investigation into the variation of the lapse rate of temperature in the atmosphere near the ground at Drigh Road, Karachi. Memoirs of the India Meteorological Department, XXIX(1): 1-53. Delhi, 1942. DAS M(055) I39m.

...The paper gives a description of the arrangements made at the Karachi Air Port for obtaining continuous records of temperature in the lowest 260 ft. of the atmosphere there. Diurnal, seasonal and annual variations of temperatures and lapse rates together with their variations on clear and cloudy days and nights are discussed. The growth and decay of nocturnal inversion and the lapse rate associated with the development of fog have been considered in detail. - Author's abstract.

13. U. S. Army Air Forces. Climate and weather of southeastern Asia. Part I. India, Burma and southern China. Publications of the Weather Research Center, Directorate of Weather, V(3): 1-129. Washington, May 1942. DAS M82 U58p.

...Summarizes topographical and climatic conditions of (1) India and Pakistan south of 30°N, Ceylon and the Mekran and (2) northeast India including East Pakistan, Burma, and southern China. The statistical summaries include monthly and annual mean, mean extreme and absolute extreme temperatures; mean amount and maximum amount in 24 hours of precipitation; number of days with precipitation $\geq$ .01"; number of days with thunderstorms; mean cloud amount; mean cloud amount at 0800 and 1600; mean relative humidity; wind direction frequency; mean wind speed; ceiling frequency; visibility frequency; upper wind speed frequencies by direction; frequency of low cloud heights; number of days with duststorms; mean number of misty days; mean number of foggy days; mean number of days with dust haze; prevailing wind direction. These data are for 2-73 stations in India and Pakistan.

1943

14. Frankel, M. H. Climatic data for selected stations in India. U. S. Weather Bureau, S. R. 224. 46pp. March 1943. DAS M82.2 U587s.

...Presents monthly and annual summaries over the period (varies by station and element) of mean temperature (°F), mean maximum and minimum temperatures (°F), highest and lowest temperatures (°F),

Source No. 14 continued.

mean and extreme frost dates, mean total amount of precipitation (in.), greatest and least amounts of precipitation (in.), maximum amount of precipitation in 24 hours (in.), mean number of days with rain $\geqslant$ 0.10", mean relative humidity at 0800 and at 1600 (also mean based on the two observations), mean cloud amount based on 3 observations per day (0800, 1000, and 1600), mean cloud amount at 0800 and 1600 or 1700, prevailing wind direction, mean wind speed (mph), and mean number of days with thunderstorms for 12-25 stations in India and Pakistan. There are also summaries over the period (usually February 1926 - December 1935) of seasonal upper wind direction frequency and seaonal mean speeds by direction of winds aloft at 12 stations in India and Pakistan; monthly and annual mean number of hailstorms for 14 districts in India, Pakistan and Burma; monthly summaries for each year (1935-1940) of number of days with snowfall at Quetta, Simla, Rawalpindi, and Srinagar.

15. India. Meteorological Department. Ice accretion in India. Technical Note No. 2. Bombay, 1943. DAS M(055) I39te.

...Discusses the conditions under which ice is most likely to form, freezing levels, method of setting out forecasts of ice accretion, and forecast of icing conditions. The table presents the monthly average and minimum heights of freezing levels at Karachi, Peshawar and Quetta in Pakistan.

16. India. Meteorological Department. India's climates: summary for airmen. 47pp. 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 and autumn) are presented. These features include information on state of sky; number of rainy days; average rainfall per day; number of days with thunder and duststorms; visibility, fog, and haze; surface and upper winds. Prior to August 1947 Pakistan was a part of India.

1944

17. Chatterjee, Sujan Bandhab. Nor'westers of Bengal. Calcutta Geographical Review, VI(1): 31-33. Calcutta, March 1944. DLC G1 .C17.

...Briefly describes the nor'wester in Bengal which usually occurs from mid-April to mid-June.

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

...Consists of monthly summaries of prevailing wind directions and mean wind speeds (mph) at surface and 1600 ft. 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 relative air densities; low and total cloud amounts for morning and for afternoon; frequency 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 number 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.

19. India. Meteorological Department. Nor'westers of Bengal. Technical Note No. 10. 11pp. Bombay, 1944. DAS M(055) I39te.

...Summarizes the results of a special investigation into the problem of nor'westers, violent thunderstorms, in April and May 1941 in prepartitioned Bengal by the staff of the Upper Air Office in New Delhi. This paper includes information on hourly frequencies, time sequences, types, and size and extent of thunderstorms. The table contains hourly frequencies of thunderstorms, frequency of each type of thunderstorm, and frequency of all types of thunderstorms combined based on data for April and May 1941 at 70 stations. Approximately 35 of these stations are in East Pakistan.

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

...Briefly discusses the wet bulb temperatures 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.) at Lahore, Sialkot, Rawalpindi, Peshawar, Multan, D. I. Khan, Jacobabad, and Karachi based on data for the period 1918-1922.

21 Sur, S. K. A note on the average intensity of rainfall in Bengal. Calcutta Geographical Review, VI(2): 14-20. June 1944. DLC G1 .C17.

Source No. 21 continued.

...Discusses the monthly distribution, seasonal distribution, noteworthy intensity, district average, and annual range of rainfall in Bengal. The tables present the annual rainfall amount, number of rainy days and mean intensity of rainfall for 24 stations in India and Pakistan; monthly, seasonal, and annual maximum and minimum intensities of rainfall with range for district; annual maximum and minimum intensities with range at Jessore and Jalpaiguri.

22. U. S. Army Air Forces. General climatic information guide. No. 180 Climate of Karachi (India). Washington, July 1944. DAS M82.1 U58G.

...Describes the location, topography, and general climatic conditions of Karachi, Pakistan. The description of general climatic conditions includes information on air masses, temperature, precipitation, cloudiness, fog and visibilities, and winds. There is also a brief comparison of climatic conditions of Karachi with Calexico in the Imperial Valley in southern California. In addition to the above information there are graphs showing monthly values of mean temperature; mean and absolute maximum and minimum temperatures; mean dew point temperature; mean number of days with maximum temperature $> 90^{\circ}$F.; mean number of days with minimum temperatures $< 60^{\circ}$F.; mean, maximum, and minimum amounts of precipitation; maximum amount of precipitation in 24 hours; mean, maximum, and minimum number of days with precipitation; frequency of precipitation spells (1-2, 3-6, $\geq$ 7 consecutive days with precipitation); estimated number of days with wet soil; mean number of clear and cloud days; % of cases of ceiling 950 ft. and visibility 2 3/4 miles, ceiling 451 to 950 ft. and/or visibility 1 to 2 3/4 miles, ceiling 451 ft. and/or visbility 1 mile; wind speed (calm, 1-7, 8-18, 19-31, and $\geq$ 32 mph) frequency. Seasonal surface wind roses are given. A table presents weather factors affecting military operations along with months of most frequent occurrence and months of least frequent occurrence of these factors.

23. U. S. Army Air Forces. Report No. 600-73: Studies on local forecasting, Karachi Air Base, Karachi, India. 8pp. & 10 in Appendix. 1944. DAS M09.34 U587a.

...Describes the topography of the surrounding terrain, gives a general summary of seasonal weather modified by local factors, and presents indications useful for forecasting weather elements hazardous to aviation for each season at Karachi Air Force Base. Tables present monthly and annual number of hours with heavy fog, number of hours with ground fog and number of hours with blowing dust; monthly mean temperature and absolute maximum and minimum temperatures ($^{\circ}$F), mean percentage occurrence of various precipitation types (thunderstorms, rain and drizzle, freezing rain, snow and sleet, and hail), mean percentage occurrence of all precipitation, mean total

Source No. 23 continued.

precipitation amount (inches), ceiling frequency, mean percentage occurrence of sky condition (clear, scattered, high broken, or overcast, low broken, and low overcast), visibility frequency, mean percentage occurrence of various visibility restrictions (fog, smoke, and haze, blowing snow and dust, precipitation, and drizzle), mean percentage occurrence of all visibility restrictions, mean percentage occurrence of ceiling < 451 feet and/or visibility < 1 mile, and mean percentage occurrence of ceiling 451-951 feet and/or visbility 1 to 2 3/4 miles; seasonal wind speed frequency by direction; monthly, seasonal, and annual flying weather. Periods of record are usually indicated for May 1942 - May 1943 and September 1943 - January 1944.

1945

24. India. Meteorological Department. Diurnal variation of pressure. Technical Note No. 15. 13pp. 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 (Chittagong, Lahore, and Karachi) in Pakistan.

25. U. S. Army Air Forces. Report No. 600-244: Studies on local forecasting, Kurmitola Airport, Bengal, India. 9pp. Washington, D. C., April 1945. DAS M09.34 U587a.

...Discusses the geographic and topographic considerations, thunderstorms, fronts, and air masses, and climatological and upper air data for Kurmitola Airport in East Pakistan. Charts show the monthly values of mean wind direction and mean wind speed (mph) at specified heights at Dacca, about 6 miles south of Kurmitola Airport, based on morning pibal ascensions during 12 years from 1928-1940. The tables present monthly summaries of ceiling frequencies for specified limits (< 1000; 1000-3000; 3000-5000; 5000-10,000; > 10,000 ft) at 0900 and 1800, mean number of days with specified sky conditions (clear, 1/10-3/10, 4/10-6/10, 7/10-9/10 and overcast) at 0900 and 1800, visibility frequencies for specified distances (< 220 yd., 220 yd.-1 1/4 mi, 1 1/4-6 1/4 mi, and > 6 1/4 mi) at Narayanganj, about 10 miles south of Kurmitola Airport, and Mymensingh, about 65 miles north of the air base. There is also a table with monthly mean number of days with precipitation, mean total amount of precipitation (inches), mean and maximum no. of days with fog, mean and maximum no. of hours with fog, and mean maximum and minimum temperatures at Dacca.

26. Ganesan, V. Post monsoon heat waves at Karachi. India Meteorological Department, Scientific Notes, IX(107): 68-71. Delhi, 1946. DAS M(055) I39s.

...Abnormally high temperatures prevail over Karachi for a few days in some Octobers. These spells of hot weather are associated with a storm or depression over the Central Arabian Sea or a trough of low pressure over the north Deccan. Such occasions are characterized by a solid easterly to northeasterly current over the belt of the country from Assam to Sind. This current apparently acquires additional heat during its passage through Rajputana, and also prevents or delays the onset of sea breeze at Karachi, resulting in a heat wave over Karachi. The typical heat wave of October 1941 is discussed in detail. - Author's abstract.

27. Great Britain. Meteorological Office. Flying conditions in the S. W. monsoon in India and neighbouring areas. Synoptic Divisions Technical Memorandum No. 117. London, 1945 or 1946. DAS M(055) G786s.

...This note supersedes Parts I and II of Synoptic Divisions Technical Memorandum No. 85. These parts have been largely incorporated in this paper which presents information on the meteorology of the S. W. 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 am and pm for the period June-September 1944.

28. Great Britain. Meorological Office. Hourly weather during the southwest monsoon in India. Addent to Synoptic Divisions Technical Memorandum No. 117. London, September 19, 1946. DAS M(055) G786s.

...Is a diagram illustrating typical hourly weather observations during the Indian monsoon for Patenga (near Chittagong) in East Pakistan and 2 stations in India (New Delhi and Madras).

29. India. Meteorological Department. Daily rainfall of India. 1891-1946. DAS C/ef AOr.

...Consists of tabular daily rainfall amounts, monthly number of rainy days for each year, normal monthly number of rainy days, monthly total rainfall amount, normal monthly rainfall amount, and heaviest rainfall during the month for rainfall stations in Burma, Pakistan, and India during the period 1891-1937 and for Pakistan and India 1938-1946.

30. India. Meteorological Department. Weather and the Indian farmer. 12pp. Delhi, 1946. DAS M86:630 I39w.

...Discusses the climate in relation to crop growth and yield, floods, droughts, cyclonic storms and depressions, thunderstorms, hailstorms, duststorms, cold waves and frost hazard, heat waves, excessive or defective insolation, high winds, the crop-weather calendar, and the meteorological organization for issue of weather bulletins to farmers.

31. Pithawalla, Maneck B. and Martin-Kaye, P. Geology and geography of Karachi and its neighbourhood. 152pp. Karachi, 1946. DGS 203(648) P683g 1946.

...Part II deals with general climatic conditions in Sind and local differences in the climate at Karachi. Tables present monthly summaries for each year (1933-1942) of maximum and minimum temperatures at Manora and Drigh Road, monthly summaries over the period (1933-1942) of mean maximum and minimum temperatures at Manora and Drigh Road, monthly range of temperature at Manora and Drigh Road, monthly and annual summaries over a 30-year period (1901-1930) of mean pressure (inches) and relative humidity at Karachi (Manora), and seasonal wind system based on 20 years of data at Karachi.

32. Roy, A. K. Air masses in India. India Meteorological Department, Technical Note No. 16. 33pp. 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 Quetta and Karachi in Pakistan during the southwest monsoon (July).

1947

33. India. Meteorological Department. India weather review. 1891-1947. Calcutta. DAS M06.1/54 I39i.

...Presents monthly summaries of mean pressure, temperature, wet bulb temperature, vapor pressure, relative humidity, and cloud amount at specified hours; mean temperature, wind speed, wet bulb temperature, vapor pressure, relative humidity, and cloud amount; highest and

Source No. 33 continued.

lowest pressures with dates; pressure range; mean maximum and minimum and absolute maximum and minimum temperatures; temperature range; wind direction frequency; wind direction frequency at specified hours; total amount of rainfall; total number of rainy days; maximum amount of rainfall in 24 hours; mean wind direction; mean wind steadiness; mean wind movement; mean wind speed and resultant direction and speed at specified heights. Data are recorded for 17 stations in Pakistan. Period of record varies by station and element.

34. India (Republic). Meteorological Department. Report on the administration. 1875-1941, 1944-1947. Simla. DAS M(06) I39a.

...Presents information on the general work and administration of the Meteorological Department of undivided India from its establishment to the partition of the Meteorological Department in 1947.

35. Sreenivasaiah, B. N. Lapse rates of temperature in the lower layers of the atmosphere determined with the aid of temperature indicators. India Meteorological Department, Scientific Notes, IX(106): 43-67. Delhi, 1947. DAS M(055) I39s.

...Lapse rates of temperature determined with the aid of Chatterji's single temperature indicator over Agra, Calcutta, Dacca, Lahore, Poona, Madras, and Jhikargacha have been studied. Monthly, seasonal, and diurnal variations of lapse rate values are discussed and the values at the different stations compared. A brief discussion of the hourly mean monthly levels of different temperatures at Agra, Calcutta, and Dacca and of the hourly variation of temperature levels at Agra is given. - Author's abstract.

1948

36. 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.

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

37. Jagannathan, P. Regression of climatic elements on latitude, longitude and elevation in India. 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.

Source No. 37 continued.

The tables presents monthly and annual normal daily ranges of temperature (^{o}F) for Katmandu in Nepal and 166 stations in India and Pakistan.

38. Ray Choudhuri, S. N. The sea breeze and diurnal variation of winds at Karachi. India Meteorological Department, Scientific Notes, X(119): 51-57. Delhi, 1948. DAS M(055) I39s.

...During the winter months when the gradient wind at Karachi is generally of land origin afternoon sea breeze sets in on sunny days, unless the gradient wind is too strong. It is, however, observed that, although the sea breeze starts from a direction perpendicular to the coast line, it veers with the progress of the day. Again, prior to the onset of the sea breeze and also on occasions when the sea breeze does not blow due to the gradient wind being strong, a veering or backing of the gradient wind is observed in the afternoon. The veering or backing is explained by the simple parallelogram law - being the result of compounding the gradient wind with the sea breeze. A comparison of the relative magnitudes of the gradient wind and sea breeze is made, leading to some criteria for judging from the morning conditions whether sea breeze is likely to blow in the afternoon. - Author's abstract.

1949

39. Hariharan, P. S. The normal 17 hrs. monthly contours corresponding to the 850 mb. and 700 mb. isobaric surfaces over India. India Meteorological Department, Scientific Notes, XI(131): 1-7. Delhi, 1949. DAS M(055) I39s.

...Summarizes and discusses the results of a study of the upper air conditions over India based on the computations of monthly normal heights of the standard surfaces over various stations and the application of corrections to these normal heights with the aid of known values of surface pressure and surface temperature and their departures from normal. The tables include monthly lapse rates at the 850-mb level for 7 stations in Pakistan, and at the 700-mb level for 3 stations in Pakistan.

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

Source No. 40 continued.

...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 include monthly and annual mean frequencies of thunderstorms at Karachi, Lahore, and Simla; monthly and annual number of days per year on which hail may be expected at Simla, Peshawar, and Lahore; 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 Chittagong, Dacca, Karachi, Lahore, Jiwani, and Peshawar The graphs present monthly frequencies of visibility (0-3, 4-5, 6, 7, and 8-9) at 0800 and 1800 for Karachi, Lahore, Peshawar, and Quetta.

41. India. Meteorological Department. Monthly and annual normals of rainfall and rainy days based on records up to 1940. Memoirs of the India Meteorological Department, XXVII(V): 101-298. Delhi, 1949. DAS M(055) I39m.

...Consists of monthly and annual normals of rainfall amount and of rainy days ($\geq$ 0.1") for each district, the 15 chief divisions, the 30 sub-divisions, and approximately 3500 stations in prepartitioned India. These normals are based on date up to 1940.

42. Malurkar, S. L. Nor'westers in Bengal. Current Science, 18(1): 5-7. January 1949. DAS M(05) C976.

...Reviews the nor'wester studies of other writers and presents the method used in this study based on an analysis of the western disturbances in a number of secondary low pressure areas which crossed Bengal or its longitude.

43. Naqvi, S. N. Coefficient of variability of 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

Source No. 43 continued.

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.

44. Roy, A. K. Air mass structure and the mechanism of thunderstorms in India during the pre-monsoon and post-monsoon seasons. Proceedings of the National Institute of Sciences of India, XV(7): 289-300. Delhi, September-October 1949. DAS M(05) N277p.

...Considers the characteristics of the air masses which prevail over India and Pakistan during the pre-monsoon season (April-May) and post-monsoon season (mid-September to mid-November) to ascertain why these seasons specially favor the growth of marked instability. The author discusses the air masses during the pre-monsoon period, main zone of thunderstorm activity, conditions favorable for the growth of active thunderstorm fields, development of waves on convergence front and thunderstorms of the post-monsoon season.

45. World Meteorological Organization. CLINO No. 34. Monthly normals for CLIMAT values, Pakistan. 7pp. 1949. DAS M82.2 W927c.

...Consists of tabular summaries over the period (1901-1930) of monthly mean pressure (mb), mean temperature (^{o}C), mean relative humidity (%), mean total amount of precipitation (mm), and frequency groups of precipitation at 8-9 stations in Pakistan. The stations are Peshawar, Dera Ismail Khan, Lahore, Quetta, Multan, Hyderabad, Karachi (Manora), Bogra, and Chittagong.

1950

46. Alisov, Boris Pavolovich. Klimaticheskie oblasti zarubezhnykh stran. (Climatic regions of foreign lands.) 350pp. (In Russian). Moscow, 1950. DAS M8 A414k1.

...Presents a table with annual mean extreme temperatures, maximum temperature (^{o}C) of the warmest month and the coldest month, maximum relative humidity of the wettest month and the driest month, extreme mean cloud amounts (%) with months of occurrence, mean amount of precipitation (cm), maximum and minimum amounts of precipitation with months of occurrence and maximum and minimum mean number of days with precipitation with months of occurrence at Karachi. Period of record is not specified.

47. Butt, M. T. Climate of the Pak Punjab. Pakistan Geographical Review, 5(1): 52-58. Lahore, 1950. DLC DS376 .P29.

...Describes the location of the Pak Punjab and its climate. The description of the climate includes notes on the rainfall, evaporation, temperature, and cold air streams.

48. Chaudhury, A. M. On the vertical distribution of wind and temperature over Indo-Pakistan along the meridian 76°E. in winter. Tellus, 2(1): 56-62. Stockholm, 1950. DAS M(05) T277.

...A mean cross-section over Indo-Pakistan along the meridian 76°E for January and February 1946 has been computed. Three jet stream centers are obtained along this meridian: one in Siberia, one just south of the plateau, and one in the tropics. The effect of the plateau gives rise to Siberian and Himalayan jets. A numerical comparison of the computed mean profile along 76°E with that of Hess (1948) along 80°W over North America is presented.

Computed wind velocity, wind shear and absolute vorticity patterns are discussed, particularly with regard to strong anticyclonic shear and very low absolute vorticity found on the south side of the Himalayan jet. The spatial distributions of the isentropic field, the gravitational stability field, the baroclinity field, and the rainfall during the winter months are discussed in regard to the sense of the meridional circulation around the Himalayan and Equatorial jets. - Author's abstract

49. Desai, B. N. Mechanism of Nor'westers of Bengal. Indian Journal of Meteorology and Geophysics, 1(1): 74-76. Delhi, January 1950. DAS M(05) I39i.

...Sets forth facts associated with Nor'westers, presents the explanation of the cause of Nor'westers put forward by some meteorologists, and gives the classification of thunderstorms over Bengal by Desai. Part of Bengal is in East Pakistan.

50. Great Britain. Meteorological Office. Equivalent headwinds on some of the principal air routes of the world. Meteorological Reports No. 7. 19pp. London, 1950. DAS M82 G786m.

...Presents a table with seasonal summaries of mean equivalent headwinds in knots on designated routes (Karachi-Bahrein, Cairo-Karachi, Karachi-Calcutta, Karachi-Delhi, Lydda-Karachi, and Karachi-Singapore), mean equivalent headwinds in knots for the return flight of these air routes, and variability of the equivalent headwind from these mean values at specified heights (10,000; 20,000; 30,000; 40,000 feet).

51. Hussain, Azra Afzal. A workable analysis of the precipitation data for Quetta. The Bulletin of the Karachi Geographical Society, 2nd issue, pp. 30-40. 1950. DLC G35 .K3.

... Discusses the seasonal rainfall periods, analysis of monthly rainfall, number of rainy days, intensity of rainfall, difference between winter and summer rains, fluctuation of precipitation, rainfall cycle, possibilities of artificial rainfall, and the future of Quetta. The tables contain hourly distribution of rainfall for each season (winter, post-winter, summer (monsoon) and pre-winter), monthly heaviest rainfall in 24 hours, monthly total rainfall amounts for the rainiest and driest months, monthly low cloud amounts and total cloud amounts for morning and for afternoon, and monthly mean number of days with fog or mist at Quetta.

52. Mull, S. and Rao, Y. P. Dynamics of thunderstorms. Part I. Review of the present explanations for pressure changes in thunderstorms. Indian Journal of Meteorology and Geophysics, 1(2): 116-136. Delhi, April 1950. DAS M(05) I39i.

...Includes surface and upper wind data during a thunderstorm associated with a squall at Peshawar on September 25, 1945.

53. Pakistan Meteorological Service. Monthly frequency tables. 1948-1950. "Supplement to Monthly Weather Report." DAS M06.1/547 P152mf.

...Presents the following summaries for 3-16 stations at approximately 0300, 0900 and 2100: wind speed (6-25, 26-50, 51-75 and > 75 kph) frequency by direction (8 points and calm) at surface, 0.15 km above the surface, and heights of 1.0, 2.0, and 3.0 km above sea level; cloud height frequency (0-9) and visibility frequency (0-9).

54. Pakistan. Meteorological Service. Relations between Meteorological and Hydrological Services in Pakistan. 2pp. Karachi, August 1950. DAS M(06) P152.

...Presents the aims and purposes of the hydrometeorological organization which was set up by the Pakistan Meteorological Department and the Central Engineering Authority. The paper also lists some of the responsibilities of the Meteorological Department.

55. Pramanik, S. K. and Sreevastava, S. N. Pibals in forecasting. Indian Journal of Meteorology and Geophysics, 1(3): 247-248. Delhi, July 1950. DAS M(05) I39i.

...Is a study to find out how far pibal directional variation with height can be of help in forecasting weather in regard to the occurrence of rain at a station. This study is based on data at Karachi (1944-1945) and Lahore (July-December 1945) in Pakistan and 2 stations in India. The results are not encouraging.

56. Ramaswamy, C. and Majumdar, K. C. The general characteristics of squalls at Peshawar. Memoirs of the India Meteorological Department, XXVIII(1): 1-53. Delhi, 1950. DAS M(055) I39m.

...Presents the results of a study of the general characteristics of squalls at Peshawar. The discussion contains information on Peshawar and its surroundings, squall records, seasons at Peshawar, monthly and diurnal distribution of squalls, direction of squalls, velocity and duration of squalls, squalls in relation to thunderstorms and duststorms, pressure and temperature variations in squalls, humidity variations in squalls, veering and backing of ground winds during the approach of squalls, squalls and local upper winds, other general characteristics of squalls, squally winds, and mechanism of squalls in the monsoon period. The tables include summaries over the period (1927-1943) at Peshawar of monthly mean, maximum, and minimum number of squalls; monthly mean, maximum, and minimum number of days with squalls; monthly and seasonal number of squalls which occurred within specified intervals (0000-0300, 0300-0600, 0600-0900, 0900-1200, 1200-1500, 1500-1800, 1800-2100, and 2100-2400 IST) of the day as percentages of the total number of squalls; monthly and seasonal frequency of squalls by direction (8 points); monthly and seasonal frequencies of peak velocities in squalls within limits (22-30, 31-40, 41-50, 51-60, 61-70, and 71-80 mph) and monthly highest velocity; monthly and seasonal duration of squalls within defined limits; seasonal frequency of squalls associated with thunderstorms, duststorms, and both thunderstorms and duststorms. In the appendix there is a listing of squalls at Peshawar with dates of occurrence, time of commencement, time of peak, time of end, duration of squall, rise in velocity, highest velocity, direction of squall wind, change in direction, change in temperature, change in pressure, and change in relative humidity.

57. Ramaswamy, C. and Suryanarayana, N. Rainfall at Peshawar. Memoirs of the India Meteorological Department, XXVIII(III): 121-137. Delhi, 1950. DAS M(055) I39m.

...This paper presents an analysis of the autographic records of rainfall at the Peshawar Observatory for the period 1928-1944. Tabular summaries are included of monthly and annual mean total amount of precipitation; monthly frequencies of rainfall amounts within specified limits; rainfall intensity for specified occasions; monthly, seasonal, and annual hourly amounts of mean total rainfall; miscellaneous rainfall summaries.

58. Rizavi, Ali Arif. Natural regions of East Pakistan. Pakistan Geographical Review, V(1): 32-51. Lahore, 1950. DLC DS376 .P29.

...In the description of the eight natural regions of East Pakistan the author includes some information on the climate of each. These regions are Eastern Hills, Padma-Jamuna Doab, Brahmaputra-Meghna, Sylhet Valley, Bagri or Upper Padma, Lower Padma, Lower Padma-Meghna, and Sundarbans.

59. Sawyer, J. S. Equivalent headwinds; application of upper-wind statistics to air-route planning. Meteorological Reports, II(6): 1-20. London, 1950. DAS M82 G786m.

...Includes graphs comparing the meteorological estimates of frequency of equivalent headwinds less than given values with B.O.A.C. operating statistics at 10,000 ft. for two periods (January - May and June - November) in 1946 between Karachi and Lydda.

60. Shamshad, Khan M. A note on the rainfall and some means of its conservation in the Zhob, Loralai and upper Sibi Districts of Baluchistan. The Bulletin of the Karachi Geographical Society, 2nd issue, pp. 26-30. 1950. DLC G35 .K3.

...Consists of brief notes on (1) the rainfall, which includes snowfall, (2) paucity of rain gauge stations, (3) conservation of rain water, and (4) rain-making in Baluchistan. There is also a table presenting monthly and annual rainfall normals for 12 stations in Baluchistan based on data up to 1940.

61. Venkiteshwaran, S. P. Winds at 10 kms and above over India and its neighbourhood. Memoirs of the India Meteorological Department, XXVIII(II): 55-120. Delhi, 1950. DAS M(055) I39m.

...Analyzes the upper wind data at 10 km above India and neighborhood for 1920-1941. The text contains information on the methods of observation and computation, variation of the number of observations at different levels, the upper wind circulation charts included in this study, main features of the upper wind circulation in different months, variation of wind speed with height, upper wind at high levels and cloud winds indicated by cirrus movements, and zonal circulation of wind. The tables present monthly resultant wind velocities and direction and mean wind speed at 1-km intervals (10-20 km) over 62 stations in India, Pakistan, Burma, Ceylon, Aden, and Saudi Arabia. Period of record is designated for individual stations.

A summary of this paper was read at a symposium on "Atmospheric Processes" held by the National Institute of Sciences in India at Bombay in August 1946. This summary was published in the Proceedings of the National Institute of Sciences of India, Volume XVI, No. 1, pp. 19-27.

62. Cold wave and extensive dust haze of February, 1950. Indian Journal of Meteorology and Geophysics, 1(3): 241-244. Delhi, July 1950. DAS M(05) I39i.

...Summarizes weather conditions during the second week of February 1950 when a severe cold wave and extensive dust haze swept over north and central India and West Pakistan. A table gives the lowest temperature during this spell with departure from normal for Karachi and 13 Indian stations.

1951

63. Ahmad, Kazi Saied-ud-Din. Climatic regions of West Pakistan. Proceedings of the Third Pakistan Science Conference, Dacca, 1951, Part II. Presidential Addresses. pp. 101-135. Lahore. DAS 506 P152pr. Also in: Pakistan Geographical Review, VI(1): 1-35, Lahore, 1951. DLC DS376 .P29.

...Describes the bases for the classification of climate according to Permenides and Aristotle, Supan, Koppen, Thornthwaite, Blair, Trewartha, and Austin Miller; climatic year concept; tri-linear graphs. The author also describes the climates of West Pakistan according to his classification. The major groups of his classification are tropical coastlands (arid marine), sub-tropical continental lowlands (high summer temperatures and late summer monsoon rains), sub-tropical continental high lands (cold snowy winters, general winter spring rains), and Chaghai-Karan (very arid). The table contains monthly and annual mean maximum and minimum temperatures and mean total rainfall amount for 31 stations in Pakistan and Kashmir.

64. 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.

Source No. 64 continued.

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.

An abstract of this paper is also recorded in Proceedings of the Third Pakistan Science Conference, Dacca, 1951, Part III, Abstracts, p. 103. DAS 506 P152pr.

65. Ghani, A. R. Pakistan; a select bibliography. Lahore, Pakistan Association for the Advancement of Science, University Institute of Chemistry, 1951. DAS 016.9547 G411p.

...On pages 19-22 and 266-268 locates and describes books, pamphlets, and articles in periodical literature published in English on the climate of territories now called Pakistan.

66. 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 of the atmosphere. This study is based on data for India, Pakistan, America, Great Britain, Batavia, and Swan Island. The following data are included for stations in Pakistan: tabular 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 Jacobabad and Peshawar; monthly normal density (gm/m^3) at heights of 7, 8, 9, and 10 gkm for Jacobabad and Peshawar.

67. Satakopan, V. Rainfall analysis for multipurpose water power projects in India. Indian Journal of Meteorology and Geophysics, 2(1): 9-24. Delhi, January 1951. DAS M(05) I39i.

...Includes the total number of rain gauge stations in each meteorological subdivision (Eastern Pakistan, West Punjab, N. W. Frontier Province, Baluchistan, and Sind) in Pakistan classified according to length of data available up to the end of 1940.

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

Source No. 68 continued.

...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. There is a table with monthly and annual summaries (13-43 years) over the period of mean temperature (^{o}F), mean extreme and absolute extreme temperatures (^{o}F), mean relative humidity, mean total amount of rainfall, mean number of days with rainfall, maximum rainfall amount in 24 hours, wind direction, and mean cloud amount at Karachi.

1952

69. Agarwala, K. S. Fluctuations of annual rainfall in Central India (1872-1947). Indian Journal of Meteorology and Geophysics, 3(3): 229-230. Delhi, July 1952. DAS M(05) I39i.

...Has as its purpose to ascertain whether the climate of Central India (most of this area is now in Pakistan) has been changing and if there has been a tendency for the rainfall to fluctuate. The annual rainfall data for the period 1872-1947 have been studied, and the conclusions are given. This note contains tabular annual decadal rainfall means for west Central India, east Central India, and for all of Central India. Annual rainfall summaries are also presented on graphs.

70. Ahmad, Kazi S. Climatic regions of East Pakistan. Pakistan Geographical Review, VII(2): 102-112. Lahore, 1952. DLC DS376 .P29.

...Describes the general climatic conditions, temperature, winds and rainfall, and the climatic regions of East Pakistan. The climatic regions include the tropical very wet, tropical, sub-tropical very wet, sub-tropical wet, and sub-tropical moderately wet.

71. Alim-ud-Din, Mian. Drainage in the Punjab. Proceedings of the Fourth Pakistan Science Conference, Peshawar, 1952. Part IV. Scientific Land Utilization. pp. 13-20. Lahore. DNAL 330.9 P172.

...Includes tables with frequencies of rainfall above 1", 2", 3", 4", 5", 6", 7", and 8" for 9 raingauge stations in Rechna Doab and Chaj Doab based on data for 10 years (1942-1951) during the monsoon

Source No. 71 continued.

season (June - September) and frequencies of heavy rains (3-4", 4-5", 5-6", 6-7", 7-8", 8-9", 9-10", 10-11", 11-12", 12-13", 13-14", and 14-15") at 14 stations in Rechna and Chaj based on 24-30 years of data from 1891-1920.

72. Banerji, S. K. Weather factors in the creation and maintenance of the Rajputana Desert. Bulletin of the National Institute of Sciences of India, No. 1, pp. 153-166. New Delhi, 1952. DGS S(640) N21ib.

...Summarizes the weather conditions which create and maintain the Rajputana Desert. The author gives information on the long-period climatic variations, rainfall analysis, space distribution of rainfall, aridity factor and precipitation ratio, insolation, solar energy, blowing of dust, and probable factors affecting the distribution of rainfall. The tables present annual rainfall data for stations in India and Pakistan.

73. Pramanik, S.K.; Hariharan, P. S.; Ghose, S. K. Meteorological conditions and the extension of the Rajasthan Desert. Indian Journal of Meteorology and Geophysics, 3(2): 131-140. Delhi, April 1952. DAS M(05) I39i.

...Analyzes the arid and semi-arid regions in India and Pakistan to determine the climatic changes, if any, in Rajasthan and the surrounding areas; gives the results of the analysis of the mean annual rainfall, mean annual maximum and minimum temperatures, mean annual relative humidity, and wind speed; presents graphs showing the annual mean rainfall, mean maximum and minimum temperatures, and mean relative humidity and monthly (April - June) and annual mean wind speed (mph) for each year (period varies by station and element) for 5-6 stations (Montgomery, Multan, Jacobabad, Hyderabad, Karachi, and Umerkot) in Pakistan.

74. 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. Also: Synoptic aspects of the monsoon circulation and rainfall over Indo-Pakistan by E. V. Chelam. Indian Journal of Meteorology and Geophysics, 4(3): 264-265, July 1953. Delhi. DAS M(05) I39i.

Source No. 74 continued.

...The circulation and rainfall distribution over India during August 1949 were studied with a view toward the 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.

Chelam points out that the patterns presented by Rahmatullah are explained in the framework of concepts recognized by Indian meteorologists; therefore it appears that a revision of conventional concept regarding the monsoon is not necessary.

75. Ramage, C. S. Relationship of general circulation to normal weather over southern Asia and the western Pacific during the cool season. Journal of Meteorology, Boston, 9: 403-408, December 1952. DAS M(05) A512j.

...Explores the major factors controlling weather-sequences and weather-distributions over the subtropical and tropical regions of Asia and the West Pacific during the cool season (November-April).

76. Ramanathan, K. R. Atmospheric conditions over the Rajputana Desert. Bulletin of the National Institute of Sciences of India, No. 1, Proceedings of the Symposium on the Rajputana Desert. pp. 179-182. 1952. DGS S(640) N21ib.

...Gives the location of the Rajputana Desert; examines atmospheric conditions over a wider area of the earth to show why desert conditions exist in this part of India; explains conditions conducive to creating or maintaining a desert; includes upper air temperatures and humidities over Agra, Ahmedabad, and Quetta; presents brief notes on the air circulation over the W. Rajputana.

77. Rangarajan, S. Fog at Santacruz Airport. Indian Journal of Meteorology and Geophysics, 3(3): 186-196. Delhi, July 1952. DAS M(05) I39i.

...On page 196 of this study the author compares the fogs at Drigh Road, Karachi, and Santacruz Airport.

78. Sen Gupta, Prabhit K. The genesis and movement of the nor'westers of Bengal. Proceedings of the Indian Academy of Science, Section A, XXXV(6): 303-309. Bangalore, June 1952. DLC Q73 .I6.

...This is an abridged report presented in the Symposium on "Physics on Thunderstorms" in New Delhi on December 28, 1951. The paper contains information on the development and the movement of the nor'westers or thunderstorms with associated violent squalls in Bengal.

79. 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. Delhi, 1952. DAS M(05) I39i.

...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 subdivision 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.

80. Tannehill, Ivan Ray. Weather around the world. 212pp. Princeton, 1952. DAS M T166we.

...Contains tabular monthly and annual summaries over an unspecified period of mean temperature and mean total amount of precipitation for Peshawar; mean daily maximum and minimum temperatures, mean relative humidity, absolute maximum and minimum temperatures, mean number of days with precipitation, and mean cloud amount for Karachi.

81. Table showing a division of the dry zone of Western Pakistan. The Bulletin of the Karachi Geographical Society, 3rd & 4th Issues, 1951-52, p. 4. DNG.

...Consists of the 6 zonal regions of West Pakistan based on self-containing river basins and the political units and distinguishing characteristics of each zonal region. These characteristics include climatic conditions.

1953

82. 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.

83. Chaudbury, A. M. A theoretical analysis of upper-air circulation over Indo-Pakistan. Pakistan Journal of Science , 5(2): 83-90. Lahore, April 1953. DGS S(648) P17j.

...Steady flow of air horizontally eastward across the Himalayas and the Tibetan plateau has been studied. A single infinite family of patterns in terms of first and second kind Bessel solutions is possible. Over this non-unique pattern an infinite number of arbitrary free oscillations whose amplitudes are not determined by the boundary conditions, may be super-imposed. The plateau can thus introduce a very complicated flow pattern, particularly in its immediate vicinity. This complex pattern is quasi-harmonic in the vicinity of the plateau but becomes sinusoidal at a large distance from the plateau. The amplitudes of the wave patterns decrease inversely as the square root of the distance.

Source No. 83 continued.

Only the position of the first trough of a particular solution coincides almost exactly with the mean observed positions of the Caspian Sea trough upstream and the Asiatic trough downstream off the coast of Indo-China. This particular pattern is one with first order Bessel solution of the second kind. The computed flow pattern over Indo-Pakistan agrees well with that observed, especially for the winter half of the year when the effect of the plateau is greatest. The free air circulation over Indo-Pakistan is thus to a large extent the result of the mechanical effect introduced by the Himalayas and the Tibetan Plateau north of Indo-Pakistan.

The effect of the plateau on the east wind has also been studied. A unique solution in terms of modified Bessel function of second kind (first order) has been obtained. The character of the modified solution is hyperbolic and decreases exponentially from the plateau, showing that the east wind in a non-divergent barotropic atmosphere when disturbed, cannot execute oscillations but that the disturbance dies down exponentially. - Author's abstract.

84. Dhir, R. D. Hydrological research in the arid and semi-arid regions of India and Pakistan. UNESCO, Reviews of Research on Arid Zone Hydrology, pp. 96-127. Paris, 1953. DAS M79 U58r.

...Contains brief notes on the meteorology of India and Pakistan. These notes include descriptive climatic information for each season in the two countries.

85. Govindaswamy, T. S. Rainfall abnormalities, week by week, in India during 1908 to 1950. The Journal of the Central Board of Irrigation and Power, 10(2 and 3): 207-244. Delhi, April and July 1953. DAS P.

...Discusses (1) the normal monthly rainfall and its coefficient of variability and (2) rainfall week by week for prepartitioned India; describes diagrams showing abnormalities of rainfall, week by week, in each of the rainfall sub-divisions for all the years 1908-50; presents diagrams and numerical values for 30 sub-divisions of India and Pakistan showing coefficient of variability of the monthly rainfall and rainfall week by week for 1945-1946 and for 1908-1950.

86. 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 the western coast of Thailand from Pakchan River to Kọ Phuket; also the Andaman and Nicobar Islands. Eighth Edition, 1953. 527pp. 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. A table contains monthly and annual summaries based on 5-71 years for Chittagong of mean pressure (mb); mean daily maximum and minimum temperatures (^{o}F); mean of the highest and mean of the lowest temperatures (^{o}F) in each month; means at 0800 and 1700 of relative humidity, cloud amount (0-10) and wind speed (knots); mean total rainfall amount (in); mean number of days with $\geq$ 0.1" of rain; wind direction (8 points and calm) frequency (%) at 0800 and 1700, mean number of days with wind force $\geq$ 8 Beaufort, and mean number of days with visibility $<$ ½ n. mile.

87. Hussain, Azra Afzal and Pithawala, Manek B. A workable analysis of the precipitation data for Quetta. Pakistan Journal of Science, V(4): 182-190. Lahore, October 1953. DAS P.

...Analyzes the precipitation at Quetta. The text includes information on seasonal rainfall periods, monthly rainfall, number of rainy days, intensity of rainfall, differences between winter and summer rains, fluctuation of precipitation, rainfall cycle, effect of physiography on rainfall, and possibilities of artificial rainfall. The tables present for Quetta summaries over the period of monthly maximum rainfall in 24 hours in inches, seasonal (winter, post-winter, monsoon and pre-winter) hourly distribution frequency of precipitation $\geq$ 0.10", monthly greatest and least amounts of precipitation based on 5 years of data (1926-1931), monthly total cloud amount for morning and afternoon and low cloud amount for morning and afternoon, and monthly mean number of days with fog or mist.

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

...Consists of tabular monthly and annual summaries for over 250 observatory stations covering the Indian area prior to partition, Ceylon, Afganistan, Tibet, Iran, Arabia, and Burma. These summaries include 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

Source No. 88 continued.

with dates of occurrence; mean total amount, and maximum amount in 24 hours with date of occurrence of rainfall; total rainfall of wettest month and total of driest month with years of occurrence; mean wind speed; mean number of days with precipitation $\geq$ .01", thunder, hail, duststorms, squalls, and fog.

89. Khan, Azra Ihsan-Ur-Rahman. Contributions to the study of the climate of the Punjab and the N.W.F.P. (Pakistan). 195pp. Photocopy. 1953. DAS M82.1/545 K45co.

...Discusses the method and procedure followed in this study, the general climatic controls, the monsoons and western depressions, the temperature, pressure and winds, precipitation, climatic regions, variability of precipitation, and suggestions for possible uses of this study on the climate of the Punjab and North West Frontier Province in Pakistan. In the appendices there are tables with monthly and annual summaries over specified periods (vary by station) up to 1940 of mean temperature and mean total amount of precipitation and Köppen's climatic classification for 18 stations in Pakistan; monthly and annual total rainfall amount for each year, 1939-1951 for 16-17 stations in Pakistan; January, June, and annual mean temperatures for each year, 1939-1951 for 15-17 stations in Pakistan.

90. Koteswaram, P.; Raman, C.R.V.; Parthasarathy, S. The mean jet stream over India and Burma in winter. Indian Journal of Meteorology and Geophysics, 4(2): 111-122. Delhi, April 1953. DAS M(05) I39i.

...Has as its purpose to locate and study the properties of the mean jet stream based on available normal radiosonde and sounding data for stations in India, Pakistan, and Burma. The authors discuss the data used in the analysis, the analysis of the data, the location of the jet stream, distribution of mean absolute vorticity, tropopause and the jet stream, and the thermodynamics of the jet stream. The tables include winter mean temperatures at 700, 500, 300, 200, 150, 100, and 80 mb levels for 14 stations in India, 3 (Chittagong, Karachi, and Peshawar) in Pakistan, 3 in Burma, and 1 in Ceylon for specified periods (vary by station).

91. Ludwig, Hildegard. Regionale Typen im Jahresgang der Niederschläge in Vorderindien und ihre Beziehung zu Landschaftsgrundlagen (Regional types in annual precipitation regime in India and their relation to landscape patterns). Hamburg. Universität. Abhundlungen aus dem Gebiet der Auslandskunde, Band 57, Reihe C: Naturwissenschaften, Band 16. 144pp. (In German). Hamburg, 1953. DAS M78.1 L948r.

Source No. 91 continued.

...An elaborate regional study of rainfall regimes in a score of subareas of India based on records of 30 years or more from hundreds of statistics in the network which was begun in 1876. Average values for each region are plotted by months and also the variation within each region shown by graphs for individual stations. The monsoon type, the transitional type and the late autumn type constitute the major regions. They are broken down into 25 subregions and those into 2 or 3 sub-subregions. Actual mean monthly fall and period or record are given for over 4000 stations, and in several cases the 10, 20 and 30 year means are given from 1871-1930 to show variations in long period means as well as spatial variations. - MAB 5.7-156.

The area in this study refers to undivided India, which includes Pakistan and Ceylon.

92. MacDonald, T. H. Burma mean freezing level contours - Burma coastal fog data. U. S. Weather Bureau, Special Report 353. October 1953. DAS M82.2 U587s.

...Includes monthly and annual mean hourly temperatures and relative humidities and their differences from the mean of the day for Chittagong; monthly mean number of days with fog at 0300 (period of record varies by month) at Chittagong; monthly visibilities associated with individual cases of fog at 0800 at Chittagong for each year (1938 and 1939).

93. Pramanik, S. K.; Hariharan, P. S.; Ghose, S. K. Analysis of the climate of the Rajasthan Desert and its extension. International Symposium on Desert Research. pp. 176-186. Jerusalem, 1953. DAS M85.53 I61d.

...Examines the data of the Rajasthan Desert to determine whether there has been any change in climate; reviews the climatological analysis regarding the extension or intensification of desert conditions; presents information on the data used in this study; discusses the annual mean rainfall, mean maximum and minimum temperatures, mean relative humidity of the Rajasthan Desert; gives conclusions. This study presents graphs showing the annual variation of mean rainfall, mean maximum and minimum temperatures, mean relative humidity, and wind speed based on varying periods between 1860 and 1950 for 5-7 stations (Montgomery, Multan, Khanpur, Jacobabad, Hyderabad, Karachi, Umerkot) in Pakistan and 6-8 stations in India.

94. Pramanik, S. K. and Jagannathan, P. Climatic changes in India - (I) Rainfall. Indian Journal of Meteorology and Geophysics, Delhi, 4(4): 291-309, October 1953. DAS M(05) I39i. Also with minor changes in: Scientific Proceedings of the International Association of Meteorology, Rome, September 1954, pp. 86-106, London, 1956. DAS M(06) I611g Met 1954(1).

...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 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 rainfall as percentage of mean for 26 stations in India and 4 in Pakistan (Jacobabad, Karachi, Multan and Lahore).

95. Ramaswamy, C. and Bose, B. L. On cold pools and their role in the development of nor'westers over West Bengal and Eastern Pakistan. Current Science, 22(4): 103-105, April 1953. DAS M(05) C976. Also: Remarks on a note on "Development of nor'westers etc." by S. L. Malurkar. Ibid. 22(7): 200-201, July 1953. Reply by C. Ramaswamy and B. L. Bose. Ibid. 22(7): 201, July 1953. DNAL 475 Sci23. Also: On the cold pools and their role in the development of nor'westers over West Bengal and Eastern Pakistan by B. N. Desai and Y. P. Rao. Indian Journal of Meteorology and Geophysics, Delhi, 5(3): 243-248, July 1954. DAS M(05) I39i.

...This is a study on the cause of the nor'westers over West Bengal and East Pakistan. The authors have studied the thickness patterns at the 700-and 500-mb. levels over the area during the nor'wester season. The results of seven spells of nor'wester activity are presented. The extensive and destructive nor'westers are associated with cold pools or cold thermal troughs at the 500 mb. level. Malurkar reviews briefly his notes on the development of nor'westers. Ramaswamy and Bose reply by stating that Malurkar has nowhere proved that the upper level condition was actually responsible for the nor'westers, or that it was associated with western disturbances moving far to the north of India. Desai and Rao make comments on the theory advanced by Ramaswamy and Bose regarding the usefulness of the presence of cold pools or troughs over Bengal and neighborhood in forecasting nor'westers over the area. To test the validity of this theory the authors have prepared thickness charts for three important nor'westers on March 13, May 1 and May 9, 1953, between 700-and 500-mb levels. In addition to the charts the text contains information on each of these nor'westers.

96. Ramaswamy, C. and Bose, B. L. On the importance of the mid- and upper tropospheric thermal systems in the development of weather in North-east India and Eastern Pakistan during the nor'wester season. Current Science, 22(10): 291-294. October 1953. DAS M(05) C976.

...Is an analysis of the 500-and 300-mb partial thickness patterns for May 1953 for the purpose of confirming the results of an earlier study on the association of nor'westers with cold pools or cold thermal troughs at the 500-mb level. Additional new points were also brought to light and stated briefly.

97. 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 10 years of data for 59 stations in Pakistan.

1954

98. Ahmad, Kazi S. Regional balance in Pakistan. Pakistan Geographical Review, IX(2): 1-15. Lahore, 1954. DLC DS376 .P29.

...On pages 4-9 presents notes on the climate of East and West Pakistan. These notes include information on temperature, rainfall, and humidity. The tables contain summaries over an unspecified period of monthly (January and June) mean temperature and mean maximum and mean minimum temperatures and annual mean temperature for 12 stations in Pakistan; seasonal and annual rainfall amount (in.) for 13 stations in Pakistan.

99. Bhalotra, Y. P. R. On the use of hill stations data for drawing contours on isobaric surfaces. Indian Journal of Meteorology and Geophysics, 5(3): 239-242. Delhi, July 1954. DAS M(05) I39i.

...Gives the results of efforts to determine the usefulness of projecting hill stations on constant pressure charts to make them more comprehensive. The discussion includes information on the method of reduction of hill station data, heights of isobaric surfaces from constant pressure charts, comparison of heights given by two methods, order of errors, and conclusions. The tables show height differences for 13 stations (1 in Punjab, 2 in Kashmir, and 10 in West Pakistan).

100. Carter, Douglas B. Climates of Africa and India according to Thornthwaite's 1948 classification. Johns Hopkins University, Publications in Climatology, VII(4): 453-474. Centerton, New Jersey, 1954. DAS M8 J65p.

...Gives information on the climatic maps of India and vicinity concerning the average annual precipitation, average annual potential evapotranspiration, average annual water deficiency, average annual water surplus, and moisture regions. A graph shows monthly values of actual and potential evaporation, precipitation amount, water deficiency, and water surplus for Karachi.

101. Chatterjee, S. B. Indian climatology; climostatics, climatic classification of India with special reference to the monsoons. 417pp. Calcutta, ⌜1954?⌝ . 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", formerly "Calcutta Review", and some journals of Calcutta College. Chapter I contains a discussion on the scope of Indian 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 methods of climatology. In Chapter III on precipitation characteristics, precipitation conditions in January and July, annual precipitation condition, air mass climatology, seasonal and annual precipitation, frequency of rainy days, variability of rainfall, and rainfall zones are discussed. A table presents wind direction frequency, mean total amount of precipitation, number of days with precipitation, mean cloud amount, and mean relative humidity for comparison at typical stations under the influence of land and sea monsoons in India, Pakistan, Ceylon, and China. 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 India. Chapter V deals with the climo-statical regions of undivided 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 for 415 stations in undivided India and (2) a list of selected meteorological stations of all classes in undivided India.

102. Datta, S. C. High level moderate to severe turbulence near the I.T.F. Indian Journal of Meteorology and Geophysics, 5(4): 377-378. Delhi, October 1954. DAS M(05) I39i.

...Reports moderate to severe turbulence at 1125 GMT at a height of 15,500 ft between Lat. 22°40'N, Long 61°40'E and Lat. 22°27'N, Long. 63°30'E on August 25, 1953, by aircraft. This was apparently in the area of the I.T.F. The note gives some upper air information and describes the synoptic situation. In addition to the textual information there are tabular temperature and mixing ratio values at levels of 900, 850, 800, and 700 mb for August 24 and 25, 1953, for Veraval and Karachi.

103. Desai, B. N. and Rao, Y. P. Some aspects of depressions and cyclones in the Indian Seas. 24pp. Bombay, 1954. DAS M15.21 D44lso.

...Discusses upper air conditions at the time of the formation of nine depressions or cyclones in the Indian Seas. Illustrative upper air data, observed on specific days, are included for Port Blair, Madras, Trivandrum, Calcutta, Jodhpur, Allahabad, Delhi, Veraval, Karachi, and Multan.

104. Khan, Mohd. Naseer. Climate of Sind. Pakistan Geographical Review, IX(1): 1-9. Lahore, 1954. DLC DS376 .P29.

...Describes the general climate, seasons and weather types, the winter season, climatic divisions, and climatic changes of Sind. The climatic divisions are desert and steppe lowland, arid highland, dry marine, and marginal monsoon.

105. Koteswaram, P. and Parthasarathy, S. The mean jet stream over India in the pre-monsoon and post monsoon seasons and vertical motions associated with sub-tropical jet streams. Indian Journal of Meteorology and Geophysics, 5(2): 138-156. Delhi, April 1954. DAS M(05) I39i.

...Is a study on the mean horizontal divergence and vertical motion in the troposphere over the country with particular reference to the circulation in the vicinity of the jet streams. The text presents information on the thermal structure of the upper troposphere in the post monsoon and pre-monsoon periods, mean contour topography at various standard pressure levels, mean meridional cross-sections, monthly variation of the jet stream, general concepts of vertical motion in the vicinity of jet streams, thermodynamical aspects of the jet stream, horizontal divergence over India, vertical motion over India by kinematic method and by adiabatic method, mechanism of jet stream and clear-

air turbulence near the subtropical jet. The tables present seasonal (post monsoon and pre-monsoon) mean temperatures at 700, 500, 300, 200, 150, and 100 mb. levels for 13 stations in India, 4 in Pakistan (Chittagong, Jiwani, Karachi, and Peshawar) and 3 in Burma based on data, wherever possible, for the period 1944-1951.

106. Pramanik, S. K. and Jagannathan, P. Climatic changes in India - (II) Temperature. Indian Journal of Meteorology and Geophysics, Delhi, 5(1): 29-47, January 1954. DAS M(05) I39i. Also with minor changes in: Scientific Proceedings of the International Association of Meteorology, Rome, September 1954, pp. 106-124. London, 1956. DAS M(06) I611g Met 1954 (1).

...Is a study on temperature trends in India. The discussion contains 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 26 stations in India and 4 in Pakistan (Jacobabad, Karachi, Multan, and Lahore) of tabular annual mean, standard deviation and coefficient of variation of maximum and minimum temperatures; tabular miscellaneous computed temperature values; moving temperature averages on graphs.

107. Pramanik, S. K. Hydrology of the Rajasthan Desert - rainfall, humidity and evaporation. International Association of Scientific Hydrology, Publication no. 38: Assemblée Générale de Rome 1954, Tome III, pp. 223-240. DAS M(06) I611g S. Hyd. no. 38. v.3.

...Includes annual mean total rainfall for 1940 and extreme amount of rainfall for Baluchistan, Sind, Punjab (S.W.), and N. W. Frontier Province of Pakistan.

108. Ramaswamy, C. and Bose, B. L. On certain new aspects of the thermal patterns associated with nor'westers over North-east India and Eastern Pakistan. Current Science, 23(3): 75-77. March 1954. DNAL 475 Sci23.

...Presents the authors' ideas concerning the mechanism of nor'westers over North-east India and East Pakistan.

109. World Meteoerological Organization. Energy from the winds. WMO No. 32. TP. 10. 205pp. Geneva, 1954. DAS M(06) W927p.

...Reports seasonal and annual mean wind speed (mps) for 23 stations in Pakistan. These summaries are based on various periods between 1881 and 1953.

110. Fournier d'Albe, E. M.; Lateef, A.M.A.; Rasool, S. I.; Zaidi, I. H. The cloud-seeding trials in the central Punjab, July - September 1954. Quarterly Journal of the Royal Meteorological Society, 81(350): 574-581. London, October 1955. DAS M(05) R888q.

...Discusses the results of experiments to test the influence of the dispersal of salt particles from the ground on amount and distribution of rainfall in central Punjab during the period July 16 - September 15, 1954. The study includes information on the technique of salt-particle dispersal, dispersal of salt, seeding program, collection and analysis of rainfall data, and evaluation of results.

111. Gilchrist, A. Winds between 300 and 100 mb. in the tropics and subtropics. Meteorological Reports, II(16): 1-28. London, 1955. DAS M82 G786m.

...Presents an account of the mean atmospheric flow between 300 and 100 mb in the tropics and subtropics for January, April, July, and October by charts of mean winds at constant pressure levels and mean atmospheric cross-sections at selected longitudes. These charts are based on data during 1951 at individual stations, including Karachi Airport in Pakistan.

112. Mull, S.; Gangopadhyaya, M.; George, C. A. A review of some upper air analyses in relation to prediction of nor'westers. Indian Journal of Meteorology and Geophysics, 6(1): 5-30. Delhi, January 1955. DAS M(05) I39i.

...Standard upper air analyses, such as delineation of thermal thickness patterns on isobaric surfaces, computation of 'development', vertical component of absolute vorticity of geostrophic winds, and horizontal wind velocity convergence were made in relation to the nor'wester thunderstorms over northeast India and East Pakistan. For the thickness analysis, the special Dine's meteorograph observations taken in April 1944 at shorter intervals of time and from a closer network of stations than in 1953 were used, while all the above-mentioned analysis were made for eight consecutive days in May 1953. No significant medium-range prognostic value was found in any of the analyses based on the available network of radiosonde and upper wind data for forecasting the nor'westers 12 to 36 hours ahead of their actual occurrence. Nevertheless the partial thickness patterns of the 700/500 mb-layer, the field of 'development' and the lower level wind velocity convergence, based on the evening data for a particular day, appeared to influence the nor'wester development on the same evening and night. - Authors' abstract.

113. Pakistan Meteorological Service. Microclimatological studies for development of some important crops in Pakistan. 5pp. Karachi, August 24, 1955.

...Gives aims and objects of the microclimatological studies for development of some important crops in Pakistan, analyzes the work involved in these studies, and notes work done previously and the results.

114. Pakistan. Ministry of Education. The Geophysical Observatory Quetta. 35pp. Karachi, 1954 or 1955. DAS M01.9 P152g.

...Part I describes the development of the Observatory with the technical assistance of UNESCO. Part II discusses the climate, the location of the Observatory, seismological equipment, the Geomagnetic Observatory, the work in atmospheric physics, library, workshop, drawing office, and the publications of the Observatory at Quetta. The source presents numerical values of monthly maximum and minimum temperatures (^{o}F), total rainfall amount, and mean relative humidity at Quetta, based on data for an unspecified period.

115. 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. Also with minor changes in: Scientific Proceedings of the International Association of Meteorology, Rome, September 1954, pp. 125-138. London, 1956. DAS M(06) I611g Met. 1954 (1).

...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 the uniform period 1901-1950, and linear trends for January and July. The tables contain for 2 stations in Burma, 4 (Jacobabad, Karachi, Multan, and Lahore) 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 average of 0800 pressure; January, July, and annual linear trends of pressure (1901-1950).

116. Robison, William C. and Dodd, Arthur V. Analogs of Yuma climate in south central Asia (India - Pakistan - Afghanistan - Iran). U. S. Quartermaster Research & Development Center, Natick, Mass. 24pp. June 1955. DAS M86 U585re RER-4.

Source No. 116 continued.

...Describes briefly the geographic setting and climate of south central Asia. The tables include July frequencies (%) of surface wind speed (calm, 1-3, 4-7, 8-12, 13-18, 19-24, 25-31, and > 31 mph) at 0730 and 1630 or 1730 based on 5 years of data for Khanpur, Nokkundi, Pad Idan, and Multan; monthly and annual summaries over the period (43-62 years) of mean temperature (°F), mean daily extreme temperatures (°F), absolute extreme temperatures (°F), mean total amount of precipitation, mean dew point at 0800, mean cloud amount (tenths), and mean wind speed (mph) at Karachi (Manora), Dera Ismael Khan, Jacobabad, and Peshawar in Pakistan.

117. Schneider-Carius, K. and Essenwanger, O. Analyse von Niederschlags-wahrscheinlichkeiten ausgewählter Stationen Vorderindiens. (Analysis of precipitation probabilities at selected Indian stations.) Geofisica Pura e Applicata, Milan, 30(1): 205-221, January-April 1955. (In German with German and English summaries) DAS P.

...For interpretation of precipitation, mean totals and frequency of precipitation-amounts for the investigating period are considered. Up to now, the experiments to get a meteorologically valid probability for this frequency were unsuccessful because the internal law of atmospheric conditions was not considered. From statistical investigations, applied to observations of precipitation for some German stations, it could be concluded that there is a logarithmic law for characterizing conditions of precipitation. Therefore on a logarithmic scale we get a real meteorological probability for the frequency of precipitation-amounts. Then the distribution consists of one Gaussian normal distribution or a sum of Gaussian normal distributions. The validity of this logarithmic law can be proved by examples from extreme climates such as Cherrapunji, Karachi, Madras, and Quetta. - MAB 7.4-229.

118. U. S. Quartermaster Research and Engineering Center, Natick, Mass. Research study report RER-4: Analogs of Yuma climate in South Central Asia. 24pp. June 1955. DAS M86 U585re RER-4.

...Extensive areas of South Central Asia have summer temperatures analogous to those of Yuma. Only in the extremely hot Indus Valley of Pakistan and the interior basins of Iran, and in the perennially cool mountains of Kashmir, Afghanistan, and northern Iran are summer temperature regimes appreciably different from those at Yuma. In winter, however, the area of temperature analogy is restricted by the occurrence of temperatures higher than at Yuma in the southern part of the Indian lowlands, and by the occurrence

Source No. 118 continued.

of lower temperatures in the elevated interior of Iran. Mean annual precipitation falls within some degree of analogy (i.e., less than 9 inches) over most of the study area. The only areas with higher rainfall are the lowland portion of India subject to monsoon rains, the northwestern part of Iran bordering the Caspian Sea, and some of the higher mountains. The combined areas of analogy and semianalogy for mean July cloudiness are approximately the same as for mean annual precipitation. Mean July wind speeds are likewise analogous or semianalogous at most of the stations for which values are available, being too high only at some of the coastal stations and in the vicinity of the Seistan Basin near the center of the region. Summer dew points are analogous in a comparatively narrow band between the humid regions that are subject to maritime influences, and the dry highland regions of Kashmir, Afghanistan, and Iran. This analogous band is widest in western Baluchistan and swings northwest near the Persian Gulf coast to the northwestern border of Iran. The greatest coincidence of analogy of combined climatic elements is in western Baluchistan as shown by the records of Panjgur; a similar area of nearly total analogy is found in the Indus River Valley of West Pakistan in the vicinity of Bahawalpur. The results of the study are summarized in a series of maps at the end of the report. - Author's abstract.

119. Venkateswara Rao, D. Heights of base and top and thickness of tropical clouds. Indian Journal of Meteorology and Geophysics, 6(4): 299-316. Delhi, October 1955. DAS M(05) I39i.

...Analyzes the heights of base and top of all genera of high and middle clouds and of thunderclouds from 1215 reports by Comet Jet Airliners over India and neighborhood during 1952 and 1953. These reports represent observations made between Karachi, Bombay, Delhi, Calcutta, Rangoon, Colombo, Singapore, and Bangkok. The author discusses the data used, the results of the study with reference to type of clouds and the seasons of the year, the variation of height of base of high and middle clouds with latitude, and a reclassification of clouds based on the results of this study. The tabular seasonal and annual cloud summaries are for the tropical area.

1956

120. Ali, Mohammad Innas and Rahman, Md. Lutfur. Meteorological correlation of thunderstorm intensity with depressions of barometric

Source No. 120 continued.

pressure. Pakistan Journal of Scientific Research, 8(3): 106-108. Lahore, July 1956. DAS P.

...Is a study on the correlation of thunderstorm intensity with barometric pressure based on data at the Pakistan Meteorological Center, Dacca. The method of observation and conclusions are given.

121. Bhalotra, Y.P.R. A spell of exceptionally low temperatures over western Pakistan and northwest India from 6 to 12 May 1955. Indian Journal of Meteorology and Geophysics, 7(2): 204-205. Delhi, April 1956. DAS M(05) I39i.

...Contains brief notes on the synoptic conditions during the spell of exceptionally low temperatures over western Pakistan and northwest India during May 1955. The tables present for May 1955 the largest departures from normal of maximum temperatures with dates of occurrence for 4 stations (Sialkot, D. I. Khan, Fort Sandaman, and Jacobabad) in Pakistan and 5 stations in India, largest departures from normal of minimum temperatures with dates of occurrence for 5 stations (Khushab, D. I Khan, Peshawar, Ft. Sandaman, and Badin) in Pakistan and 5 in India, and total amount of rainfall $\geqslant$ 1" recorded in 24 hours with dates of occurrence for 2 stations (Ft. Sandaman and Multan) in Pakistan and 6 stations in India.

122. Iyer, V. Doraiswamy and Pradhan, R. N. Monthly frequencies of rainfall in India. Memoirs of the India Meteorological Department, XXX(VI): 217-289. Delhi, 1956. DAS M(055) I39m.

...Presents monthly and annual summaries over the period (1931-1940) of 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.

123. 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, April 1956. Also: Mean zonal wind circulation over India by P. Koteswaram. Ibid. 8(3): 346-347, July 1957. Also: Mean zonal wind circulation over India by D. A. Mooley. Ibid. 9(4): 404-407, October 1958. Delhi. 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 71½° and 80½°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.

Source No. 123 continued.

The tables contain the coordinates, elevation, and period of record of temperature data for all radiosonde stations (Peshawar and Multan in Pakistan; 6 stations in India; Ratmalana in Ceylon) for January, February, July, and August during the period 1944-1949; seasonal (monsoon and winter) mean temperature and relative humidity at 1000, 900, 850, 800, 700, 600, 500, 400, 300, 250, 200, 150, 100, 80, and 60 mb levels for these radiosonde stations; frequencies of winds $\geqslant$ 70 knots at heights of 6.0, 7.5, 9.0, 10.0, 11.0, and 12.0 km for 5 stations (Drosh, Peshawar, Jhelum, Lahore, and Multan) in Pakistan and 23 stations in India.

Koteswaram criticizes on the basis of insufficient data and at Jodhpur unreliable radiosonde data the conclusion by Mooley that there were two wind maxima in the upper troposphere at the 200-mb level - one at 31°N and the other at 22½°N.

Mooley replies to criticism by Koteswaram.

124. Pakistan. Meteorological Service. Report on administration and development of meteorology and geophysics in Pakistan up to 31st March 1956. Karachi. DAS M(06) P152re.

...Discusses the development of the Pakistan Department of Meteorology and Geophysics from August 1947 to March 1956. The discussion includes information on the administrative set-up; observatories; forecasting offices; regional meteorological centers; the Headquarters Organization which includes the administration, organization, theoretical meteorology, Climatological Section, Aerological Section, Synoptic Section, Weather Central, Library, publications issued, instrumental meteorology, Instruments Branch, workshop and laboratory, Stores and Supplies Branch, applied meteorology, Aviation Section, Marine Meteorology Section, hydrometeorology and Agri-Meteorological Organization; flood forecasting and warnings; River Navigation Weather Warning Service; meteorology of arid zones and humid tropics; cloud physics and artificial rain; meteorological service for animal husbandry, agriculture and forestry; Geophysical Organization which includes seismology, geomagnetism, ionospheric observations, ozone observations, night frost survey and solar radiation observations; solar physics; International Geophysical Year - 1957/1958 which includes meteorology, geomagnetism and ionosphere, cosmic rays, oceanography and seismology; research and investigation; position of Meteorological Service in International Circles; cooperation with U. N. Agencies; expansion of activities. The appendixes list the personnel of the Pakistan Meteorological Service, expeditions to the Himalayas and meteorological papers.

125. Pakistan. Meteorological Department. Technical Instruction No. M7/Ag3. 7 pp. Karachi, November 21, 1956.

...States the object of establishing the Agricultural

Source No. 125 continued.

Meteorological Observatories in different parts of the country and gives technical instructions for recording meteorological and plant observations at these observatories.

126. Ramaswamy, C. On the sub-tropical jet stream and its role in the development of large-scale convection. Tellus, 8(1): 26-60. Stockholm, February 1956. Also: On sub-tropical jet stream and its role in the development of large scale convection by B. N. Desai and Reply by C. Ramaswamy. Ibid 9(1): 135-137, February 1957. DAS M(055) T277.

...This paper contains mainly the results of a synoptic and climatological study of the large-scale convection in northern India and Pakistan during the three months preceding the onset of the south-west monsoon. It has been shown that the sea-level and lower tropospheric charts give little clue to the development of the large-scale convection and that the latter is overwhelmingly determined by the divergence in the waves in the sub-tropical jet-stream. It has further been shown from detailed synoptic evidence that nor'westers, andhis, and the majority of thunderstorms without squalls in northern India and Pakistan in the pre-monsoon period are fundamentally the same phenomenon. The role of cold-air advection in the middle and upper troposphere in the development of large-scale convection has also been discussed. This study has further revealed that the regions of upper-divergence and convergence can be qualitatively located by identifying certain typical patterns on the high-level maps more than 12 hours before the usual time of commencement of convection and that, consequently, these maps can be used as effective tools in the issue of area-warnings against thunder in general and nor'westers and andhis in particular.

A general study has also been made of the large-scale convection in southeast Australia, Union of South Africa, Bechuanaland, Southern Rhodesia, northeast Argentina, Uruguay, southeast Brazil, and southeast United States and the similarities between the large-scale convection in these countries and in Indo-Pakistan have been brought out. On the basis of these studies, it has been suggested that the jet stream plays the very important role of producing large-scale convection in the subtropics all over the world wherever it over-runs its equatorward side, moist air possessing a high degree of latent instability.
- Author's abstract.

Desai criticizes statements made by Ramaswamy. He states that the claim that one can forecast the broad regions of thunderstorms or nor'westers and convective dust storms on the basis of vorticity patterns in the upper tropsphere at and above the 500-mb level for more than 12 hours in advance in northern India and Pakistan cannot be justified.

Ramaswamy presents brief remarks on the points raised by Desai for the purpose of clarification.

127. 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.

128. 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 4 stations (Chittagong, Karachi, Lahore, and Peshawar) in Pakistan, 23 stations in India and 3 stations in Burma monthly and annual normal mean temperature (^{o}C) and precipitation (cm) and mean potential evapotranspiration (cm); annual water need (cm), water surplus (cm), and water deficiency (cm); moisture index; climatic type; climatic subtype. The source also presents monthly and annual potential evapotranspiration, precipitation, soil moisture storage-change, soil moisture storage, actual evapotranspiration, water deficiency, and water surplus for Sukkur. The period of record for most of the stations is more than 35 years.

129. Subrahmanyam, V. P. The water balance of India according to Thornthwaite's concept of potential evapotranspiration. Annals of the Association of American Geographers, XLVI(3): 300-311. September 1956. DAS P.

...Contains monthly and annual potential evapotranspiration values according to Thornthwaite's formula, monthly and annual actual water balance computations, and graphs showing the comparison of potential and actual evapotranspiration with precipitation by month for individual stations in India, Burma, Pakistan, and Ceylon. These data are for Sukkur in Pakistan.

130. United Nations. Economic Commission for Asia and the Far East. Multiple-purpose river basin development. Part 2B. Water resource development in Burma, India and Pakistan. Flood Control Series, No. 11. 135pp. Bangkok, December 1956. DGS 552(600) qUn2bef.

...On pages 81-83 describes the climate and rainfall of West and East Pakistan.

131. Bhatia, Shyam Sunder. Arid zone of India and Pakistan: A study in its water balance and delimitation. Indian Journal of Meteorology and Geophysics, 8(4): 355-366. Delhi, October 1957. DAS M(05) I39i.

...Describes the technique used in this study; discusses the water need, rainfall, water deficiency, and the delimitation of the arid zone of India and Pakistan; gives conclusions. The tables present annual water needs, summer water needs, maximum monthly and minimum monthly water needs for the year, annual rainfall amount, seasonal (monsoon and winter) rainfall aamount, maximum monthly rainfall amount for the year, monthly water deficiency, annual water deficit, number of months with water deficiency, maximum monthly water deficiency for the year, month with maximum water deficiency, annual water surplus, Thornthwaite's aridity index, Thornthwaite's moisture index, Köppen's climatic type, and De Martonne's aridity index for 2-17 stations in Pakistan and 3-30 stations in India.

132. Chakravortty, K. C. and Basu, S. C. The influence of western disturbances on the weather over northeast India in monsoon months. Indian Journal of Meteorology and Geophysics, 8(3): 261-272. Delhi, July 1957. DAS M(05) I39i.

...Includes a table showing the dates of the western disturbance, the approximate track, weather caused in northeast India and East Pakistan, position of axis of trough, and remarks about the disturbances for each year (1950-1954).

133. Fournier d'Albe, E. M. Cloud-seeding trials using common salt. Artificial Stimulation of Rain, Proceedings of the First Conference on the Physics of Cloud and Precipitation Particles held at Woods Hole Oceanographic Institution, September 7-10, 1955, Sponsored by the Geophysics Research Directorate, Air Force Cambridge Research Center, Air Research and Development Command, and the Geophysics Branch, Office of Naval Research. pp. 207-210. New York, 1957. DAS M09.67 U581pr.

...Describes the process followed in seeding the clouds with common salt in the Punjab by the Pakistan Meteorological Service.

134. Fournier d'Albe, E. M. Some observations of the geographical distribution of giant hygroscopic nuclei. Artificial Stimulation of Rain, Proceedings of the First Conference on the Physics of Cloud and Precipitation Particles held at Woods Hole Oceanographic Institution, September 7-10, 1955, Sponsored by the Geophysics Research Directorate, Air Force Cambridge Research Center, Air Research and Development Command, and the Geophysics Branch, Office of Naval Research. pp. 73-79. New York, 1957. DAS M09.67 U581pr.

Source No. 134 continued.

...The concentration and size distribution of giant hygroscopic nuclei in the surface air was measured twice weekly throughout a period of two years at five stations in West Pakistan. The results suggest that the sea surface and coasts are the only important source of such particles in this area. The loss of particles by fall under gravity is negligible except for those of mass greater than 10^{-9}g, and the main agent in their removal from the atmosphere appears to be precipitation. On the other hand, the evaporation of rain or large cloud droplets may produce locally high concentrations of giant nuclei. Some measurements have also been made in Mexico which tend to support these conclusions. - Author's abstract.

135. Jagannathan, P. Seasonal oscillation 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 the half-yearly oscillations in the mean temperature of air at 4 feet above ground level at 167 meteorological stations in India and neighbourhood have been separated. The dependence of the components of the vectors of the different oscillations on the location of the stations have been determined. Regression equations for representing the components of the oscillations as a linear function of latitude, longitude 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 have been discussed. - Author's abstract.

136. Karim, A and Hossain, M. On the single value climatic indices and the pedo-climatic zones of East Pakistan. The Oriental Geographer, July 1957. pp. 145-153. Dacca. DLC G35 .E225.

...Deals with an examination of the available climatic data for East Pakistan so as to fix the pedo-climatic zones in consideration of the single value climatic factors viz., Lang's rain factors, Meyer's N-S. Q., Transeau ratio as adopted by Vilensky and Prescott ratio of soil boundary. There are tables with mean total rainfall (in), mean temperature (^{o}F), mean relative humidity, and saturation deficit for 17 stations in East Pakistan.

137. Kahn, Mohammed Ibrahim. A study of structure, behaviour and effects of tropical cyclones in West Pakistan. M. A. Thesis, Karachi University, Department of Geography, 1957. DAS M15.2 K45st.

...Discusses the location, physical features, and climate of West Pakistan; tropical cyclones; life history of some tropical cyclones in West Pakistan; frequency of cyclones of the Arabian Sea and of the Bay of Bengal; area of formation of cyclones in the North Indian Ocean;

Source No. 137 continued.

tropical cyclones of the Arabian Sea and of the Bay of Bengal affecting West Pakistan; tracks of cyclones and their relation to upper level atmosphere; cyclones and floods. A table contains annual mean total amount of rainfall at 36 stations in West Pakistan.

138. Khan, Mubashir Lall. Water balance and magnitude of water deficiency in the arid zone of West Pakistan. Pakistan Geographical Review, XII(2): 65-69. Lahore, 1957. DLC DS376 .P29.

...Deals with the aridity and water deficiency of West Pakistan. The table presents summaries over an unspecified period of monthly and annual potential evapo-transpiration, precipitation and water deficiency, and monthly storage and storage change in centimeters at Drosh, Lahore, Nokkundi, Sukkur, and Peshawar.

139. Mubashir, L. K. Climatic fluctuation in the Outer Himalayas & adjacent parts in W. Pakistan during the past century. Pakistan Journal of Science, 9(5): 202-208. Lahore, September 1957. DAS P.

...The problem of climatic fluctuation is one of the most interesting aspect of modern climatology. In this paper, an effort has been made to detect oscillation in the semi-arid, subhumid, and humid parts of West Pakistan with the help of meteorological record of Lahore, Murree, and Peshawar.

An attempt has also been made to study the periodicity of fluctuation by finding correlation between rainfall and sunspots. The Bruckner cycle has also been tested. The conclusions have been supported by glaciological evidence. - Author's abstract.

140. Quadir, M. A. The effect of precipitation on soil erosion in Sind and Baluchistan. Symposium on Soil Erosion & Its Control in the Arid & Semi-Arid Zones, Karachi, Pakistan, 7-11 November 1957. 9pp. DAS M:631.45 Qlef.

...Gives an analysis of the rainfall data in Baluchistan and Sind. The tables contain monthly, seasonal, and annual summaries over specified periods of mean total rainfall for 29 stations in Sind and Baluchistan; seasonal and annual frequency of rainfall intensity in inches per hour at Karachi Airport, Chhor, Hyderabad, Jacobabad, Quetta, Dalbandin, Sibi, and Loralai.

141. Ramadas, L. A. Evaporation and potential evapo-transpiration over the Indian sub-continent. The Indian Journal of Agricultural Sciences, 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 evapo-transpiration over the Indian sub-continent. The area includes India, Pakistan, and Burma.

142. Ramdas, L. A. Evaporation control. Indian Journal of Meteorology and Geophysics, 8(Spl. No.): 120-128. Delhi, December 1957. DAS M(05) I39i.

...After discussing "Natural Evaporation" from extensive areas in relation to "evaporating power" as recorded from small pans, and their distribution over the Indian Sub-continent, the paper examines the various techniques for the conservation of water by minimising losses due to evaporation. The use of mono-molecular film covers over water surface for suppressing evaporation has been studied in some detail. - Author's abstract.

143. Subrahmanyam, V. P. Summer concentration of thermal efficiency as an index of thermal continentality. The Indian Geographer, 1&2 (2&1): 108-114. New Delhi, August 1957. DLC G1 .I63.

...Briefly presents (1) the modified Zenker formula suggested by Conrad for evaluation of the continentality coefficients and (2) Thornthwaite's concept of potential evapotranspiration for the classification of climates. The author then applies these concepts to undivided India based on data for about 250 stations in India, Pakistan, Burma, and Ceylon.

144. Pakistan Meteorological Service. Pakistan Journal of Science, 9(4): 139-141. Lahore, July 1957. DAS P.

...Describes the scope of activities of the Pakistan Meteorological Service. This includes administration, organization, theoretical meteorology, instrumental meteorology and workshop, library and archives, applied meteorology and geophysics.

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145. Ahmad, Kazi S. Water supply in the Indus Basin and allied problems. Pakistan Geographical Review, XIII(1): 1-17. Lahore, 1958. DLC DS376 .P29.

...Contains information on the rainfall of the Indus Basin, the variability of rainfall and its effect on crops, experiments in cloud seeding in West Pakistan, and snowfall.

146. Ahmad, Mahammad Shafi. Précipitations, evapotranspiration et aridité en Pakistan Occidental. (Precipitation, evapotranspiration and aridity in West Pakistan.) Université de Rennes, Travaux du Laboratoire de Climatologie de la Faculté des Lettres, No. 1. 91pp. (In French) 1958. DAS M(055) R414tr.

...Discusses the aridity of West Pakistan according to Thornthwaite (1948) and the problem of evaluation of the water requirement for vegetation; lists the rainfall stations with coordinates and elevation; gives tabular weekly microclimatic data for the Verger Experimental Observatory of Agricultural Meteorology at Quetta during 1956. These microclimatic data include relative humidity, sunshine duration, wind speed, evaporation, and precipitation. Tables also present monthly mean temperature, noncorrected potential evapotranspiration, potential evapotranspiration, amount of precipitation, evapotranspiration at 1-2 stations (Multan and Quetta); water balance in soil and climatic classification of 19 stations according to Thornthwaite (1948); monthly and annual mean and median rainfall amounts at Karachi (1856-1940), Hyderabad (1866-1930), Kalat (1882-1940), Quetta (1878-1940), Lahore (1862-1940), Peshawar (1863-1940) and Leh (1876-1940); monthly mean temperature, relative humidity, sunshine duration (hours), and wind speed at Quetta during 1956. Illustrative graphs are also included in the envelope of annexes.

147. Graystone, P. Equivalent headwinds at heights of 30,000 feet & 40,000 feet along air routes. Supplemented and revised. Great Britain Meteorological Office, Meteorological Reports No. 20. 35pp. London, 1958. DAS M82 G786m.

...Gives the tabular average equivalent headwinds in knots on the route from the first named terminal to second (Cairo - Karachi, Nicosia - Karachi, Beirut - Karachi, Baghdad - Karachi, Basra - Karachi, Bahrain - Karachi, Sharjah - Karachi, Aden - Karachi, Lydda - Karachi, Karachi - Calcutta, Karachi - Singapore, Karachi - Rangoon, Karachi - Dacca, Karachi - Colombo, Karachi - Bangkok, Karachi - Bombay, Istanbul - Karachi, Karachi - Delhi, Dacca - Rangoon, and Habbaniya - Karachi) and on the return flight and the variability of the equivalent headwind from these mean values at each height (30,000 and 40,000 feet) for each mid-season month.

148. Khan, Mubashir L. A preliminary study of the atmospheric temperature in West Pakistan. Pakistan Geographical Review, XIII (1): 28-54. Lahore, 1958. DLC DS376 .P29.

...Discusses temperature as a function of the latitude, as a function of the altitude, and as a function of the prevailing air masses and winds; includes information on mean monthly and annual temperature, absolute extreme temperatures, mean annual and absolute ranges of temperature, and periodic and aperiodic diurnal ranges of temperatures; presents tabular monthly and annual absolute maximum and minimum

Source No. 148 continued.

temperatures with range and diurnal range of temperature for 17-32 stations in Pakistan.

149. Naqvi, S. N. Periodic variations in water balance in an arid region - a preliminary study of 100 years' rainfall at Karachi. United Nations Educational, Scientific and Cultural Organization, Climatology and Microclimatology, Proceedings of the Canberra Symposium. pp. 326-345. Paris, 1958. DAS M84 U58c1.

...Is a study on the variations of rainfall at Karachi during the last 100 years. The discussion presents information on the data used in this study; characteristics of Karachi precipitation; measures of aridity; periodicity of rainfall at Karachi; rainfall frequency in July in successive years of the short period of three to five years, the medium cycle of ten to thirteen and bigger cycles; correspondence with cycles of solar activity. Tables include for Karachi summaries of monthly and annual mean total rainfall amount, highest total rainfall amount with year of occurrence and average total rainfall on a rainy day based on data for 1856-1955, number of times when there was no rain and when there was some rain for each month January to December based on data for 1856-1955; monthly maximum rainfall amount in 24 hours with date of occurrence based on data for 1881-1955; monthly and annual number of rainy days ($\geq$ .10") based on data for 1881-1940; monthly and annual number of rainy days with any amount based on data for 1892-1955; monthly mean total amount of rainfall on a rainy day and on a wet day based on data for 1881-1940; monthly length of spells of wet weather (1892-1945); percentage frequencies of total monthly rainfall based on data for 1856-1955; monthly and annual total rainfall amount for each year 1856-1956.

150. Quadir, M. A.; Khan, Enayatullah; Khan, M. V. Surface wind data of Karachi for use in synoptic climatology. Pakistan Journal of Science, 10(5): 205-210. Lahore, September 1958. DAS P.

...Presents an interpretation of the frequency distributions of surface winds at Karachi in terms of moving synoptic patterns, as the season advances. The tables contain monthly (November-March) wind speed (1-6, 7-15, 16-23 knots) frequency by direction (8 points and calm) and wind direction (8 points and calm) frequency at 0000, 0300, and 1200 GMT at Karachi Airport based on data for 1947 to 1957.

151. Shanbhag, G. Y. Water requirement during January, May, August and October in India and vicinity (II). The Journal of the Central Board of Irrigation and Power, 15(3): 367-375. Delhi, July 1958. DAS P.

...Discusses the method of computing and mapping the water requirement for January, May, August, and October in India, Pakistan, and Burma.

152. Shanbhag, G. Y. Water requirement of the first two summer months in India and vicinity. The Journal of the Central Board of Irrigation and Power, 15(2): 220-231. Delhi, April 1958. DAS P.

...Investigates the hydrological balance of the climate in India, Burma, and Pakistan for March and April.

153. Sinha, K. L. Incidence of widespread rain in different seasons in the various parts of India and Pakistan. Indian Journal of Agricultural Science, XXVIII(III): 359-371. New Delhi, September 1958. DAS P.

...Discusses the features of the seasonal distribution of the widespread rainfall in the Indo-Pakistan region and the connected meteorological factors. The discussion includes such topics as rainy day for a station and widespread rain over an area, average rainfall of a station on a rainy day in each season in different sections of Indo-Pakistan, and seasonal distribution of widespread rain. There are numerical values of seasonal and annual mean rainfall on a rainy day at Srinagar in Kashmir; Karachi in Pakistan; Dibrugarh, Pamban, Bombay, Nagpur, Calingapatam, Lucknow, and Cherrapunji in India.

154. Sinha, K. L. Influence of distant monsooon lows on weather over Jodhpur. Indian Journal of Meteorology and Geophysics, 9(3): 251-254. Delhi, July 1958. DAS M(05) I39i.

...Includes a table with mean relative humidity values for July at heights of 2, 2.5, 3, 4, and 5 km for Quetta and at heights of 0.5, 1, 1.5, 2, 2.5, and 3 km for Karachi.

1959

155. Ahmad, Kazi S. Canal water problem in the middle Indus plain. Proceedings of IGU Regional Conference in Japan, August 28 - September 3, 1957, Tokyo and Nara. pp. 582-589. Tokyo, 1959. DAS 910.6 I61pr.

...The tables contain (1) mean annual rainfall amount for the Indus, Jhelum, Chenab, Ravi, Sutlej, and Beas catchment areas and (2) normal annual rainfall amount for Lahore, Lyallpur, Montgomery, Multan, Sukkur, and Hyderabad.

156. Ahmad, Kazi S. and Khan, Mubashir L. Variations of moisture types and their bearing on soil erosion in West Pakistan. Pakistan Geographical Review, XIV(1): 1-13. Lahore, 1959. DLC DS376 .P29.

...Shows the significance of potential evapotranspiration in determining the water balance and establishes the extent of fluctuation

Source No. 156 continued.

of various moisture types and their bearing on soil erosion. The text includes information on potential evapotranspiration, water deficiency and water surplus, moisture types, variability of moisture belts, the arid zone, semi-arid and dry sub-humid zone, and the moist zone. The tables contain statistical summaries over specified periods (vary by station) of moisture type distribution at 10 stations; monthly and annual summaries of potential evaporation, precipitation, storage change, storage, water deficiency, and water surplus for Karachi, Quetta, Parachinar, Murree, and Lahore; annual water need, summer concentration of T. E., annual precipitation, water surplus, water deficiency, number of months with water deficiency, moisture index, and climatic type for 29 stations.

157. Bhatty, M. A. Potwar Plateau climate. Pakistan Geographical Review, 4(2): 46-55. Lahore, 1959. DLC DS376 .P29.

...Describes the climate, rainfall, temperature, and general weather conditions of the cold weather, hot weather, rainy, and the retreating monsoon seasons. The author also discusses the thunderstorm, hailstorms, and duststorms of the hot weather season. This study contains numerical values of monthly mean total amount of rain (in.) at Rawalpindi and Jhelum, monthly maximum and minimum temperatures at Rawalpindi, monthly frequency of thunderstorms at Rawalpindi, monthly frequency of dust-storms in Potwar, and annual mean maximum and mean minimum temperatures at Rawalpindi based on data for an unspecified period; monthly (July - September) and rainy season (July - September) total rainfall amount for each year (1926-1930) for Jhelum, Rawalpindi, and Attock.

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

...Applies Koppen's, Thornthwaite's (1931), De Martonne's and Gorczynski's classifications of climate to prepartitioned India, but these do 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.

159. K., U. K. New site for the federal capital of Pakistan. Pakistan Geographical Review, XIV(2): 93-96. Lahore, 1959. DLC DS376 .P29.

...Describes the new site for the federal capital, its topography and its climate.

160. Khan, Mubashir L. Secular variations of annual precipitation in West Pakistan. Pakistan Journal of Science, 11(1): 23-42. Lahore, January 1959. DAS P.

...The paper sets out a statistical analysis of the precipitation records of eight stations for the last century. The data have been treated in the manner of a time series of stochastic type. The secular changes in the distribution constants have been examined by fitting orthogonal polynomials up to 5 degrees of freedom. The regression coefficients for linear, parabolic, and higher terms have been calculated. The regression coefficients for linear trend reveal that the precipitation has been decreasing at Quetta, Multan, Lahore, Sialkot, and Peshawar at an yearly rate of 0.024, 0.022, 0.030, 0.011, and 0.040 inches respectively. Karachi and Rawalpindi show an increase of precipitation amounting to 0.014 and 0.053 inches per year. The rainfall series have been further examined by running means and pentad and decade averages. Bruckner periods have also been tested. - Author's abstract.

161. Naqvi, Syed Sibte Nabi. The pulsating monsoon in South East Asia and associated floods in the Indo-Gangetic River systems. Pakistan Geographical Review, XIV(2): 49-60. Lahore, 1959. DLC DS376 .P29.

...Discusses the basic causes of the southwest monsoon, pulsations in the monsoon current, and floods in the Indo-Gangetic River systems and their forecasting. This address also appears in Eleventh Pakistan Science Conference, Karachi, February 5-10, 1959, Presidential Address, Section of Geology, Geography and Anthropology, pp. F1 - F14. Lahore. DAS M53.21 N217pu.

162. Natarajan, G. and Banerji, R. C. Fog over Agartala Airfield. Indian Journal of Meteorology and Geophysics, 10(2): 161-168. Delhi, April 1959. DAS M(05) I39i.

...Presents a table showing the monthly (September - March) and annual number of occasions of fog at Dacca with simultaneous occurrences at Agartala. Dacca is an alternate aerodrome for Agartala.

163. Quadir, M. A. and Nabi, Ghulam. The variability of Karachi climate and weather during three decades (1929-1958). Pakistan Journal of Science, 11(4): 203-212. Lahore, July 1959. DAS P.

...Discusses the pressure, dry-bulb temperature, wet bulb/dew point/relative humidity/mean vapor pressure, mean daily maximum and minimum temperatures, rainfall, surface wind, cloud amount, sunshine, thunderstorms, and dust-storms at Karachi. The tables present monthly mean pressure (mb) at 1200 GMT, monthly and annual mean dry-bulb temperatures (^{o}F) at 1200 GMT, monthly mean daily dew-point temperatures (^{o}F) at 1200 GMT, monthly and annual mean daily maximum and minimum temperatures (^{o}F), monthly prevailing wind direction at 0300 and 1200 GMT, monthly mean wind speeds (knots), monthly frequency of sunshine

Source No. 163 continued.

of 9 hours or more, monthly frequency of thunderstorms, monthly frequency of duststorms, and monthly frequency of fog at Karachi summarized for three periods (1929-1938; 1939-1948; 1949-1958). The source also contains numerical values of monthly absolute maximum and minimum temperatures over the period (1929-1958) for Karachi, seasonal and annual total rainfall and number of rainy months at Manora (Karachi) for each decade from 1869-1958, and monthly and annual mean total rainfall amount at Manora (Karachi) for various 30-year periods between 1869 and 1958.

164. 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 practice prevalent in the India Meteorological Department, viz., "few falls", "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

165. Caldwell, John C. Let's visit Pakistan. 96pp. New York - Toronto. 1960. DLC DS377 .C3.

...Compares the climates of East Pakistan and West Pakistan on pages 12-24.

166. Khan, Mubashir L. Recent pluviometric changes in the arid and semiarid zones of West Pakistan. Pakistan Geographical Review, 15(1): 1-24. Lahore, January 1960. DLC DS376 .P29.

...Assesses the recent changes of rainfall in the arid and semiarid zones of West Pakistan by examining the secular and periodic variations. This study is based on rainfall data for Karachi, Quetta, Multan, Montgomery, Lahore, Sialkot, Rawalpindi, and Peshawar.

167. Khan, Muhammad Ihsan-ur-Rahman. Some afforestation problems and research needs in relation to erosion control in arid and semi-arid parts of West Pakistan. Symposium on Soil Erosion and its Control in the Arid and Semi-arid Zones held at Karachi in November, 1957 under the Joint Auspices of F.A.C.P. and UNESCO. pp. 223-232. Karachi, 1960. DLC S622 .S9 1957.

Source No. 167 continued.

...Discusses briefly the low and extremely variable rainfall and presents the need for more microclimatic studies in the arid and semiarid areas of West Pakistan. A graph shows the rainfall variability at 4 stations (Lahore, Peshawar, Montgomery, and Multan) with BS or BW climates according to Koppen's classification in a period of 20 years from 1931-1951.

168. Khan, Muhammad Ihsan-ur-Rahman. The need and possibilities of establishing shelterbelts for erosion control in arid and semi-arid parts of West Pakistan. Symposium on Soil Erosion and its Control in the Arid and Semi-arid Zones held at Karachi in November, 1957 under the Joint Auspices of F.A.C.P. and UNESCO. pp. 215-222. Karachi, 1960. DLC S622 .S9 1957.

...Includes monthly normal mean daily wind speed (mph) and prevailing wind direction at Khushab and Multan.

169. Lawton, G. H. The Thal Project in West Pakistan. The Australian Journal of Science, 22(9): 379-385. Sydney, March 1960. DLC Q1 .A77.

...On pages 381 and 382 the climate of the Thal area is discussed briefly. This includes brief notes on rainfall and temperature.

170. Mizra, M. A. Certain ecological observations in northwest Pakistan. Fifth World Forestry Congress, August 29 - September 10, 1960, Proceedings, 3: 1745-1748. Resumés in French and Spanish. DAS M86/547 M677ce.

...Briefly describes the temperature, wind, rainfall, relative humidity, and evaporation in northwest Pakistan.

171. Naqvi, Sibte Nabi. Arid zone research; a report on the meteorological and geophysical researches for the development of arid areas in Pakistan. 39pp. Karachi, March 1960. DAS M85.53 N217ar.

...Describes the general climatic conditions of West Pakistan and East Pakistan, the development of the Meteorological Service since Pakistan became an independent state in August 1947, and the assistance of UNESCO in the arid zone research program; discusses the projects organized for the development of the arid lands in Pakistan; gives conclusions. The projects for the development of the arid lands primarily refer to artificial rain-making, ecological and phenological studies, micro-climatology, special studies in climatology and weather modification, hydrology and ground hydrology, mineral and water prospecting by geophysical methods, miscellaneous studies in parameters having bearing on problems of arid zone, and an integrated survey for development of an arid valley in Kalat Division.

172. Naqvi, Sibte Nabi and Khan, W. U. Hydrometeorological network in Pakistan for purposes of water resources development and flood control. United Nations, Economic Commission for Asia and the Far East, Hydrologic Networks and Methods, Flood Control Series no. 15, pp. 113-114. Bangkok, 1960. DAS M79 U58hy.

...Gives a history of the precipitation network in Pakistan and presents information on number of observatories and number of stations recording snowfall, evaporation, global radiation, and direct solar radiation in Pakistan.

173. Naqvi, Sibte Nabi. Integrated effect of climate on weathering and erosion in the Marine Desert near Karachi. Symposium on Soil Erosion and its Control in the Arid and Semi-arid Zones held at Karachi in November, 1957 under the Joint Auspices of F.A.C.P. and UNESCO. pp. 15-47. Karachi, 1960. DLC S622 .S9 1957.

...On pages 22-25 there are brief notes on the occurrence of hailstorms, diameter and velocity of raindrops, and rainfall characteristics based on data for a period of 100 years in Karachi. Tables present monthly and annual mean wind velocity (mph) and mean total rainfall amount at 18 stations in the Marine Desert in and around the Federal Capital of Pakistan (Karachi) based on data for the period April 1955 - March 1957; wind speed frequency by direction in mean wind, in gust and the lull for July 1929 at Drigh Road Aerodrome; average number of hours in a year for which different pressures in wind per square foot are exerted on surfaces perpendicular to winds from 16 directions at Karachi Airport based on hourly observations from May 1951 to December 1955.

174. Qadri, S. M. Alam. Wind erosion and its control in Thar. Symposium on Soil Erosion and its Control in the Arid and Semi-arid Zones held at Karachi in November, 1957 under the Joint Auspices of F.A.C.P. and UNESCO. pp. 169-183. Karachi, 1960. DLC S622 .S9 1957.

...A table presents monthly summaries of mean maximum and minimum temperatures (F), mean relative humidity at 0300 GMT, and mean wind speed (knots) at 0300 GMT based on normals at Chhor.

175. Quadir, M. A. The effect of precipitation in Sind and Baluchistan. Symposium on Soil Erosion and its Control in the Arid and Semi-arid Zones held at Karachi in November, 1957 under the Joint Auspices of F.A.C.P. and UNESCO. pp. 49-61. Karachi, 1960. DLC S622 .S9 1957.

Source No. 175 continued.

...Analyzes the frequency of heavy rainfall, high rainfall frequency and intensity-durations curves of rainfall in Baluchistan and Sind.

176. Ramdas, L. S. 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.

...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.

177. 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 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. The authors describe the data used, the procedure followed, and the results of this study.

178. Saha, B. P. Microseismic evidence for the existence of cold fronts in association with the Nor'westers. Indian Journal of Meteorology and Geophysics, 11(2): 137-144. Delhi, April 1960. DAS M(05) I39i.

...Group or storm type miscroseisms were recorded during the passage of Nor'westers over the head Bay of Bengal. These microseisms are of frontal type, and in the present paper they have been ascribed to cold fronts associated with the Nor'westers. No direct methods based on meteorological observations could be successfully used to prove the existence of the cold fronts associated with Nor'westers during pre-monsoon season. It is considered that records of microseisms furnish indirect evidence about the existence of the cold fronts in Nor'westers. - Author's abstract.

179. Sen Gupta, Prabhat K. Sunspot influence on movement of storms over the Bay of Bengal and associated atmospheric variations. Weather, XV(2): 52-58. London, February 1960. DAS M(05) R888w.

...Investigates the possible relationship between sunspot activity and the movement of disturbances. For this purpose the author examines the track of all mature storms in the Bay of Bengal from 1905 to 1949.

180. Shanbhag, G. Y. Water requirement during February, June, July and September in India and vicinity (III). The Journal of the Central Board of Irrigation and Power, 17(2): 215-224. Delhi, April 1960. DAS P.

...Discusses the method of computing and mapping the water requirement during February, June, July, and September in India, Pakistan, Nepal, and Burma.

181. Sharif, Muhammad. Mastung sand dunes - their formation and control. Symposium on Soil Erosion and its Control in the Arid and Semi-arid Zones held at Karachi in November, 1957 under the Joint Auspices of F.A.C.P. and UNESCO. pp. 285-307. Karachi, 1960. DLC S622 .S9 1957.

...On pages 286-291 describes the climate of the Mastung Valley in the Kalat Division of West Pakistan. Tables contain monthly and annual summaries over a period of 30 years of mean total rainfall amount and number of rainy days at Mastung; number of calm days, maximum wind speed (mph), and mean wind speeds at 0900, 1400, and 1700 for each month (May - July 1957) at Mastung; monthly and annual potential evapotranspiration calculated on the basis of the Thornthwaite formula and normal mean relative humidity at 0800 and 1700 at Quetta; monthly and annual total rainfall amount in 1955, a dry year, and in 1956, a year with unusually heavy rains, for Mastung.

182. Thirlaway, H.I.S. The results of arid zone research at the Geophysical Institute, Quetta. Pakistan Geographical Review, 15(1): 32-49. Lahore, January 1960. DLC DS376 .P29.

...Contains brief remarks on the rainfall and temperature of the Western Frontier area of West Pakistan on pages 32 and 33.

1961

183. Ahmad, Kazi S. and Khan, Mubashir L. Variability of rainfall and its bearing on agriculture in the arid and semi-arid zones of West Pakistan. Pakistan Geographical Review, 16(1): 35-50. Lahore, January 1961. DLC DS376 .P29.

...Presents various methods used to study the variability of annual rainfall and illustrates the results on maps of West Pakistan.

184. Ahmad, M. S. Water requirements of plants in the Quetta Valley, West Pakistan. Plant-Water Relationships in Arid and Semi-arid Conditions, Proceedings of the Madrid Symposium, pp. 155-163. UNESCO, 1961. DAS M86: 580 S989pla 1961.

...Is a study on the water balance of vegetation in the Quetta Valley of the semiarid zone of Pakistan, using the methods of Penman and Turc. A graph presents weekly values of evaporation

Source No. 184 continued.

from an open water surface computed after Penman, observed evaporation from an open pan, and computed potential transpiration for a typical year.

185. Bharadwaj, O. P. The arid zone of India and Pakistan. United Nations Educational, Scientific and Cultural Organization, A History of Land Use in Arid Regions, pp. 143-174. Paris, 1961. DAS 631.49 S783hi.

...Discusses the (1) climate since the close of the Pliocene, (2) climate during prehistoric times, and (3) present climatic conditions. The author presents information on current temperature condition, rainfall, cold season, hot season, and rainy season of the arid zone of India and Pakistan.

186. Dunn, Gordon E. Tropical cyclone early warning system for East Pakistan; analysis and recommendations. Sponsored by United States Operations Mission to Pakistan. 63pp. Karachi, April 1961. DAS M09.57 U587tr.

...Following the destructive tropical cyclones in October 1960 in East Pakistan the assistance of the U. S. International Cooperation Administration to make recommendations for a modern cyclone early warning system was requested by the Governor of East Pakistan. The study is the analysis and recommendations of the author who was selected as advisor for this project. The items of discussion included in this study are the general problem, the forecast problem, the communications problem, community organization and cyclone preparedness, cost of complete early warning system, and time schedule and establishment of improved cyclone warning system.

187. Halim, Abdul. Forecasting frost during the blossoming period of fruit trees in Quetta Valley. Pakistan Journal of Science, 13(4): 184-190. Lahore, July 1961. DAS P.

...Discusses the forecasting of frost on radiation nights by Faust's method with some modification for the Quetta Valley, which is the main fruit-growing area in West Pakistan. This method can be useful in saving fruit blossoms and exposed delicate instruments which would break by the freezing of water inside glass bulbs.

188. Kendrew, W. G. The climates of the continent. Fifth edition. 608pp. Oxford, 1961. DAS M8 K33c.

...In Chapter XIX discusses the climate of India, Pakistan, Burma, and Ceylon. The discussion includes information on the climate for each season, tropical cyclones, droughts, and climatic regions. The tables contain summaries over specified periods of mean number of days on which lightning or thunder is recorded for

Source No. 188 continued.

Peshawar (7 years); monthly and annual mean temperature (F) and annual temperature range for Peshawar (33 years), Lahore (23 years), Multan (33 years), Quetta (30 years), Jacobabad (30 years), Karachi (43 years), and Chittagong (60 years); mean total amount of precipitation (inches) for Chitral and Dacca for unspecified periods, Peshawar (60 years), Lahore (23 years), Multan (33 years), Quetta (60 years), Jacobabad (60 years), Karachi (59 years), and Chittagong (60 years).

189. Khan, Mubashir Lall. Water requirements of West Pakistan. Indus, 2(8): 21-26. Lahore, September 1961. DGS P(648) In25.

...Computes the water requirements of West Pakistan according to Thornthwaite's method of potential evapotranspiration. A table shows monthly potential evapotranspiration for 40 stations in West Pakistan.

190. Ramdas, L. A. Crops and weather in India. 127pp. 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 coordinated crop weather scheme. The tables present seasonal and annual normal rainfall at 30 sub-divisions of India and Pakistan; date of establishment of the SW monsoon at 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 Lahore, Quetta, and Drigh Road in Pakistan and 10 stations in India; monthly mean evaporation in 29 sub-divisions of Pakistan and India.

191. Shanbhag, G. Y. Water requirement during the last two months of the year - in India and vicinity (IV). Journal of Central Board of Irrigation and Power, 18(2): 130-137. New Delhi, February 1961. DAS P.

...Maps and discusses the water requirement for November and December in India, Burma, Pakistan, and Nepal. The table presents monthly and annual water requirements in centimeters for 74 of

Source No. 191 continued.

of the most important stations used in this study.

192. Severe cyclones in the Bay of Bengal in May 1961. Indian Journal of Meteorology and Geophysics, 12(3): 502-503. Delhi, July 1961. DAS M(05) I39i.

...Describes the two severe cyclonic storms from the Bay of Bengal which struck the East Pakistan coast in May 1961 and the synoptic conditions associated with these storms.

193. Severe cyclones in the Bay of Bengal in October 1960. Indian Journal of Meteorology and Geophysics, 12(1): 144-145. Delhi, January 1961. DAS M(05) I39i.

...Presents notes on the weather conditions associated with two severe cyclones which struck the East Pakistan coast in October 1960.

1962

194. Asghar, A. G. and Ahmad, Nur-ud-Din. Irrigation requirements and consumptive use of water by crops in West Pakistan. Pakistan Journal of Science, XIV(4): 166-180. Lahore, July 1962. DLC Q73 .P26.

...Includes tabular monthly summaries of mean maximum and minimum temperatures (^{o}F), mean temperature (^{o}F), and mean total rainfall amount for 11 stations in West Pakistan. Period of record is not indicated.

195. Chandrasekhara, C. S. and Sundaram, K. V. Regions for planning - Rajasthan Canal area, a case study. Bombay Geographical Magazine, X(1): 51-59. Bombay, December 1962. DGS S(640) B63m.

...Includes a table showing the annual water deficiency (cm) and Thornthwaite's aridity and moisture indices for Khanpur, Hyderabad, and Jacobabad in Pakistan and 7 stations in India.

196. Halim, Abdul. The easterly jet stream of summer over West Pakistan. Pakistan Journal of Science, 14(3): 143-149. Lahore, May 1962. DAS P.

...Analyzes the radiosonde data at Karachi and Quetta during the period July 1957 - June 1961 to study the nature of the easterly jet stream during the summer and monsoon months (April-September) over southern West Pakistan. The tables present monthly (April-September) mean contour heights (gdm) of standard isobaric surfaces and monthly (April-September) mean contour heights of 200-and 150-mb levels from data on corresponding dates for Karachi and Quetta. The summer easterly jet streams can be of economic value to air services

Source No. 196 continued.

in Pakistan.

197. Halim, Abdul. A topoclimatological survey of the Quetta Valley for nocturnal cooling. Pakistan Journal of Science, XIV(4): 181-185. Lahore, July 1962. DLC Q73 .P26.

...The damage to fruit blossom in the Quetta Valley due to radiation frost in 1953 induced workers to carry out topoclimatological survey of the valley in order to study the general pattern of its cooling on cloudless nights. The analysis of observations are presented in this paper. It brings to light that the lowest parts of the Valley, where most of the fruit orchards are located due to availability of water, are the most vulnerable spots for maximum cooling and, therefore, it is advisable to plan the siting of new orchards on higher slopes where water can be made available through a stepped bund system. - Author's abstract.

198. Hosain, Adad. Hydrologic work in East Pakistan. United Nations, Economic Commission for Asia and the Far East, Field Methods and Equipment used in Hydrology and Hydrometeorology (Transactions of Interregional Seminar on Field Methods and Equipment used in Hydrology and Hydrometerology held at Bangkok, Thailand, from 27 November to 11 December 1961), Flood Control Series No. 22, pp. 106-109. New York, 1962. DAS M79 U58f.

...Describes the general features and climate of East Pakistan, the collection of hydrological data, and the performance of the Directorate of Hydrology in this province of Pakistan. A table contains the monthly and annual summaries over an unspecified period of mean total rainfall (inches) for 18 stations in East Pakistan.

199. Hussain, Muhammad; Ahmad, Nur-ud-Din; Aziz, Shaukat. Evaporation from free water surface. Pakistan Journal of Science, 14(6): 308-316. Lahore, November 1962. DAS P.

...Presents tabular monthly summaries for each year and over the period of evaporation based on direct estimations from the pan for the period 1947-1961 and by Penman's method for the period 1951-1959 for Lahore; monthly summaries over the period (1951-1960) of evaporation by the Blaney and Criddle method for Lahore; monthly summaries year by year and over the period of evaporation by Penman's method for Peshawar (1951-1959); monthly summaries over an unspecified period of evaporation by Blaney and Criddle method for Peshawar.

200. Khan, Wirasat Ullah. Estimating water supplies in small ungauged river basins. United Nations, Economic Commission for Asia and the Far East, Field Methods and Equipment used in Hydrology and Hydrometeorology (Transactions of Interregional Seminar on Field Methods and Equipment used in Hydrology and Hydrometeorology held at Bangkok, Thailand, from 27 November to 11 December 1961), Flood Control Series No. 22. pp. 119-127. New York, 1962. DAS M79 U58f.

...Is a study based on data for the Hub Basin to determine if it is possible to make fairly reliable estimates of water supplies in a small basin on the basis of precipitation records alone, provided the density of precipitation network in and near the basin and the length and reliability of the available precipitation are adequate. The text includes information on climatic features, rainfall records, mean rainfall and its seasonal distribution, frequencies of heavy rainfall, extremes of rainfall, storm rainfall, variability of rainfall, droughts, and evaporation. The tables contain monthly and annual summaries of mean total rainfall, number of rainy days, greatest rainfall amount and maximum average rainfall amount in 24 hours in the Hub Basin. There are also tabular summaries for 14 stations (1-8 stations per element) in this basin of monthly, seasonal (summer and winter) and annual mean total rainfall amount and number of rainy days ($\geq$ 0.10"); annual frequency of $\geq$ 3" of rainfall in 24 hours; monthly and annual greatest rainfall amount, greatest rainfall amount in one day, mean total evaporation, mean variability of rainfall, highest and lowest total evaporation, mean dry bulb and wet bulb temperatures, and mean wind speed; droughts; storm rainfall. Period of record varies by station and element.

201. Mattimore, Norine Marie. Climatic regions of the subcontinent of India, a modified Köppen classification. Thesis (M. A.). Clark University, Worcester, Massachusetts, 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 requires 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.

202. Mubashir, L. K. Water balance of West Pakistan. Indus, 3(7): 18-25. Lahore, August 1962. DGS P(648) In25.

...Includes information on the potential evapotranspiration, precipitation, water deficiency, and water surplus of West Pakistan. A table presents monthly potential evaporation, precipitation, storage change, storage, water deficiency, and water surplus values for Jacobabad, Karachi, Lahore, Murree, Panjgur, Peshawar, Dera Ismail Khan, Drosh, and Fort Sandeman.

203. Naqvi, Sibte Nabi and Rahmatullah, M. Weather and climate of Pakistan. Indus, 3(8): 19-32. Lahore, September 1962. DGS P(648) In25.

...Discusses the (1) climatic classification, (2) seasonal (cold weather, nor'wester or hot weather, monsoon and post monsoon) climate of East Pakistan and of West Pakistan, and (3) long-range forecasts of seasonal rainfall.

204. Pakistan. Meteorological Service. Upper air data; monthly means of pilot balloon data. 1948-1955, 1957, 1959-1962. Karachi. DAS M06.7/547 P152up.

...Presents monthly mean wind speed (mps) and resultant wind speed (mps) and direction at surface and specified heights and at specified hours for 3-23 stations in Pakistan.

205. 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 18-20 stations in Pakistan of mean pressure, mean temperature, mean relative humidity, mean total amount of precipitation, and precipitation frequency.

1963

206. Conway, H, McKinley, Jr.; May, Stancel L., Jr.; Armstrong, Evan, Jr. The weather handbook. 255pp. Atlanta, 1963. DAS M09 C767w.

...Includes tabular monthly and annual summaries over an unspecified period for Karachi and Chittagong of mean maximum and minimum temperatures, absolute maximum and minimum temperatures, mean total amount of precipitation, mean relative humidity at 1600 (Karachi) and 1730 (Chittagong), and mean number of days with precipitation $\geq$ 0.1 inch.

207. 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.

This paper was presented at the Symposium on Monsoon Meteorology, Tenth Pacific Science Congress, Honolulu, September 1961.

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

209. Jagannathan, P. Trends in the characteristics of seasonal variation of temperature in the arid and semi-arid regions. Indian Journal of Meteorology and Geophysics, 14(1): 3-22. Delhi, January 1963. DAS M(05) I39i.

...Analyzes a long series of temperature data of representative stations in the arid and semi-arid regions of India, Pakistan, U.S.S.R., Iraq, Egypt, Sudan, United States, Argentina, and Australia to aid in providing an answer to the question "Is the climate changing?" The source contains information on the annual march of temperature, scope of study, material used in this study, graduation of the seasonal variation of temperature, results, and conclusions. The stations used in this study include Quetta in Pakistan.

210. Khan, Arshad Noor. Synoptic pattern of rainfall over East Pakistan. Pakistan Journal of Science, XV(1): 9-16. Lahore, January 1963. DLC Q73 .P26.

...The present work based on long forecasting experience gives a very useful description of different surface weather patterns and their relationships to rainfall in East Pakistan. Due to very incomplete aerological data during bad weather, no attempts have been made to describe similarly the typical upper flow patterns. However, the importance of westerly surface disturbances - reflecting more pronounced features in the middle and upper troposphere - is stressed. It is to be hoped that further systematic evaluations including aerological data may supplement this investigation towards the goal of improved regional forecasting. - Author's abstract.

211. Khan Ghori, Mohammad Ibrahim. Relation between floods & cyclones in West Pakistan. Geografia, II(2): 123-126. Karachi, winter 1963 DNG.

...Describes atmospheric disturbances which cause heavy rainfall and lead to floods in West Pakistan. The cyclonic storm of September 12-20, 1950, is given as an illustration of these atmospheric disturbances. A table contains the amount and distribution of rainfall in West Pakistan caused by this storm, and another table briefly describes other storms followed by floods in this area.

212. Mubashir, L. K. Recent air circulation changes in South and Central Asia. Indus, 4(9): 28-32. Lahore, October 1963. DGS P(648) In25.

...Deals with the climatic fluctuations in the monsoon realm of South Asia as a whole. This study is based on the examination of decennial departures and inter-quintile differences of pressure for stations in South and Central Asia. Decade averages of annual pressure from 1871-1950 are included for stations in Ceylon, Pakistan, India, and Burma.

213. Mubashir, L. K. Recent trends in temperature and rainfall in South and Central Asia. Indus, 4(10): 19-25, Lahore, November 1963. DGS P(648) In25.

...Deals with two important climatic elements, temperature and rainfall, in South and Central Asia. This study presents the variation trends in these elements and continues the study by the same author on "Recent air circulation changes in South and Central Asia." Decennial averages (1871-1950) of temperature and rainfall are included for stations in India, Ceylon, Burma, and Pakistan.

214. Pakistan. Meteorological Service. Pakistan national report on meteorology. 2pp. Karachi?, 1963. DAS M(06) P152pa.

...Deals with the functions of the National Meteorological Service in Pakistan. In briefly describing these functions this paper includes information on synoptic meteorology, Institute of Meteorology, climatology, integrated survey, and the installation of remote-recording meteorological instruments at aerodromes.

215. Pakistan. Meteorological Service. Pakistan weather review. Monthly weather report. August 1947 - September 1963. Karachi. DAS M06.1/547 P152pa.

...Descriptive weather summaries for East and West Pakistan are presented. For 45-110 stations there are monthly summaries of mean pressure, temperature, wet bulb temperature, dew point temperature, vapor pressure, relative humidity, and cloud amount at specified hours; monthly wind direction frequency at specified hours; monthly wind direction frequency; monthly total rainfall amount with departure from normal; monthly maximum amount of rainfall in 24 hours with date; monthly total number of rainy days ($\geqslant$ 0.1") with departure from normal; monthly mean wind speed with departure from normal; monthly mean maximum and mean minimum temperatures with departures from normal and highest and lowest temperatures with dates of occurrence; monthly total number of days with thunder, hail, fog, haze (dust), and dust storms. Period of record varies by station and element. Annual summaries of the above elements are also recorded in 1955. Additional monthly and annual summaries for 1955 include hourly duration of bright sunshine, sunshine duration frequency, maximum and minimum duration of bright sunshine with dates, nocturnal radiation temperature, mean hourly pressure, mean and absolute extremes of pressure, mean hourly temperature, mean and absolute extremes of temperature, mean hourly relative humidity, mean and absolute extremes of relative humidity, total hourly rainfall and maximum rainfall in one hour, mean hourly wind velocities, and mean maximum and minimum and absolute maximum wind velocities for selected stations.

216. Rahmatullah, M. Monsoon precipitation of August 1949 as related to upper air flow pattern over Eurasia. Pakistan Journal of Science, XV(1): 17-23. Lahore, January 1963. DLC Q73 .P26.

...The establishment and the development of the Monsoon over Indo-Pakistan is closely related to the movement of the Equatorial Convergence Zone (ECZ) of the Indian Ocean. Whereas in other parts of the world the ECZ is confined to within a few degrees of the Equator, it moves considerably north over the Indian Ocean till by June it makes it first appearance in North India. The paper deals with an investigation of the precipitation and circulation pattern of August 1949, for which daily series of synoptic weather maps at sea level and 500 mb, as prepared by the U. S. Weather Bureau in co-operation with the U. S. Army, Navy, and Air Force were available.

In the month of August 1949 alone there were no less than five different circulation and precipitation patterns, each uniquely related to the position of the ECZ at 5,000 ft and 10,000 ft. In order to study the long wave pattern, the average height of the 500-mb surface between 40°N and 60°N has been calculated for 5-day intervals over Eurasia between 0-130°E for the month of August 1949. It was found that the mean trough position between 90°E and 100°E is inducive to fairly good distribution of rainfall over Indo-Pakistan. A ridge in this position will have the reverse effect. Profiles of the average height of the 500-mb surface between 20°N to 30°N brought out the presence of a mean trough at 90°E. A secondary trough at 70°E was responsible for 60 to 100 per cent precipitation in most of West Pakistan.

To study the effect of Jet streams on monsoon precipitation, geostrophic west wind averages between 0°E and 130°E for 5-day intervals for the month of August was calculated. A pronounced Jet lies over Eurasia between 40° - 50°N with a secondary Jet between 30-35°N. A third Jet between 20° -25°N lasting only during the first week corresponds well with the secondary trough on the 500 mb. The intensity of the monsoon precipitation was found to depend on the position and intensity of the Jets. - Author's abstract from the Proceedings of the Fourth Pakistan Science Conference, Peshawar, 1952, Part III. Abstracts: Section Physics, pp. 158-159. Lahore. DNAL 330.9 P172.

217. Rahmatullah, M. Study of rainfall over Chittagong coast during 1955. Quarterly Journal of the Royal Meteorological Society, 89(379): 147-150. London, 1963. DAS M(05) R888q.

...The rainfall distribution over Chittagong Coast for the year 1955 was studied to determine the importance of 'heavy' rainfall of 3 in. or more in the rainfall distribution curve. Chittagong

Source No. 217 continued.

City and Cox's Bazar were taken as representative stations for this study. In 1955, Chittagong City with a annual normal of 108 in., recorded 148 in. of rain. Cox's Bazar, on the other hand, with an annual normal of 140 in. had only 134 in. of rain. Out of the total of 99 rainy days during 1955, the number of heavy rainfall days in Chittagong was only 14, accounting for 57 per cent of the total rainfall of the year. In the case of Cox's Bazar, out of 108 rainy days during 1955, only 10 days recorded heavy rain of 3 in. or more, accounting for about 35 per cent of the total annual rainfall of the year. It was found that the 'heavy' rainfall curve is the most important feature determining the pattern of the rainfall distribution curve over Chittagong Coast. - Author's abstract.

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

...Upper troposheric 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 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 northwesterly 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.

219. 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 concentrations 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.

220. Rocket experiment in Pakistan. World Meteorological Organization, WMO Bulletin, XII(2): 105-106. April 1963. DAS M(05) W927w.

...Describes the first experiment on June 7, 1962, to study the wind profile and shear in the zone extending from an altitude of 80-130 km by means of a weather rocket at Sonmiani, about 35 miles northwest of Karachi.

221. Severe cyclonic storm in the Bay of Bengal, May 1963. Indian Journal of Meteorology and Geophysics, 14(4): 517. Delhi, October 1963. DAS M(05) I39i.

...Briefly describes the development and destruction of a severe cyclonic storm on May 28-29, 1963. This storm accompanied by tidal waves and rains affected the coastal districts and off-shore islands of East Pakistan.

1964

222. Ahmad, Kazi S. A geography of Pakistan. 216pp. Karachi-Lahore-Dacca, 1964. DLC DS377 .A6.

...Chapter IV "Climate" gives information on temperature, pressure and winds, the Bay of Bengal branch of winds, the Arabian Sea branch of winds, rainfall, humidity, and climatic regions of Pakistan. Tabular summaries over an unspecified period of maximum and minimum temperatures for the hottest month and the coldest month for 17 stations, graphs showing the monthly mean total rainfall amount (inches) for 14 stations and graphs showing the monthly maximum and minimum temperatures for 14 stations in Pakistan are included.

223. Alam, F. C. Kurshid. Mass curves of unusual rainfall recorded at Lahore during the monsoons. Symposium on "Climate of Lahore" held on 24th and 25th March, 1964, on the occasion of Celebration of Fourth World Meteorological Day at Library Hall, Regional Meteorological Centre, Lahore. 2pp. DAS M82.1/547 P152sym.

...Discusses the mass curves of Lahore for the September 1954 storm and presents the mass curves of Lahore for the three outstandingly intense rainfalls in Enclosure I.

224. Alam, Florence C. Khurshid. Normal June-October precipitation in northern West Pakistan. Pakistan, Department of Meteorology and Geophysics, Scientific Note, Volume 16, No. 2. 12pp. Karachi, June 1964. DAS M(055) P152sc.

...Presents the results of a project to develop a map of normal seasonal precipitation in the mountainous areas of the northern region of West Pakistan.

The precipitation data used in this paper, the topographic parameters, topographic precipitation relation, anomaly map, and isohyetal pattern are discussed.

225. Alam, Florence C. Kurshid. Normal June-October precipitation in the Punjab Plains. Pakistan, Department of Meteorology and Geophysics, Scientific Note, Vol. 16, No. 4. 7pp. 1964. DAS M(055) P152sc.

...Describes the precipitation data used in this study and the isohyetal pattern of the Punjab Plains. A table presents a station list with coordinates, elevation, period of record, and normal seasonal precipitation in inches for each station.

226. Asrarullah,-. The Upper Kurram Region. Pakistan Geographical Review, 19(1): 31-50. Lahore, January 1964. DLC DS376 .P29.

...Compares physiographic and climatic conditions of Parachinar, Quetta, and Murree. This study includes brief notes on the temperature and rainfall; tables with monthly and annual summaries over an unspecified period of mean extreme temperatures and mean total rainfall amount (inches) at Murree, Parachinar, and Quetta; graphs comparing the monthly values of mean extreme temperatures and monthly and annual mean total rainfall amount at Murree, Parachinar, and Quetta.

227. Flohn, Hermann. Investigations on the tropical easterly wave (Untersuchengen über die tropische (Ost-Strahlströmung). Bonner Meteorologische Abhandlungen, Heft 4 (1964). 83pp. 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 Karachi July-August resultant winds at 200, 150, and 10-mb levels summarized over the period (1957-1962); July-August resultant winds at heights of 16 km and 14 km for 1957 and 1958; average July-August temperature at 850, 700, 500, 300, and 200-mb levels; statistical wind parameters at heights of 12.2, 14.2, and 16.3 km for July and for August based on data for the period 1958-1962.

228. Khan, M. Khalil; Moazzam, Sufi Mohammad; Ahmed, S. S. Discussion on comparative study of runway temperature and Stevenson screen air temperature observations recorded at Lahore airport. Symposium on "Climate of Lahore" held on 24th and 25th March 1964, on the occasion of Celebration of Fourth World Meteorological Day at Library Hall, Regional Meteorological Centre, Lahore. pp. 1-7. DAS M82.1/547 P152sym.

...The Regional Meteorological Centre, Lahore, arranged at Lahore Airport for recording observations of air temperature over the Runway and in the Stevenson Screen during the four years 1960 to 1963 at the five synoptic hours 0000, 0300, 0600, 0900, and 1200 G.M.T.

Source No. 228 continued.

The distance between (1) the spot on runway where observations recorded by psychrometer and (2) the Stevenson Screen is about 30 yards.

It has been observed that the runway temperatures are higher than those of screen temperatures, on an average, by about $1^{o}F$ throughout the year during the day time (0300 to 1200Z). The mean maximum difference is $1.3^{o}F$ and $1.4^{o}F$ in the months of May and June, respectively. It has also been observed that the early morning temperatures are less by $0.5^{o}F$ for the runway during the winter season (December) and postmonsoon (November) season.

The reason for the higher values of runway temperature is attributed to radiation effect and that for the lower values of runway at 0000 G.M.T. only may be accounted for copious radiation loss from ground thus air in contact is cooler than in the Screen. - Authors' abstract.

A table presents monthly mean and maximum differences of runway temperatures and screen temperatures recorded during the 4 years 1960-1963 at 0000, 0300, 0600, 0900, and 1200Z at Lahore Airport.

229. Khan, Mohammad Khalil and Moazzam, Sufi Mohammad. Dust storms over the plains of West Pakistan. Pakistan, Meteorological Service, Celebration of Fourth World Meteorological Day held from 23rd to 25th March, 1964 at Regional Meteorological Centre, Lahore. Lahore, 1964. DAS M82.1/547 P152ce.

...Is a study on dust storms over the plains of West Pakistan. The text contains information on dust haze; dust-raising winds; occurrence of dust-storms; frontal dust-storms; turbulence in the prefrontal air-mass; dust-storms associated with ITF; frequency, time of occurrence and duration of dust-storms; premonsoon dust-storms versus monsoon rainfall; causes of dust-storm at Lahore and adjacent areas on July 12, 1963. The tables present the monthly and annual hourly frequency of dust-storms at Lahore (Jail Road) based on data for the period 1944-1962 and monthly and annual total rainfall amount for each year (1944-1962) at Lahore.

230. Khan, Mohammad Khalil and Moazzam, Sufi Mohammad. Frosts in West Pakistan in January, 1964. Pakistan, Meteorological Service, Celebration of Fourth World Meteorological Day held from 23rd to 25th March, 1964 at Regional Meteorological Centre, Lahore. Lahore, 1964. DAS M82.1/547 P152ce.

Source No. 230 continued.

...Presents information on some types of weather such as frost which cause damage to crops. These type of weather also include earth cooling and dry and moist cold waves. The authors given an example of a synoptic situation in January 1964 producing snow in some areas and widespread frost. The tables contain 5-day normal maximum and minimum temperatures, daily maximum and minimum temperatures, daily relative humidity at specified hours (0000, 0300 and 1200) for January 1964 at Lahore, Lyallpur, Montgomery, Multan, Khushab, and Sialkot.

231. Khan, Mohammad Khalil and Moazzam, S. M. Unusual duststorms and thunderstorm over Lahore on 12th July, 1963. Pakistan, Meteorological Service, Celebration of Fourth World Meteorological Day held from 23rd to 25th March 1964 at Regional Meteorological Centre, Lahore. Lahore, 1964. DAS M82.1/547 P152ce. Also text without illustrations in: Proceedings of the Sixteenth Pakistan Science Conference, Lyallpur, 1964, Part III, Abstracts: Section of Physics, pp. H-14 to H-16. Lahore. DAS 506 P152pr.

...Describes the general features of the climate of Lahore, causes of rainfall in the monsoon period (July to September), causes of dust-storms which hit Lahore and its surrounding areas by 1645 WPST on July 12, 1963, and the observations recorded on this date.

232. Khan, Mohammad Khalil and Moazzam, S. M. Unusual weather of Lahore during summer season (May 1963). Pakistan Journal of Science, Lahore, 16(5): 263-272, September 1964. DAS P. Also in: Pakistan, Meteorological Service, Celebration of Fourth World Meteorological Day held from 23rd to 25 March, 1964 at Regional Meteorological Centre, Lahore. Lahore, 1964. DAS M82.1/547 P152ce. An extended abstract appears in: Proceedings of the Sixteenth Pakistan Science Conference, Lyallpur, 1964, Part III, Abstracts: Section of Physics, pp. H-16 to H-18. Lahore. DAS 506 P152pr 16: 1964 pt. 3.

...Discusses the general weather conditions prevalent over Lahore during summer season, causes over Lahore, the usual weather conditions over West Pakistan, and the cause of variation of rainfall over Jail Road Observatory and Lahore Airport Observatory.

233. 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. 15pp. Boulder, Colorado, October 1964. DAS 600 U585re.

...Is a study on the surface-distribution of absolute humidity and its climatic variation over the Indian Sub-continent (India, Pakistan, and Burma). This report presents mean absolute humidities

Source No. 233 continued.

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.

234. Lettau, Katharina and White, Fred. Fourier analysis of India rainfall. Indian Journal of Meteorology & Geophysics, 15(1): 27-38. Delhi, January 1964. DAS M(05) I39i.

...The temporal and areal distribution of monthly precipitation normals over the Indian sub-continent is studied by means of harmonic analysis. Amplitude and phase angle charts of the first three harmonics illustrate the regional boundaries for different rain patterns. The annual distribution over South India is discussed in some detail as an example of the super-imposition of the two dominating annual events which are the SW monsoon and the NE monsoon. The importance of topography on the actual amount of rainfall and its distribution under the influence of both regimes at Coondapoor and Nagercoil is described with the aid of characteristics amplitude ratios.

A secondary maximum during February is well established over the mountains of West Pakistan and Kashmir. The phase angle charts show that it is propagated in two geographic directions, from northwest to southeast along the south side of the Himalayas, and from north to south along the west side of the Baluchistan mountains. The only area where the intensity of winter rains exceeds that of summer precipitation was found to be the intermontane region of Baluchistan. - Authors' abstract.

235. Malik, Fakir Mohammad. Highest 12-hour persisting dewpoints in the northern region of West Pakistan for June through October. Pakistan, Department of Meteorology and Geophysics, Scientific Note, Volume 16, No. 1. 9pp. Karachi, 1964. DAS M(055) P152sc.

...This report, based on observed dewpoint data for 16 stations in the northern region of West Pakistan and 3 stations in India, gives the results of a project to determine upper limits of observed dewpoints to be used in connection with storm maximization procedures. Tabular values of the highest 12-hour persisting dewpoints for the 15th and last day of each month for May 31 - October 31 are recorded.

236. Moazzam, Sufi Mohammad. Mechanism of rainfall over the sub-montane districts of West Pakistan. Pakistan, Meteorological Service, Celebration of Fourth World Meteorological Day held from 23rd to 25th March, 1964 at Regional Meteorological Centre, Lahore. Lahore, 1964. DAS M82.1/547 P152ce.

...The rainfall over the submontane districts is due for the most part to the southeasterlies, however the western disturbances play an important role in the rainfall of West Pakistan. The convectional type of thunderstorms with light rainfall occurs in such places as Peshawar, Cherat, Drosh, and the major portion of N.W.F.P.

237. Moazzam, Sufi Mohammad. Probable maximum precipitation for November-May season over the Swat River Basin. Pakistan, Department of Meteorology and Geophysics, Scientific Note, Vol. 16, no. 5, 14pp. Karachi, 1964. DAS M(055) P152sc.

...Determines the probable maximum precipitation over the Swat River Basin above Munda Headworks during the winter season and provides additional meteorological criteria considered pertinent to the establishment of the probable maximum flood. The text includes information on the topography and meteorology of the Swat River Basin, a brief history of the storm on February 2-4, 1959, storm analysis, depth-area-duration curves, storm maximization, and seasonal variation of precipitation.

238. Mowla, K. G. Constant pressure charts and upper air analysis. Pakistan, Meteorological Service, Celebration of Fourth World Meteorological Day held from 23rd to 25th March, 1964 at Regional Meteorological Centre, Lahore. Lahore, 1964. DAS M82.1/547 P152ce.

...Up to 1940 the forecasters in the Indo-Pakistan sub-continent depended on streamline charts from pilot balloon data for upper air analysis. After 1940, isentropic surfaces were used as the reference surfaces for upper air analysis by some meteorologists. Gradually there was a change to constant pressure surfaces by some. From the partition of India to date Pakistan forecasters still depend on streamline charts based on pilot balloon data, but Pakistan is now moving in the direction to adopt constant pressure charts analysis as the main tool of their technique for high analysis and forecasting.

239. Mowla, K. G. The Lahore rainfall for one hundred years. Symposium on "Climate of Lahore" held on 24th and 25th March 1964, on the Occasion of Celebration of Fourth World Meteorological Day at Library Hall, Regional Meteorological Centre, Lahore. pp. 1-7. DAS M82.1/547 P152sym.

Source No. 239 continued.

...Is a study of the annual rainfall, rainfall in each decade, and monthly rainfall during the hundred years (1862-1961) at Lahore. This probably presents some useful tools for the forecast of summer and winter rainfall in Lahore. The tables contain annual frequency of rainfall during the period (1862-1961), summer and winter rainfall amounts with departure from normal for the 10 decades from 1862-1961, monthly frequency of rainfall during the hundred years, monthly normal rainfall amount based on 40 years of data, and monthly mean rainfall amount based on 100 years of data at Lahore.

240. Mubashir, L. K. Fourier analysis of annual rainfall in West Pakistan. Indus, 5(5): 12-22. Lahore, June 1964. DGS P(648) In25.

...Discusses the usefulness of Fourier analysis for discovering rainfall cycles in West Pakistan. This study is based on data for 12 stations in West Pakistan for varying periods of record during the period 1863-1955.

241. Mubashir, L. K. Significance tests of rainfall cycles in West Pakistan. Indus, 5(6): 10-17. Lahore, July 1964. DGS P(648) In25.

...Discusses the significance of rainfall periodicities found by harmonic analysis. This study is based on data for 12 stations in West Pakistan.

242. Naqvi, Sibte Nabi. The meteorological problems of the deltaic flood-plains of East Pakistan. UNESCO, Scientific Problems of the Humid Tropical Zone Deltas and their Implications, Proceedings of the Dacca Symposium, 24 February to 2 March 1964, pp. 123-133. Paris, 1966. DAS 574.9 U581sc.

...Discusses the features revealed by a preliminary examination of temperature, humidity, and rainfall data of the deltaic stations in East Pakistan. Tables present (1) monthly temperature characteristics of the delta and (2) mean temperature for coldest warmest months, mean total rainfall for wettest and driest months, annual mean total rainfall amount (cm), annual potential evapotranspiration (cm), annual water deficiency and surplus (cm), moisture index and climate type according to the classification of Thornthwaite, and climate type according to the classification of Köppen for 6-9 stations in East Pakistan. These stations are Pabna, Jessore, Faridpur, Narayanganj, Comilla, Khulna, Satkhira, Barisal, and Noakhali.

243. Siddiqi, K. U. Criteria for defining heat wave in West Pakistan. Pakistan Journal of Science, 16(2): 69-72. Lahore, March 1964. DAS P.

...Discusses the method of arriving at rational criteria for defining a heat wave in West Pakistan during the months from March to October. The tables contain monthly (March-October) mean maximum and highest maximum temperatures (^{o}F), values of ½ the highest maximum temperature minus the mean maximum temperature (^{o}F), and the critical temperature (^{o}F) necessary for heat wave for 35 stations in West Pakistan.

244. Siddiqi, K. U. and Khan, Arshad Noor. Synoptic patterns of rainfall over West Pakistan. Pakistan Journal of Science, 16(5): 235-242. Lahore, September 1964. DAS P.

...This study was made to try to determine significant synoptic patterns which are responsible for causing rainfall over West Pakistan. The authors have divided this study into three parts which are further subdivided according to systems involved in the occurrence of rainfall in West Pakistan. The three parts are (1) rainfall by western disturbances, (2) rainfall by a combination of western disturbances and monsoon system, and (3) rainfall by monsooon systems only. Maps present examples of various synoptic patterns causing rainfall.

245. Singh, M. S. Structural characteristics of the subtropical jet stream. Indian Journal of Meteorology and Geophysics, 15(3): 417-424. Delhi, July 1964. DAS M(05) I39i.

...Characteristics of the subtropical jet-structure over India and Pakistan were studied with the help of longitudinal cross-sections. It was observed that the subtropical jet is a broad band of great latitudinal span located in the break between the middle and the tropical tropopauses. Generally the jet-core has two Layers of Maximum Wind (LMW) attached to it. But it is replaced by separate cores with no LMWs when the branching of the jet stream takes place. Connected to each core and located beneath it is found a layer of frontal type of discontinuity which may be called the "Subtropical Front". The present knowledge about the westerly jet streams over India and Pakistan has been discussed in the light of above findings. - Author's abstract.

246. Subbaramayya, I. and Rao, N. Jaganmohana. The frequency distribution of rainfall of different intensities. Journal of the Meteorological Society of Japan, Ser. II, Vol. 42, No. 5. pp. 277-284. October 1964. Tokyo. DAS M(05) M589sj.

Source No. 246 continued.

...Includes a table which presents computed and observed percentage frequencies of rainfall at 11 stations in India and at Jacobabad in West Pakistan.

247. Subramanian, D. V. and Banerji, A. K. Premonsoon squall lines in Northeast India and East Pakistan - Radar cum synoptic study. World Conference on Radio Meteorology Incorporating the Eleventh Weather Radar Conference, Boulder, Colorado, September 14-18, 1964. pp. 398-402. DAS M01.81 W9272wo 1964.

...Describes the results of an investigation which was undertaken to explain certain distinctive features relating to the time of formation and direction of movement of the squall lines in Northeast India and East Pakistan; suggests classification of the squall lines based on their source region and mechanism of formation; discusses representative examples.

248. Swaminathan, D. R. Convective activity associated with jet stream. Indian Journal of Meteorology & Geophysics, 15(2): 247-250. Delhi, April 1964. DAS M(05) I39i.

...Includes a table of maximum wind of $\geqslant$ 100 knots during March 8-14, 1962, at 0000 and 1200 GMT. On March 8, 1962, Karachi had a maximum wind speed of 150 knots.

249. U. S. Air Weather Service. Climatic data summaries for selected Asian and Pacific stations. Special Study 105-3. San Francisco, July 1964. DAS M(055) U58s.

...Includes tabular monthly and annual summaries over the period at Chittagong (5-64 years) and Karachi Airport (4-43 years) of mean and absolute extreme temperatures; mean total amount of precipitation; mean total amount of snow fall; mean number of days with precipitation $\geqslant$ .005", measurable snow, snow fall $\geqslant$ 2.5", thunderstorms, fog at 0900 LST and flying weather (IFR at 0900 LST and closed at 1800 at Chittagong; VFR, IFR and closed at Karachi); mean relative humidity; mean sea level pressure; mean vapor pressure and mean dew point temperature for Chittagong; 99.95% pressure altitude for Karachi Airport. The source also contains monthly (January, April, July, and October) mean vapor pressure and mean dew point temperature for Karachi Airport.

250. Wahab, Abdul. Climate of Lahore on the basis of temperature associated with rainfall and relative humidity and a brief account of temperature of Lahore. Symposium on "Climate of Lahore" held on 24th and 25th March, 1964, on the Occasion of Celebration of Fourth World Meteorological Day at Library Hall, Regional Meteorological Centre, Lahore. 4pp. DAS M82.1/547 P152sym.

Source No. 250 continued.

...Is a study relating to temperature as the basis of the classification of climate with a brief account of the temperature of Lahore. The table contains normal summaries of monthly and annual mean dry bulb and wet bulb temperatures at 0300 and 1200 GMT, mean daily maximum and minimum temperatures, mean temperature, highest and lowest recorded temperatures with dates of occurrence, mean relative humidity at 0300 and 1200 GMT, and mean total amount of rainfall in inches at Lahore.

251. Pakistan. 1953, 1953/54-1955/1956, 1957/58-1963/64. Karachi. DLC DS376 .P25, DLC DS384 .S53 1953 and DLC DS377 .P29 1960-61. DAS 330.5 P152pa 1957-1958.

...Describes briefly the functions and development of the Pakistan Meteorological Service from the time Pakistan became an independent nation to 1964. There are lists of the number of each type of observatory during 1947, 1952-53, 1954-55, 1955-56, 1961, 1963, and 1964 in Pakistan. Information on the reorganization and developments in the Pakistan Meteorological Department includes such topics as (1) experiments on artificial rainfall in West Pakistan, (2) flood warning organization in Punjab, (3) reorganization of River Port Warning System in East Pakistan, (4) establishment of Agricultural Meteorological Observatories, (5) establishment of additional forecasting offices, Geophysical Observatory and Atmospheric Research station, (6) arid zone research in West Pakistan, (7) radio meteorology, (8) oceanography, (9) library, (10) machine computation, (11) cyclone warnings in East Pakistan, (12) workshop and training, (13) sferics, (14) climatological network, and (15) forecasting service.

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252. Bhaskara Rao, N. S. and Mazumdar, S. A technique for storm-wave forecasting. Proceedings of the Symposium on Meteorological Results of the International Indian Ocean Expedition, Bombay, India, 22-26 July 1965. pp. 250-261. DAS M:551.46 S989pr.

...The present investigation is an elaboration of the authors' previous study (1965), and covers the coastline of the Indo-Pakistan subcontinent and Burma, from Sind to the Arakan coasts.

It has been shown that the topography of the sea-bed near the coast and the strength and direction of the on-shore gales due to cyclonic storms play a vital role in the occurrence of storm-waves. Equations, based on hydrodynamical and other theoretical considerations

Source No. 252 continued.

have been developed for providing a basis for the technique. Numerical computations have been carried out for different points of the coastline, using the contours of the bottom topography of the sea near the coast at these points; and on the basis of these permanent features, the coastline has been divided into zones of different degrees of vulnerability to storm-waves. The variable features viz. the altitudes and direction of approach of cyclonic storms have been discussed, and their implications, especially with regard to favourable and unfavourable pre-conditions of the sea, explained. A few well-documented cases have also been discussed by way of illustration, and the limitations and the practical advantages of the technique brought out. - Authors' abstract.

253. Halim, Abdul. Effect of high ground on contours of upper air pressure surfaces. Pakistan Journal of Science, XVII(1): 27-28. Lahore, January 1965. DAS P.

...Examines the effect of high ground on contours of upper air pressure surfaces based on radiosonde data for Karachi, Quetta, and Peshawar during the International Geophysical year (July 1957-June 1959).

254. Mubashir, L. K. Further tests of significance of rainfall cycles in West Pakistan. Indus, V(12): 12-22. Lahore, February 1965. DGS P(648) In25.

...Presents further tests of the rainfall periods found by harmonic analysis. Computations have been made at 12 stations in West Pakistan.

255. Naqvi, Sibte Nabi and Rahmatullah, Muhammad. Climatology of Islamabad the capital of Pakistan. Pakistan Geographical Review, 20(1): 31-40. Lahore, January 1965. DLC DS376 .P29.

...Discusses the climatological features of the Federal Capital area under the headings of temperature, humidity, wind, cloud, rainfall, thunderstorms, and fog. The statistical summaries include monthly mean and mean extreme temperatures on graphs at Rawalpindi and Murree; monthly rate of fall of the mean daily maximum and minimum temperatures per 1000 ft between Khushab-Rawalpindi and Rawalpindi-Murree on graphs; tabular monthly and annual means at 0300 and 1200 GMT of relative humidity, dry bulb temperature, wet bulb temperature, and vapor pressure (mb) at Murree and Rawalpindi; tabular monthly and annual wind direction frequencies (% of days) in the morning and in the afternoon at Rawalpindi and Murree; tabular monthly and annual mean total rainfall amounts (inches) at Rawalpindi and Murree. The climate of Islamabad, the new Federal Capital in Potwar Plateau, generally follows the pattern of Rawalpindi.

256. Pakistan. Meteorological Service. Regional daily weather report for Quetta, Kalat, Hyderabad and Khairpur Divisions, the Federal Capital Area, Gulf of Oman and Persian Gulf. 1955-1965. Title varies. Karachi. DAS M09.2/547 P152re.

...Consists of a descriptive summary of observations recorded at 0800 for the area, area and local forecasts, and tabular daily data for individual stations. These tabular daily data include rainfall amount in 24 hours with departure from normal, relative humidity at 0800 with departure from normal, maximum and minimum temperatures with departures from normal, pressure at 0800 and geopotential of the 850-mb pressure level for 23-29 stations in Pakistan. There are also temperature observations at 0800 and upper air observations (wind direction and speed, temperature, and humidity) at 5,000, 10,000 and 20,000 ft at Karachi. Times of sunrise, sunset, moonrise, and moonset are also recorded for Karachi.

257. Raghavan, K. Co-existence of tropical storms. Indian Journal of Meteorology & Geophysics, 16(1): 69-74. Delhi, January 1965. DAS M(05) I39i.

...Results of a climatological study of two or more tropical cyclones/depressions that occurred simultaneously over the sea (Bay of Bengal and Arabian Sea) and the land area (India, Pakistan, Burma, and Ceylon) during the years 1923 to 1962 are presented. Not more than two storms exist at a time in the region, and they are observed during the period June to December. There was no occasion when both the storms existed in the Arabian Sea or in the Bay of Bengal. The shortest distance apart between the co-existing storms was 1000 km. The line joining the centres of two co-existing storms was generally east-west. Statistics of the storms are presented in charts and tables. - Author's abstract.

258. Ramage, C. S. The summer atmospheric circulation over the Arabian Sea. Proceedings of the Symposium on Meteorological Results of the International Indian Ocean Expedition, Bombay, India, 22-26 July 1965. pp. 197-207. DAS M:551.46 S989pr.

...The summer heat low system extending from Somalia across southeast Arabia to northwest India is the most extensive and intense on earth. Although it develops in the normal way over desert regions in response to the sun's zenithal march, it is maintained and intensified through the summer by subsidence of air originally lifted and warmed by the release of latent heat in monsoon rain systems to the east and south. The subsidence not only dominates West Pakistan, Arabia, and Somalia but severely restricts low cloud formation over the central and western Arabian Sea.

Source No. 258 continued.

The heat low exports cyclonic vorticity in the middle and upper troposphere to the northern Arabian Sea. When a deep layer of moist air is present over the eastern part of this area, subtropical cyclogenesis occurs, producing a burst of west Indian monsoon rains. This in turn, by increasing subsidence above the heat low, intensifies it and its associated low-level monsoon circulation. When supply of moist air is cut off the subtropical cyclone fills, the heat low weakens and a break takes place in the monsoon rains. With renewal of the moisture supply, the sequence is repeated. - Author's abstract.

259. Raman, C. R. V.; Keshavamurty, R. N.; Jambunathan, R.; Ramanathan, Y. Some aspects of the meridional circulation over the Indian monsoon area. Proceedings of the Symposium on Meteorological Results of the International Indian Ocean Expedition, Bombay, India, 22-26 July 1965. pp. 401-412. DAS M:551.46 S989pr.

...Careful analyses are made at standard isobaric levels, of wind, height, temperature and moisture fields for mean July, active monsoon (7 July 1963) and weak monsoon (19 July 1963). Based on 5-degree grid point values derived therefrom, internal, potential and latent heat energies are computed and also the meridional fluxes of these energies and of relative angular momentum. Significant differences are noticed in the meridional circulation and fluxes. For mean July, a direct energy-producing monsoon cell operates along 90°E and an indirect energy consuming Hadley cell operates along 55°E. The change over takes place around 75°E. During strong monsoon the monsoon cell extends westwards to 75°E. There is net meridional inflow of total energy over Arabian Sea over Bay of Bengal increases during strong monsoon. - Authors' abstract.

260. Rashid, Haroun er. East Pakistan, a systematic regional geography & its development planning aspects. 383pp. Lahore - Peshawar - Hyderabad - Karachi, 1965. DGS 504(648) R184e.

...Chapter III, "Climate" presents descriptive summaries of temperatures, rainfall, fog, mist, dew, hoarfrost, humidity, winds, typhoons, pressure, seasons, and climatic zones in East Pakistan. The tables contain summaries over an unspecified period of monthly mean maximum and minimum temperatures (°F), monthly and annual mean total amount of rainfall, monthly and annual mean relative humidity, and monthly average saturation deficit in mm of Hg for 10-29 stations in East Pakistan.

261. 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 at 124 stations in India, Nepal, Pakistan, Ceylon and Burma have been subjected to harmonic analysis and study.

262. Desai, B. N. Why little rain over the west and north Arabian Sea and over and around the West Pakistan heat low during the southwest monsoon season? Indian Journal of Meteorology and Geophysics, 17(3): 399-400. Delhi, July 1966. DAS M(05) I39i.

...Ramage's view and model to explain little rain over the west and north Arabian Sea and over and around the West Pakistan heat low have been examined and it is shown that they cannot be accepted. The hitherto prevalent viewpoint about the same is able to explain observations during the IIOE period with a slight modification as suggested by Desai, if one takes into consideration facts of weather, climatology and topography of the Indian subcontinent. - Author's abstract.

263. Frisby, E. M. and Sansom, H. W. Hail incidence in the tropics. U. S. Electronics Command, Fort Monmouth, New Jersey, Technical Report ECOM 02105-F. Final Report, Contract No. DA 28-043 AMC-02105(E). 48pp. September 1966. DAS M(055) U5812ec ECOM 02105-F. Also summarized in: Miami. University of Miami, Coral Gables, Florida. Radar Meteorological Laboratory, Report No. 12. Proceedings of the 1966 Conference on Tropical Meteorology held in Miami Beach, Florida, 26-27 May 1966. pp. 2-10. October 1966. DAS M(051) M618in no. 12.

...On page 15 there is a brief note on the occurrence of hail in India and Pakistan, and on page 42 a table contains monthly summaries for East Pakistan (22° - 26°N., 89° - 92°E) of mean number of days with hail based on data for the period 1951-1960.

264. Frisby, E. M. Hail incidence in the tropics. Part II. U. S. Army Electronics Command, Fort Monmouth, New Jersey, Technical Report ECOM-2768. 7pp. October 1966. DAS M(055) U5812ec ECOM-2768.

...Includes a graph showing the monthly number of cases of hailstorms in East Pakistan based on data for 1951-1960.

265. Frost, R. Major storms in West Pakistan in September in relation to the Mangla Dam Project. The Meteorological Magazine, 95(1123): 57-63, February 1966. DAS M(05) G786m.

...As a part of the Mangla Dam project it was planned to divert the River Jhelum in September 1965 and the mean date of the recession of the south-west monsoon was taken as a provisional date for the diversion. Occasionally at the end of the monsoon in September (most often between the 16th and 20th of the month) there are major storms and floods in West Pakistan, and a long-term study which was made of these storms suggested that their frequency, which was low at the turn of the century, reached a maximum in the period 1945-50 and is now declining. The storm pattern appears to be linked with a secular change of sea temperature in the Bay of Bengal where the depressions originate as developments in the Northern Equatorial Trough. The depressions favour a track towards West Pakistan if the 300 mb ridge over East Pakistan extends west to mean position. Synoptic studies were used to check the suitability of the date for the diversion. - Author's abstract.

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

...Presents monthly and annual summaries over specified periods (vary by station and element) for 10 stations in Pakistan of mean maximum and minimum temperatures, mean of the highest and mean of the lowest temperatures, and absolute maximum and minimum temperatures in ^{o}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 $\geq$ 0.1". The stations used in this source are Chittagong, Jacobabad, Hyderabad, Karachi, Lahore, Multan, Pasni, Narayanganj, Peshawar, and Quetta. Identical data appear in the first edition of this source which was published in 1958.

267. Jayaraman, S.; Srinivasan, T. R.; Rai Sircar, N. C. Persistence of the movement of the tropical cyclones/depressions in the Bay of Bengal during the premonsoon and post monsoon periods. Indian Journal of Meteorology & Geophysics, 17(3): 395-398. Delhi, July 1966. DAS M(05) I39i.

...Examines the tracks of cyclonic storms and depressions in the Bay of Bengal during the premonsoon (April-May) and the post monsoon (October-December) seasons for the period 1891-1960 for the purpose of obtaining more information on the prediction of the speed and direction of movement of such disturbances over the sea areas. This is very important for the issuance of warnings against heavy rainfall and gales in coastal districts of India, Pakistan, and Burma well in advance.

268. Kureshy, K. U. Urbanization of West Pakistan in relation to aridity. Pakistan Geographical Review, 21(2): 1-13. Lahore, July 1966. DLC DS376 .P29.

...Gives tabular annual potential evapotranspiration (cm.), water surplus, water deficiency and moisture index of twenty seven stations in West Pakistan.

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

...Compares the annual values of mean rainfall amount, mean relative humidity, precipitation/temperature ratio, mean daily maximum and minimum temperatures, and mean cloud amount at Lahore and Jacobabad in West Pakistan and Agra, Neemuch, and Bikaner in India. There are also comparisons of the normal number of days in the year with a rainfall of more than two mm/day, mean daily maximum temperature higher than 40°C and mean daily minimum temperature less than 5°C, and number of days in the year satisfying all three of these criteria at Lahore, Multan, Jacobabad, Hyderabad, Bhuj, Ahmedabad, Neemuch, Jodhpur, Bikaner, Hissar, and Jaipur in Pakistan and India. The above data appear in section on climatic interaction between the region and its surrounding area.

270. Meigs, Peveril. Geography of coastal deserts. United Nations Educational, Scientific and Cultural Organization, Arid Zone Research - XXVIII, 140pp. Paris, 1966. DAS M85.53 M512ge.

...Includes monthly and annual summaries over the period (specified for some stations) of mean temperature, mean daily maximum and minimum temperatures (°F), mean cloud amount (0-10), and mean total amount of precipitation (in.) for 5-8 stations in Pakistan. They are Karachi (Manora), Karachi (Drigh Road), Hyderabad, Bela, Ormara, Sonmiani, Turbat, and Gwadar.

271. Naqvi, Sibte Nabi. The meteorological problems of the deltaic flood-plains of East Pakistan. United Nations Educational, Scientific and Cultural Organization, Humid Tropics Research, Vol. 6 , 1966. p.123-133. (UNESCO Scientific Problems of the Humid Tropical Zone Deltas and their Implications; Proceedings of the Dacca Symposium.) DAS 574.9 U581sc.

...The whole of East Pakistan outside the district of Chittagong and Chittagong hill tracts is situated in the flood-plains of the Ganges, Brahmaputra, Meghna, Tista, and Surma Rivers, but this study deals primarily with flood-plains of the proper delta region, roughly triangular in shape, covering an area of $\sim$ 15,504 mi^2 and distributed over 6 districts. The problem of the nor'wester squalls is introduced. Another problem since 1960 is that of the incidence of

Source No. 271 continued.

tropical cyclonic storms and storm surges which cause heavy losses of life and property. The problem of evaporation and water balance in relation to land use is discussed. Yet another problem is that of the great fluctuation in sea level in the winter and the monsoon period. It is concluded that maritime influence penetrates northwards up to Nasirabad and Rangpur districts and this appears to play a fundamental role in the origin of tornadic nor'wester squalls on the border areas to the east and west of this narrow belt and east of Jessore district where the continental air mass appears to provide a key for the location of squally regions in this tropically humid area and that it would be highly rewarding if more time were devoted to this type of analysis than has been so far in synoptic practice. - MGA 18.6-302.

272. Rahmatullah, M. and Jafri, S. A. Stratospheric wind pattern in subtropics based on data from meteorological sounding rocket firings at Sonmiani during 1964-65. International Space Science Symposium, 6th, Mar del Plata, Argentina, May 11-19, 1965, Problems of Atmospheric Circulation. Edited by R. V. Garcia and T. F. Malone. Washington, D. C., Spartan Books, 1966. pp.95-105. DAS M13 I61pr.

...The salient features of the stratospheric wind circulation based on 16 meteorological rocket firings from Sonmiani during 1964-65 are: 1. Strong easterlies during summer months with maximum speed of the order of 70 m/sec at 55 km in July. 2. Transition from easterlies to westerlies at 55 km in Aug. and the gradual penetration of westerlies to lower levels between Sept. and Oct. 3. Establishment of winter westerlies in mid-Dec. with wind speed of the order of 50 m/sec. 4. The breakdown of the winter westerlies by strong easterlies in the midst of winter presumably due to global changes in stratospheric circulation. 5. Transition from summer to winter condition at 55 km in Aug. and between Sept. and Oct. at lower tropospheric levels. The change from winter to summer pattern between April and May. 6. Predominantly zonal character of the stratospheric wind circulation with only weak meridional component, which shows considerable fluctuations from month to month. - MGA 18.3-429.

273. Rizwan Abidi, S. M. Artificial rainfall. Indus, VIII(2): 12-20. Lahore, March 1966. DGS P(648) In25.

...Briefly describes the source of precipitation in East and West Pakistan, presents notes on rites and ritual practiced to induce rainfall in earlier days, discusses the scientific approach to artificial rainfall, and describes the future of artificial rainfall

Source No. 273 continued.

in Pakistan. Research in this field has not even reached the blue print stage in Pakistan. The Porali Basin in Lasbela district is ideally suited for such an experiment.

274. Snead, Rodman E. Physical Geography Reconnaissance: Las Bela Coastal Plain, West Pakistan. Louisiana State University, Coastal Studies Institute, Technical Report No. 15, Pt. 1, Contract Nonr 1575(03). 118pp. Baton Rouge, April 1966. DAS M(051) L888tec no. 15, pt. 1.

...In Chapter II the author discusses the weather and climate of the Las Bela area of Pakistan. The discussion includes information on the reasons for this desert region, the temperature, relative humidity, precipitation, winds, and storms of the Las Bela Region. The tables contain annual absolute maximum and minimum temperatures based on data for the period 1953-1959, monthly maximum and minimum relative humidities with time of occurrence summarized for the period 1928-1947, annual total rainfall amount for each year (1931-1958), minimum and maximum recorded rainfall for rainiest month and driest month with years of occurrence, and monthly and annual mean total number of rainy days based on data for the period 1955-1959 for 1-8 stations (Karachi (Manora), Karach (Drigh Road), Las Bela, Ormara, Panjgur, Hyderabad, Kalat, Pasni, and Sonmiani) in Pakistan.

275. Uwagawa, Masahito. Cyclones in the Bay of Bengal. Symposium on Water Resources Utilization in Southeast Asia, Kyoto, September 17, 18 and 19, 1965. pp. 77-85. Kyoto University, 1966. DAS M(055) K99sy No. 3.

...Briefly discusses the cyclones that originate in the Bay of Bengal, topographical features of Gangetic delta, damages wrought by recorded cyclones, meteorological data at Chittagong during a cyclone on May 28 and 29 in 1963, and the durability of coastal embankments built under the Coast Embankment Project.

1967

276. Ahmad, M. Shafi. Rocket measurements of the upper atmosphere winds at Sonmiani, Pakistan. International Space Science Symposium, 7th, Vienna, May 10-18, 1966, Space Research VII: 962-972. Proceedings of the Symposium. Amsterdam, 1967. c Vol. 2ɔ : 962-972. DAS 629.4072 S732sp 7th (v.2).

Source No. 276 continued.

...Rocket measurements of the upper atmosphere winds at Sonmiani, Pakistan, using sodium vapour payload carried out on 30 November (evening) and 1 December (morning) 1964 are described in this paper. Large wind shear amounting to 31 m/sec/km was observed on 1 December at a mean height of 105 km. The wind profiles obtained from both the firings have shown lack of oscillatory element above 120 km. This is compatible with Kochanski's suggestion that the internal gravity waves have a relatively weak contribution at these and higher levels compared to the general drift and tidal components. The observed rotation with height of the wind vector, on the other hand, appears to agree more with Grove's results for the southern hemisphere than with the opposite sense of rotation observed in temperature latitudes in the northern hemisphere. On the basis of results from Sonmiani and from Indian range at Thumba, it is suggested that a transition zone might exist on either side of the equator where the sense of wind vector rotation undergoes the change from what may be called the 'southern-hemisphere' to 'northern-hemisphere' type. The suggested transition zone appears to extend, perhaps only occasionally, to latitudes as far away from the equator as that of Sonmiani (25^{o}N). - Author's abstract.

277. Alam, F. C. Khurshid. Probable maximum precipitation over the Swat Basin (monsoon season). United Nations, Economic Commission for Asia and the Far East, Assessment of the magnitude and frequency of flood flows (ST/ECAFE/Ser. F/30), Water Resources Series No. 30. pp. 178-197. New York, 1967. DAS M79.4 I615as.

...Describes the physical features, climatology, and the flood due to rainfall in the Swat-Panjkora River Basin and makes a study of the storms in the area. Graphs of the monthly values of mean maximum and minimum temperatures and mean total rainfall amount for Chakdara, Drosh, and Peshawar are presented.

278. Bedi, H. S. and Parthasarathy, B. Cold waves over northwest 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 $22\frac{1}{2}^{o}$N and west of $82\frac{1}{2}^{o}$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, its lasts only for about 2-4 days. Maximum intensity of cold wave is also in Baluchistan, 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. 278 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.

The tabular summaries of frequency distribution of duration of the first three cold waves in days during 50 winter seasons (1915-16 to 1964-65) and the frequency distribution of lowest negative anomalies of minimum temperature recorded during cold wave conditions in 50 winter seasons are reported for 54 stations in India and Pakistan.

279. 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. Boston, 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.

280. Desai, B. N. Trough of low pressure over the Gangetic Valley during the southwest monsoon season and its implications - a suggested new approach. Indian Journal of Meteorology and Geophysics, 18(4): 473-476. Delhi, October 1967. DAS M(05) I39i.

...Current ideas about the trough of low pressure over the Gangetic Valley, facts of weather and climatology during the southwest monsoon season, and the role of the topographical features of the Indo-Pakistan sub-continent in the formation of the trough, have been stated briefly. A new approach about the establishment of the trough is suggested, and implications of the same are discussed. - Author's abstract.

281. Frisby, E. M. and Sansom, H. W. Hail incidence in the tropics. Journal of Applied Meteorology, Boston, 6(2): 339-354, April 1967. DAS M(05) J86joa.

...On page 347 presents brief remarks on hail in India and Pakistan. On page 354 a table contains monthly number of cases (1951-1960) of hail in East Pakistan.

282. Pakistan. Meteorological Service. Weekly weather report for Pakistan and Kashmir. March 30, 1949 - September 27, 1967 (Broken record). DAS M06.1/547 P152w.

...Consists of weekly descriptive summaries of weather for West and East Pakistan; tabular summaries of weekly and cumulative actual rainfall amount, normal rainfall amount, and departures from normal for the divisions of Pakistan; maps showing the divisions of Pakistan with normal, above-normal, below-normal, and scanty amounts of rainfall. The number of divisions in Pakistan varies. In the earlier years there are daily weather maps at 0300 and 1200 GMT; maps with numerical values of actual daily maximum and minimum temperatures for individual stations; maps showing the distribution of the daily departures from normal of maximum and minimum temperatures by isolines; maps with plotted wind direction and speed at 1.5 km above sea level in the morning for individual stations.

283. Shamshad, Khan M. Note on a technique of long range forecasting for monsoon rain in West Pakistan. Journal of Applied Meteorology, Boston, 6(1): 199-202, February 1967. DAS M(05) J86joa.

...Using statistical data for the period 1949-1962, a new method of long-range forecasting for monsoon rain in West Pakistan is demonstrated. It is inferred that if the monthly mean value of the contour gradient between lat. 17°N and 45°N is less than normal during April, the westerlies are weaker and the chances of a good monsoon following this situation will be greater than normal. If the mean 700-mb height over the peninsula decreases, the tendency for the formation of low pressure systems will be greater with a corresponding tendency for greater rainfall. - MGA 18.6-220.

284. Spate, O. H. K. & Learmonth, A. T. A. India and Pakistan, a general and regional geography. Third edition revised and completely reset. 877pp. London, 1967. DAS 915.4 S738in.

...Discusses the climate of India and Pakistan on pages 46-72. The topics discussed are the cool season, the hot weather, the rains, the retreating monsoon, climate and human activities, and the classification of climates.

285. U. S. Air Weather Service. U. S. Naval Weather Service worldwide airfield summaries. Volume II, Part 1. Middle East. October 1967. DAS M06.3 U5815u.

...Presents tabular monthly and annual summaries over specified periods of absolute maximum and minimum temperatures (°F), mean maximum and minimum temperatures (°F), mean number of days with maximum temperatures $\geq$ 90°F, mean number of days with minimum

Source No. 285 continued.

temperatures $\leqslant$ 32°F and $\leqslant$ 0°F, mean dew point temperature (°F), mean relative humidity, mean pressure converted to an altitude (ft) by using the U. S. Standard Atmosphere, mean amount of precipitation (in.), mean amount of snowfall (in.), mean number of days with precipitation $\geqslant$ 0.1", mean number of days with snowfall $\geqslant$ 1.5", mean number of days with visibility < ½ mile, mean number of days with thunderstorms, percent frequency of wind speed $\geqslant$ 17 knots and $\geqslant$ 28 knots, percent frequency of ceiling < 5000 ft and/or visibility < 5 miles, percent frequency of ceiling < 1500 ft and/or visibility < 3 miles for specified intervals (00-02, 03-05, 06-08, 09-11, 12-14, 15-17, 18-20, and 21-23 LST) and percent frequency of ceiling < 300 ft and/or visibility < 1 mile for specified intervals (00-02, 03-05, 06-08, 09-11, 12-14, 15-17, 18-20, and 21-23 LST) for 2-6 airfields in East Pakistan. There are monthly and annual summaries over specified periods for 2-5 airfield areas in East Pakistan and for East Pakistan of mean number of days at 00, 06, 12, and 18 LST with ceiling $\geqslant$ 1000 ft and visibility $\geqslant$ 3 miles; ceiling $\geqslant$ 2000 ft and visibility $\geqslant$ 3 miles with surface wind < 10 knots; surface wind $\geqslant$ 17 knots and no precipitation; surface wind 4-10 knots and temperature 33-89°F and no precipitation; sky cover < 3 tenths and visibility $\geqslant$ 3 miles; ceiling $\geqslant$ 2500 ft and visibility $\geqslant$ 3 miles; ceiling $\geqslant$ 6000 ft and visibility $\geqslant$ 3 miles; ceiling $\geqslant$ 10,000 ft and visibility $\geqslant$ 3 miles. For East Pakistan there are monthly and annual summaries of mean maximum and minimum temperatures (°F) and largest and smallest amounts of mean total precipitation. The airfields in East Pakistan are Bogra, Jessore, Dacca Tezgaon, Brahmanbaria, Khulna, and Chittagong.

286. U. S. Air Weather Service. U. S. Naval Weather Service worldwide airfield summaries. Vol. II, Part 2. Middle East. October 1967. DAS M06.3 U5815u.

...Includes tabular monthly and annual summaries over specified periods of absolute maximum and minimum temperatures (°F), mean maximum and minimum temperatures (°F), mean number days with maximum temperatures $\geqslant$ 90°F, mean number of days with minimum temperatures $\leqslant$ 32°F and $\leqslant$ 0°F, mean dew point temperature (°F), mean relative humidity, mean pressure converted to an altitude (ft) by using the U. S. Standard Atmosphere, mean amount of precipitation (in.), mean amount of snowfall (in.), mean number of days with precipitation $\geqslant$ 0.1", mean number of days with snowfall $\geqslant$ 1.5", mean number of days with visibility < ½ mile, mean number of days with thunderstorms, percent frequency of wind speed $\geqslant$ 17 knots and $\geqslant$ 28 knots, percent frequency of < 5000 ft and/or visibility < 5 miles, percent frequency of ceiling < 1500 ft and/or visibility < 3 miles for specified intervals of time (00-02, 03-05, 06-08, 09-11, 12-14, 15-17, 18-20

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and 21-23 LST) and percent frequency of ceiling < 300 ft and/or visibility < 1 mile for specified intervals of time (00-02, 03-05, 06-08, 09-11, 12-14, 15-17, 18-20, and 21-23 LST) for 9-22 airfields in West Pakistan. There are monthly and annual summaries over specified periods for 9-22 airfield areas in West Pakistan and for 3 climatic areas in West Pakistan of mean number of days at 04, 10, 16, and 22 LST (or 05, 11, 17, and 23 LST) with ceiling ≥ 1000 ft and visibility ≥ 3 miles, ceiling ≥ 2000 ft and visibility ≥ 3 miles with surface wind < 10 knots, surface wind ≥ 17 knots and no precipitation, surface wind 4-10 knots and temperature 33-89°F and no precipitation, sky cover < 3 tenths and visibility ≥ 3 miles, ceiling ≥ 2500 ft and visibility ≥ 3 miles, ceiling ≥ 6000 ft and visibility ≥ 3 miles, and ceiling ≥ 10000 ft and visibility ≥ 3 miles. For the three climatic areas of West Pakistan there are monthly and annual summaries of mean maximum and minimum temperatures (°F) and largest and smallest amounts of mean total precipitation.

287. 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. 359pp. 1967. DAS M82/267 U58sd 1967.

...Discusses general weather conditions, pressure, extratropical and tropical cyclones, winds, monsoons, autumn transition period, spring transition period, land and sea breezes, temperature, precipitation, thunderstorms, cloudiness, and visibility for the south and west coast of India, Ceylon, eastern coast of West Pakistan, and the Arabian Sea on pages 14-30 and 87. The tables present seasonal sea and swell frequencies on page 57 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), means at 0800 and 1600 of relative humidity, mean cloud amount (tenths), mean number of days with cloud cover < 3/10 average amount and > 7/10 average amount, mean total amount of precipitation (inches), greatest and least amounts of precipitation (inches), maximum amount of precipitation (inches) in 24 hours, mean number of days with precipitation ≥ 0.01". wind direction (8 points and calm) frequency at 0800 and 1700, mean wind speed at 0800 and 1700, mean number of days with wind speed ≥ 34 knots, and mean number of days with visibility > 1100 yds at 0800 on page 325 at Karachi. Period of record varies by element.

288. World Weather Records. Issuing Office varies: Smithsonian Institution, U. S. Weather Bureau, U. S. Environmental Data Service. Washington, D. C., 1944-1967. DAS M06.1 W927wo.

...Presents monthly and annual summaries for each year and over specified periods during the period 1853-1960 of mean station and sea level pressures, mean temperature and mean amount of precipitation for 21 stations in Pakistan.

1968

289. Ahmad, M. Shafi. Luminous vapor measurements of upper atmosphere winds at Sonmiani, Pakistan. Space Research, 8: 882-887. Amsterdam, 1968. DAS 629.4072 S732sp 8: 1967.

...Nike-Apache rocket carrying a sodium payload was launched from Sonmiani Rocket Range at 1359 UT (evening twilight) on 25 February 1966. Profiles of wind speed and direction obtained on this occasion are presented. These data along with those obtained earlier from two launchings in November-December 1964 from Sonmiani and three launchings from the Indian range at Thumba are discussed. All these data appear to be in accord with the earlier suggestion of a transition zone on either side of the equator, where the wind vector rotation changes from the so-called "southern hemisphere" type to the "northern hemisphere" type. - Author's abstract.

290. Desai, B. N. Is the low-level inversion over north-west India and West Pakistan during the monsoon season due to air-masses or due to subsidence? Current Science, Bangalore, 37(24): 694-695, December 20, 1968. DLC.

...Refers to the paper of Flohn et al. (1968), Ramage (1966), Miller and Keshava Murthy (1967), and Bellamys (1949) computations of divergence over eastern West Pakistan. In his latest paper, Desai (1968) shows that the subsidence ideas of Flohn (1965, 1966) and Ramage do not support each other and that workers who put forward subsidence ideas do not mean the same thing; some consider ascending motions while others consider descending motion in the lower levels over the desert. The author concludes that his air mass ideas (Desai 1966, 1967) are still of value and explain most of the observed facts more satisfactorily than do the recently propounded subsidence ideas. - MGA 20.11-255.

291. Domrös, Manfred. "Zur Frage der Niederschlagshäufigkeit auf dem Indischen-Pakistanischen Subkontinent nach Jahresabschnitten." =On the question of rain frequency on the Indo-Pakistan subcontinent

Source No. 291 continued.

according to annual periods." Meteorologische Rundschau, 21(2): 35-43, March/April 1968. (In German with English summary) Berlin. 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 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 traveling disturbances: monsoon depressions 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.

292. Flohn, Hermann; Hantel, Michael; Ruprecht, Eberhardt. Air-mass dynamics or subsidence processes in the Arabian Sea summer monsoon? Journal of the Atmospheric Sciences, 25(3): 527-529, Boston, May 1968. DAS M(05) A512j.

...Presents the results of the investigation of a problem under discussion for several years. This problem is, "Is the inversion over the Arabian Sea and over Northwest India and West Pakistan due to conservative air-mass properties or due to subsidence." The topics discussed are divergence and convergence over the Arabian Sea and vertical velocity over northwest India and West Pakistan.

293. Nelson, H. L. Climatic data for representative stations of the world. 82pp. Lincoln, Nebraska, 1968. DAS M82.2 N426c1.

...Includes monthly and annual mean amount of precipitation (inches) and monthly mean temperature (^{o}F) based on data for 10 years or more at Chittagong, Dacca, Karachi, Multan, and Peshawar on page 52.

294. Rahmatullah, M. and Jafri, S. A. Fluctuations in stratospheric and mesospheric winds at Sonmiani during IQSY. Space Research, 8: 871-881. Amsterdam, 1968. DAS 629.4072 S732sp 8: 1967.

...A comparative study of the stratospheric and mesospheric winds at Sonmiani based on meterological sounding rocket observations from October 1964 to March 1966 has been made. It was observed that the stratospheric and mesospheric winds increased with solar activity during 1965. This was also reflected in the stronger zonal wind circulation for the autumn and winter months of 1965-66. The most pronounced westerly jet in the mesosphere occurred in the months of February and March with winds exceeding 65 m/sec.

Extreme fluctuations in the stratospheric wind pattern were observed in the month of January. The zonal wind component in the stratosphere did not show any important diurnal effect, but the meridional wind component above 50 km showed considerable variation between morning and evening soundings. In most of the evening soundings the meridional wind component above 50 km was from the north, but in one of the morning firings it was observed to be from the south confirming Groves' postulate of a travelling wave of global extent in the meridional wind component at 50 km. - Authors' abstract.

295. Rahmatullah, M.; Ahmad, M. Shafi; McDermott, D.P.; Groves, G. V. Upper atmosphere wind and temperature at Sonmiani, Pakistan, derived from rocket grenade experiments. Space Research, 8: 888-895. Amsterdam, 1968. DAS 629.4072 S732sp 8: 1967.

...The results from the launching of 29 April 1965 give the temperature at the stratopause level with a double maximum in the 40-50 km region. The stratopause temperature at 50 km is about 23^{o}C higher than the corresponding CIRA value. The temperature at 30 km is about 20^{o}C lower than the model. The change from winter westerlies to summer easterlies occurs around 50 km during mid-April and gradually affects the higher levels as the month progresses. The meridional winds between 45 and 60 km have oscillatory characteristics.

The firing conducted on 27 March 1966 revealed a broad stratopause but, apart from a general increase over the CIRA 1965 values of about 10^{o}C, the temperature and wind structure is not unusual. The

Source No. 295 continued.

meridional component exhibits an oscillatory pattern as noted in the previous firing. - Authors' abstract.

296. Rees, David. Determinations of upper atmosphere structure above 90 km by optical observations on rocket-borne chemical releases. Space Research, 8: 909-919. Amsterdam, 1968. DAS 629.4072 S732sp 8: 1968.

...Results are presented from six launchings at Eglin Air Force Base (Florida), Sardinia, and Pakistan during 1965-66 of wind velocity, temperature, density, and pressure above 90 km obtained by ground-based observations on rocket-borne releases of trimethyl aluminium and grenades. A brief description is given of the optical ground equipment, which consisted of spectrometers and camera equipment, together with a new photoelectric device for determining sonic velocity from the shock waves of grenades in the luminous trimethyl aluminium trail. - Author's abstract.

297. Snead, Rodman E. Weather patterns in Southern West Pakistan. Archiv für Meteorologie, Geophysik und Bioklimatologie, Ser. B, Vienna, 16(4): 316-347, 1968. English, German and French summaries. pp. 316-317. DLC.

...Southern West Pakistan is an area of transition between the Indian summer monsoon system to the east and the winter cyclonic system of southwest Asia to the west. As a transition area, it receives scanty, unreliable rainfall averaging less than 10 in./yr (254 mm) from several storm types. Six main weather patterns cross the region: the large subtropical anticyclonic high pressure cell that predominates most of the year; western depressions originating over the Mediterranean Sea; Arabian Sea cyclones; local thunderstorms and dust storms; a modified monsoon pattern; and eastern depressions originating over the Bay of Bengal or central India. A discussion of the physical and synoptic characteristics for each weather pattern and storm type is presented, and summary charts of the weather pattern are included. - MGA 20.9-248.

1969

298. U. S. Environmental Data Service. Climates of the world. 28pp. Washington, January 1969. DAS M82.1/2 U5883cl.

...Includes summaries of mean daily maximum and minimum temperatures (^{o}F) for January, April, July, and October and annual extreme temperatures (^{o}F) for Dacca (60 years), Karachi (43 years), Multan (60 years),

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and Rawalpindi (60 years). There are also summaries of monthly and annual mean total amount of precipitation (inches) for Dacca (61 years), Karachi (59 years), Multan (60 years), and Rawalpindi (60 years).

299. U. S. Environmental Data Service. Monthly climatic data for the world. 1950-...(November 1969). Asheville. DAS M06.1 U587m.

...Presents for 5-21 stations in Pakistan monthly summaries of mean pressure, mean temperature, departure of mean temperature from normal, mean relative humidity, departure of mean relative humidity from normal, total amount of precipitation, departure of total amount of precipitation from normal, total number of days with precipitation $\geq$ 1mm, precipitation quintile, and sunshine duration.

1970

300. Pakistan. Meteorological Service. Pakistan daily weather report. May 23, 1949-... (January 1970). DAS M09.2/547 P152p.

...Consists of daily observations at 0300 and 1200: $RRRT_dT_d$ Nddff VVwwW PPPTT $N_hC_LhC_MC_H$ $W_tD_HD_MT_xT_x$ or $W_tD_HD_MT_nT_n$ for 1949-1956; RRR W_t N dd ff VV ww W PPP TT Nh CL h CM CH Td Td T_xT_x or T_nT_n for 1957-January 1970. Other data include wireless reports from ships; rawinsonde observations at 0000; upper wind (Hddff) at 0200, 0800, and 2000; upper air ($HHHTTTT_dT_dT_d$) at surface and standard and significant levels; daily weather map; actual maximum and minimum temperature map; departure of maximum temperature from normal. Period of record varies by station and element. The number of stations reporting data varies from 1-70.

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5 Peru (AD-670 031)
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