Cee 476

Lecture #6

Precipitation: Spatial Variability

Fig 3.6

Temporal Variability (Seasonal)

Fig 3.15

Corresponding Streamflow Variability
(Seasonal

Fig 4.21

Approx 6-hr Duration PMP
"Probable Maximum Precipitation"

(Used to estimate Spillway Design
Floods -- Probable Maximum Flood)

World Extremes

Fig 3.16

Data Sources P95

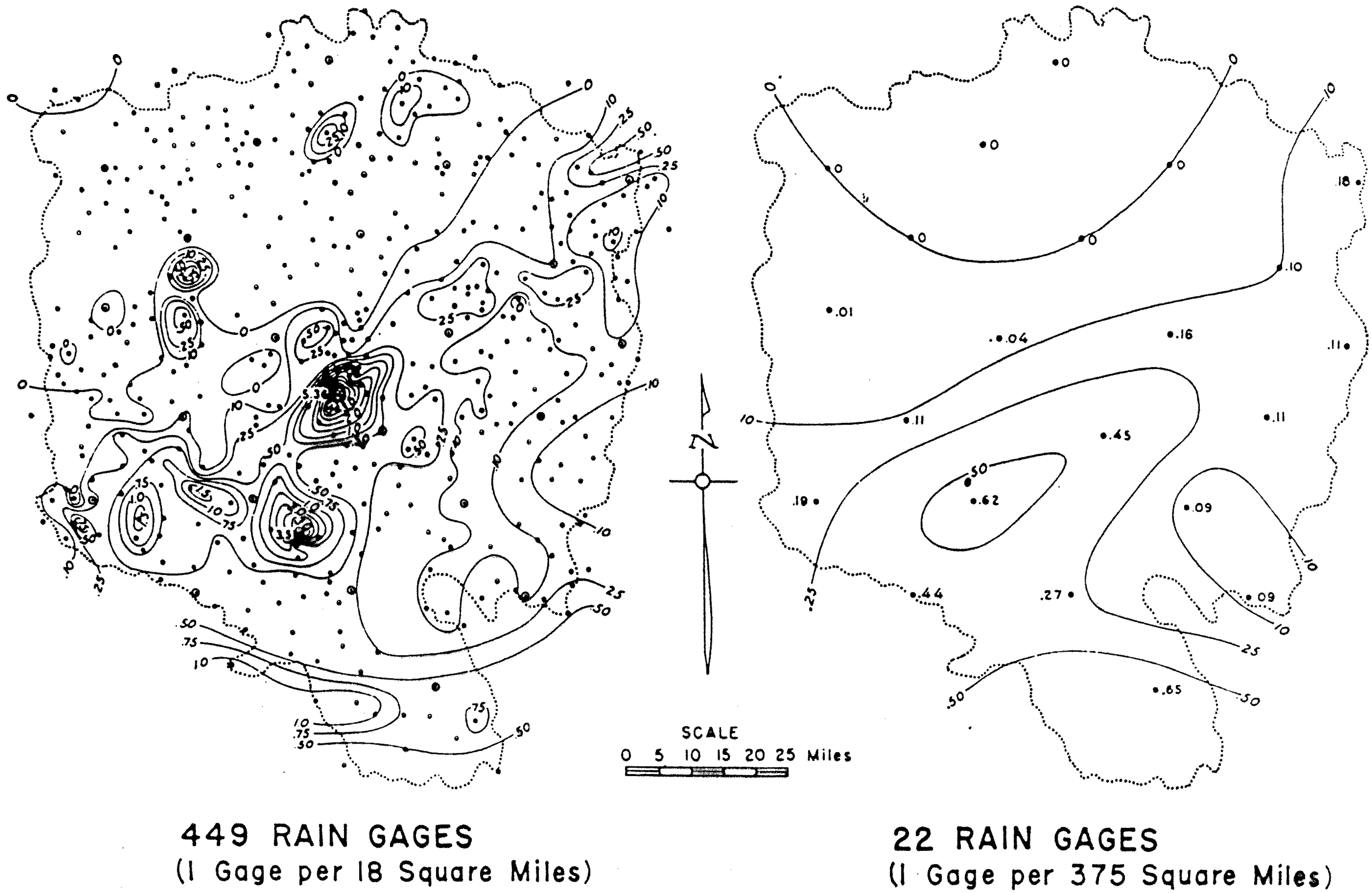

Figure 3-6 Isohyetal maps of the storm of Aug. 3, 1939, in the Muskingum Basin, Ohio, showing the effect of network densit on the apparent storm pattern. (*U.S. National Weather Service.*)

Remarkable Surface Synoptic Maps from the 1930s

BY JOHN N. RAYNER

Illustrated example from the 1930s of an unmined data source for research into mesoscale synoptic weather phenomena.

In the mid-1960s Guy-Harold Smith, an emeritus professor at The Ohio State University, showed me some fascinating weather maps. Dr. Smith, a cartographer and former chair (1933–63) of geography at the university, explained that he had been involved in analyzing data from the Muskingum River basin of eastern Ohio for the Soil Conservation Service in the late 1930s. He had kept copies of one particular set of maps, for 1500 LT 12 October 1937. They depicted at high resolution a clearly defined surface warm front lying across the region. Fortunately I had the foresight to trace all of the data and maps onto 450 mm × 600 mm sheets. These are now reproduced in digital form. The present location of the originals is unknown.

SOURCE OF THE DATA. A significant portion of the U.S. public has always had a concern for the natural environment. Perhaps that was inevitable in the early days of the nation when most people worked on the land. Indeed, 58% of the people were considered farmers in 1862 when the U.S. Department of Agriculture (USDA) was established. Although this was down to 21% by 1930, the devastating effects of the Dust Bowl of the early 1930s raised public awareness and Congress created The Soil Conservation Service (SCS) in 1935 under the USDA as a replacement for the Soil Erosion Service (SES) (Harlow 1994). The latter had been established in 1933 under the Department of Interior, largely as the result of the work of Hugh Hammond Bennett (1881–1960), a soil scientist in the USDA (Helms 1998). Bennett was made chief of the new unit, a position he held until he retired in 1951. Incidentally, the Weather Bureau had initiated the USDA's work in soils in 1892 (Buie 1980), the year after it was transferred from the USDA from the Army Signal Corps, where it was known as the Weather Service.

In the 1930s a number of research projects involving the conservation of natural resources were initiated or were already in progress. Concern over the need for employment during the Depression produced additional financial support from the Federal Government. Several of these projects under the USDA were unified by its secretary in 1935 (Buie 1980). For example, 10 erosion-control experiment stations, including Zanesville, Ohio, were transferred to the SES. In the same year, the Emergency Conservation Work camps (manned by the Civilian Conservation Corps) were also transferred to the SES from the Forest Service. Buie (1980) indicated that these camps and the Works Progress Administration

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• Moisture Sources
• Dominant Weather Patterns

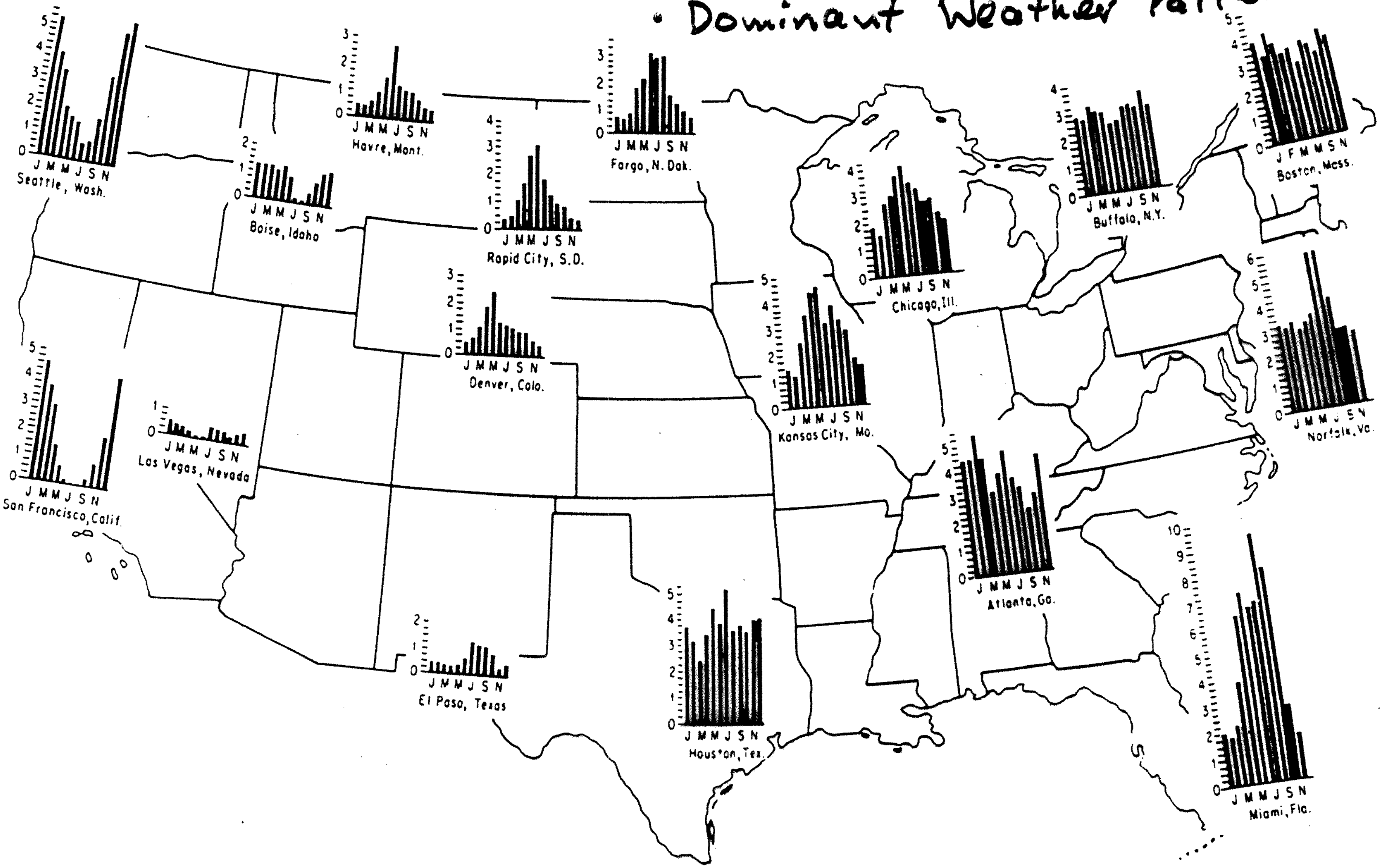


Figure 3-15 Normal monthly distribution of precipitation in the United States, in inches (1 in = 25.4 mm). (*U.S. Environmental Data Service.*)

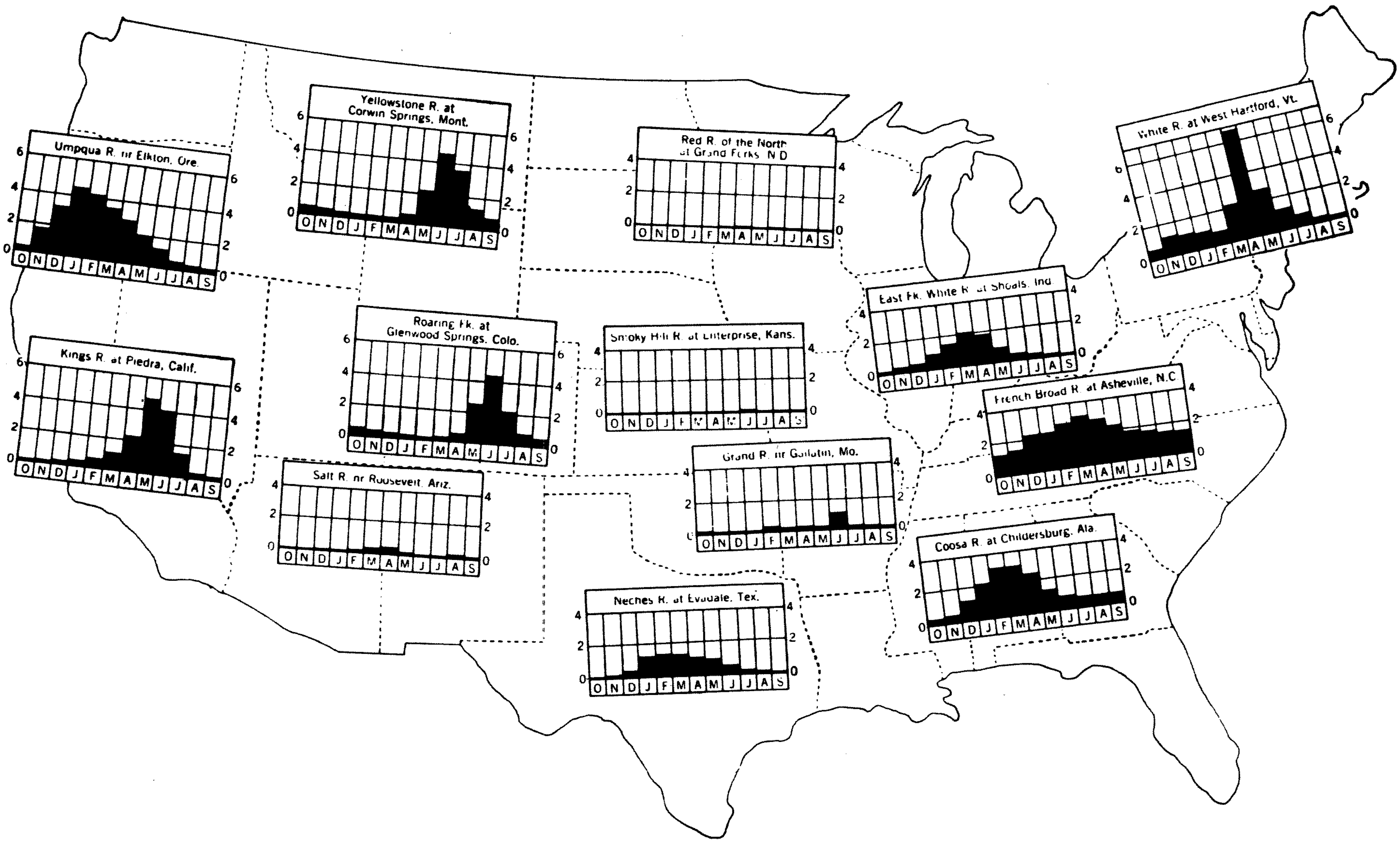


Figure 4-21 Median monthly runoff (inches) at selected stations in the United States.

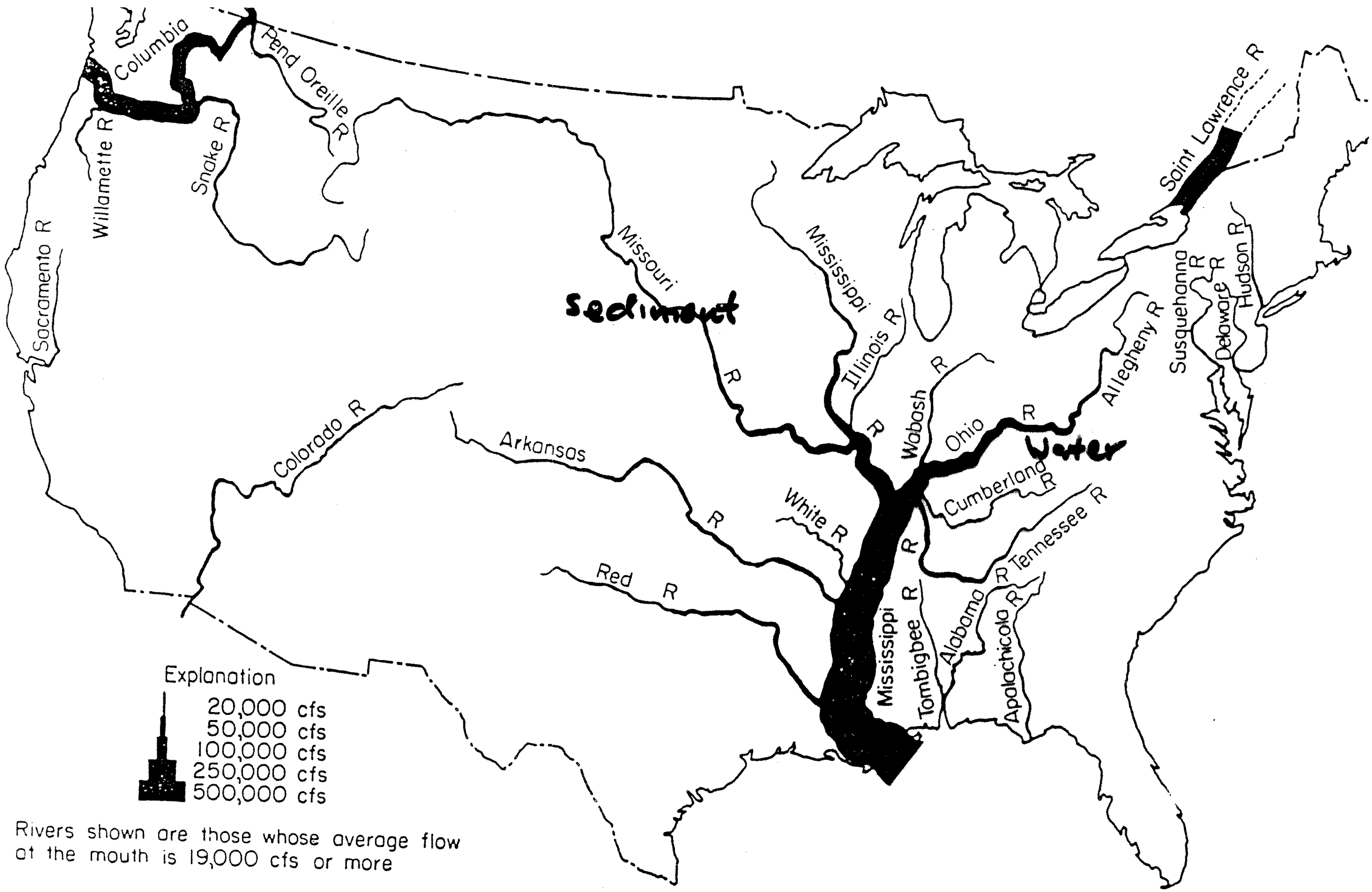


FIG. 14-19. Large rivers in the United States (*U.S. Geological Survey* [109]).

Figure 15. **Probable maximum precipitation (inches) east of the 105° meridian for an area of 10 square miles and 6 hours' duration. 288–D–2449A, 288–D–2754, 288–D–2755.**

United States Department of the Interior, Bureau of Reclamation, Design of Small Dams, Second Edition, 1973

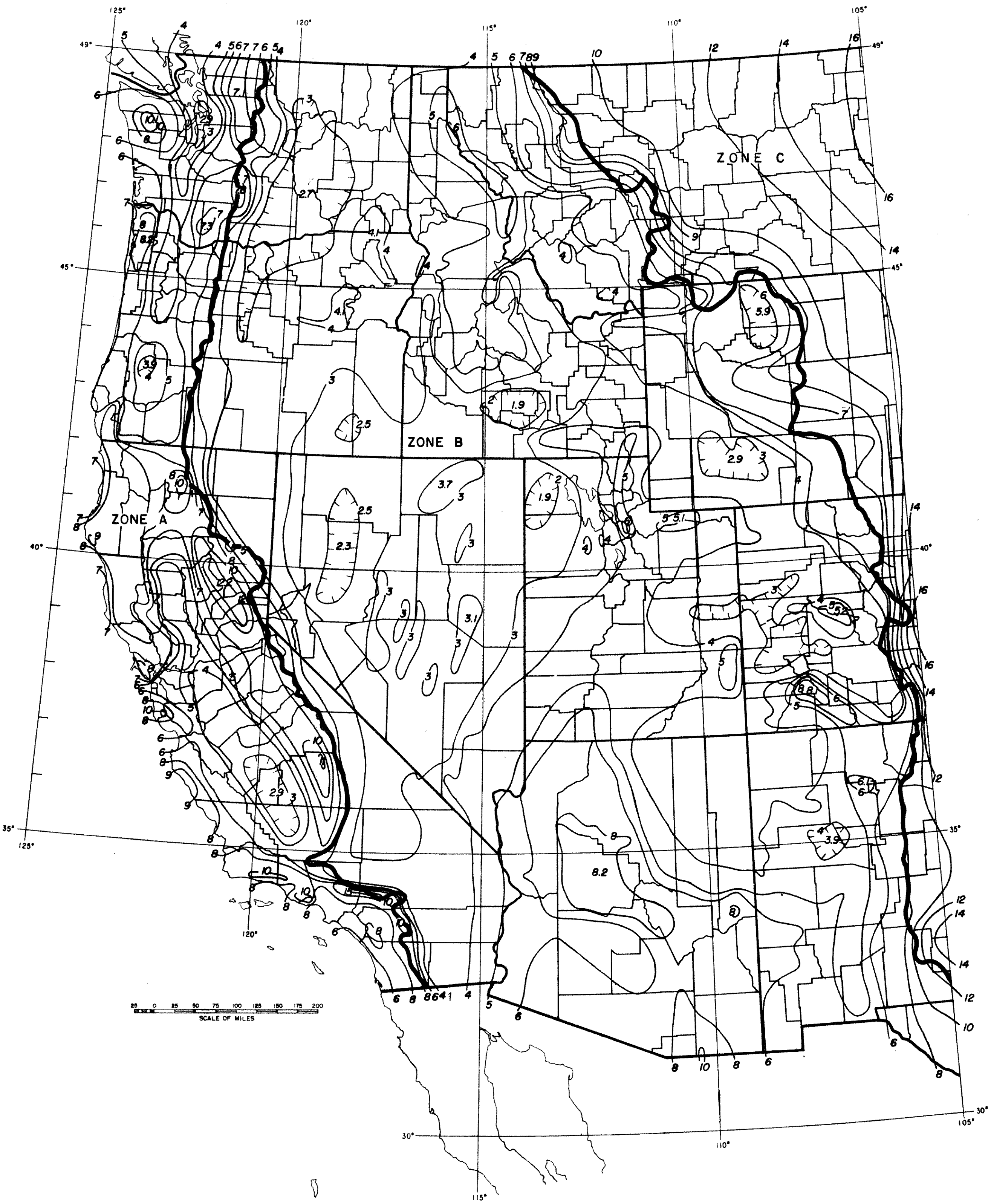


Figure 17. Probable maximum 6-hour point values in inches for general-type storms west of the 105° meridian. 288-D-2756, 288-D-2757.

- World Extremes – Precipitation
- Data Sources p95

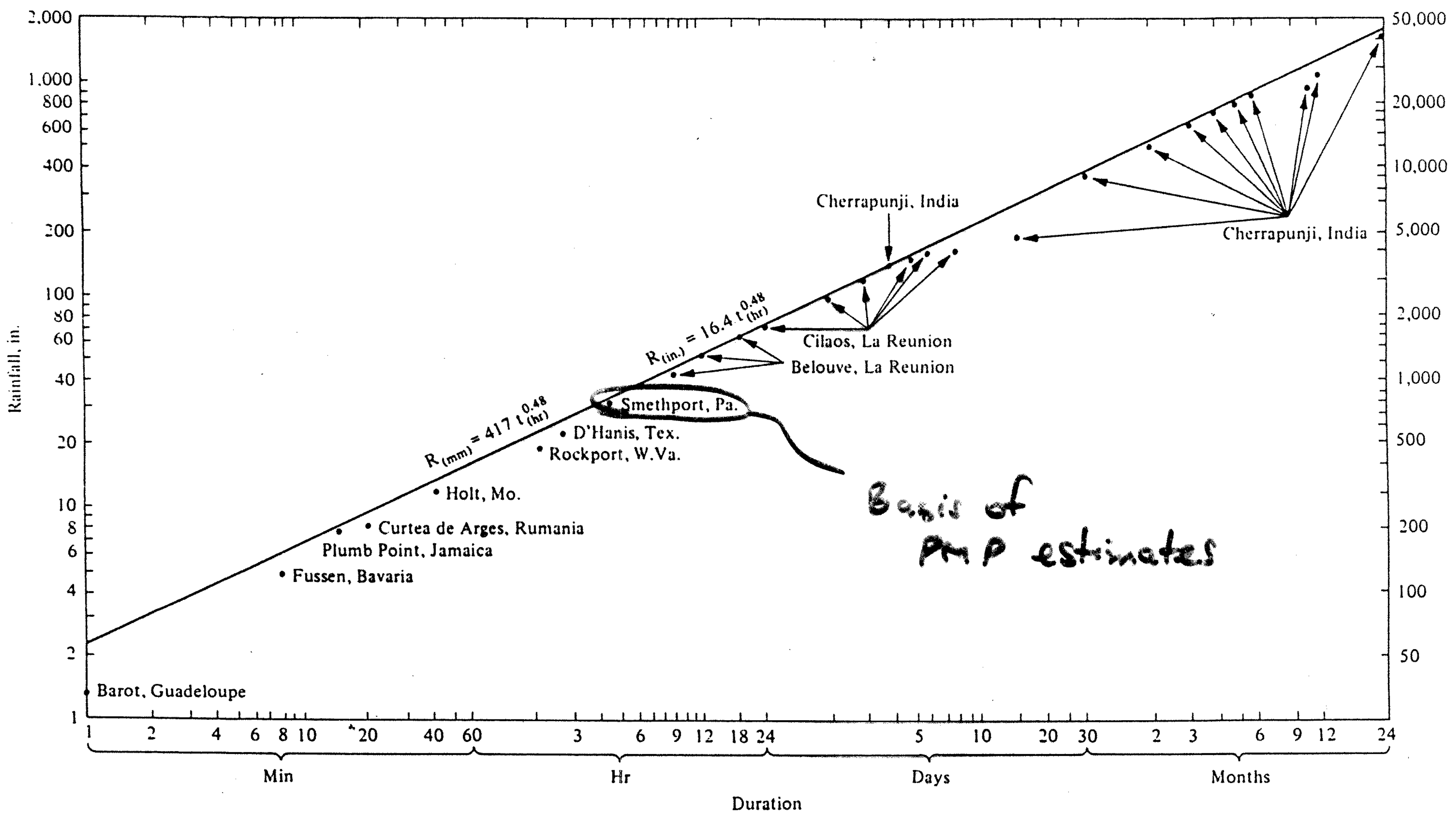


Figure 3-16 World's greatest observed point rainfalls.

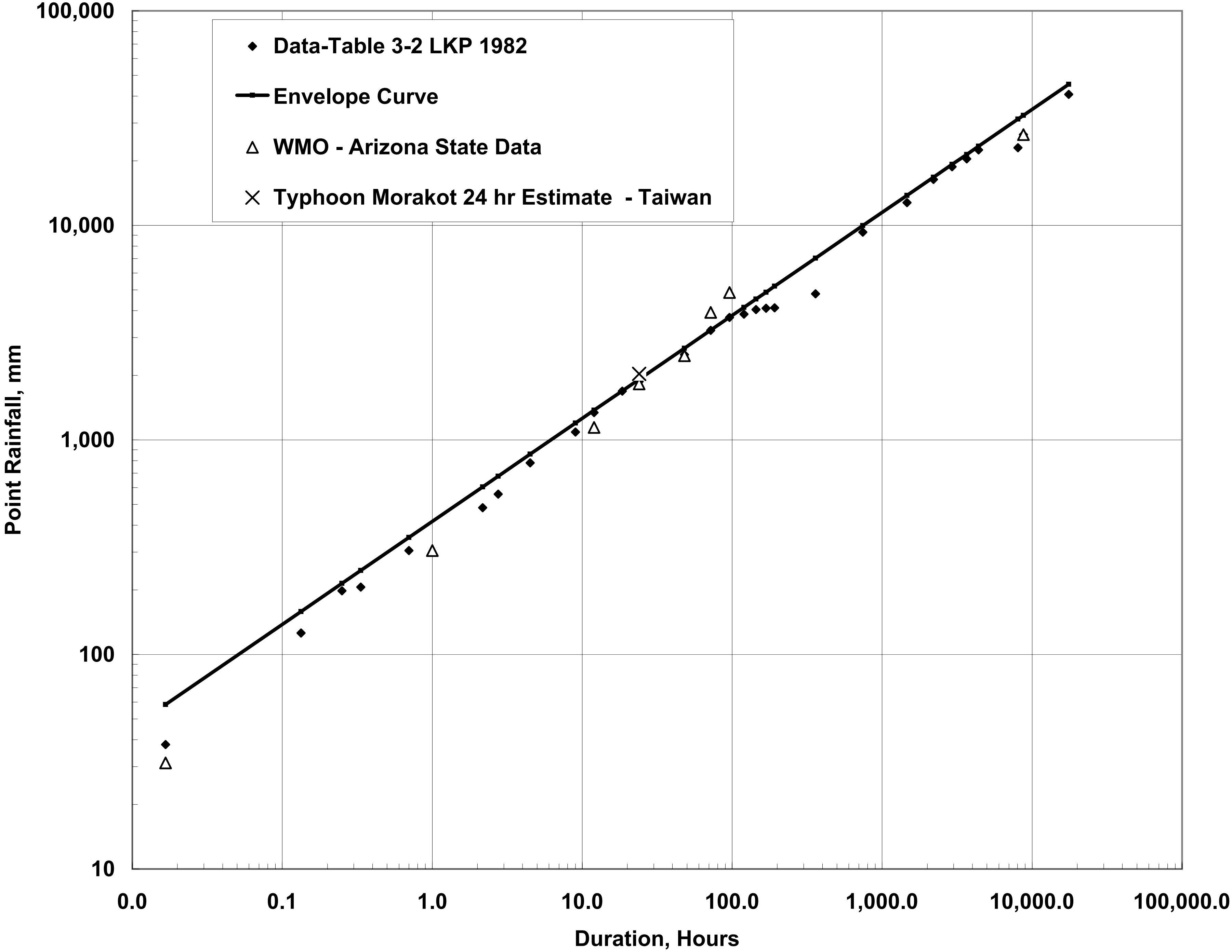
Table 3-2 World's greatest observed point rainfalls

Duration	Depth in	Depth mm	Location	Date
1 min	1.50	38	Barot, Guadeloupe	Nov. 26, 1970
8 min	4.96	126	Füssen, Bavaria	May 25, 1920
15 min	7.80	198	Plumb Point, Jamaica	May 12, 1916
20 min	8.10	206	Curtea-de-Arges, Roumania	July 7, 1889
42 min	12.00	305	Holt, Mo.	June 22, 1947
2 hr 10 min	19.00	483	Rockport, W.Va.	July 18, 1889
2 hr 45 min	22.00	559	D'Hanis, Tex. (17 mi NNW)	May 31, 1935
4 hr 30 min	30.8+	782+	Smethport, Pa.	July 18, 1942
9 hr	42.79	1,087	Belouve, Réunion	Feb. 28, 1964
12 hr	52.76	1,340	Belouve, Réunion	Feb. 28–29, 1964
18 hr 30 min	66.49	1,689	Belouve, Réunion	Feb. 28–29, 1964
24 hr	73.62	1,870	Cilaos, Réunion	Mar. 15–16, 1952
2 days	98.42	2,500	Cilaos, Réunion	Mar. 15–17, 1952
3 days	127.56	3,240	Cilaos, Réunion	Mar. 15–18, 1952
4 days	146.50	3,721	Cherrapunji, India	Sept. 12–15, 1974
5 days	151.73	3,854	Cilaos, Réunion	Mar. 13–18, 1952
6 days	159.65	4,055	Cilaos, Réunion	Mar. 13–19, 1952
7 days	161.81	4,110	Cilaos, Réunion	Mar. 12–19, 1952
8 days	162.59	4,130	Cilaos, Réunion	Mar. 11–19, 1952
15 days	188.88	4,798	Cherrapunji, India	June 24–July 8, 1931
31 days	366.14	9,300	Cherrapunji, India	July 1861
2 mo	502.63	12,767	Cherrapunji, India	June–July 1861
3 mo	644.44	16,369	Cherrapunji, India	May–July 1861
4 mo	737.70	18,738	Cherrapunji, India	Apr.–July 1861
5 mo	803.62	20,412	Cherrapunji, India	Apr.–Aug. 1861
6 mo	884.03	22,454	Cherrapunji, India	Apr.–Sept. 1861
11 mo	905.12	22,990	Cherrapunji, India	Jan.–Nov. 1861
1 year	1041.78	26,461	Cherrapunji, India	Aug. 1860–July 1861
2 years	1605.05	40,768	Cherrapunji, India	1860–1861

process [70, 71]. Most evaluations of quality made to date indicate values of 90 percent or more, but values as low as 50 percent have been obtained at times of rapid melting.

Measurement of the depth of accumulated snow on the ground is a regular function of all U.S. National Weather Service observers. Where the accumulation is not large, the measurements are made with a rain-gage measuring stick. In regions where large accumulations are the rule, permanent *snow stakes* are used. *Aerial snow-depth markers,* a type of stake adapted for visual reading from low-flying aircraft, are used in some remote areas. All stakes for measuring snow depth should be installed where they will be least affected by blowing or drifting snow [72]. Snow depths are reported in inches in the United States, but most countries use centimeters.

The hydrologist is usually more interested in the water equivalent of the



100,000
10,000
1,000
100
10
Point Rainfall, mm
0.0
0.1
1.0
10.0
100.0
1,000.0
10,000.0
100,000.0
Duration, Hours
Data-Table 3-2 LKP 1982
Envelope Curve
WMO - Arizona State Data
Typhoon Morakot 24 hr Estimate - Taiwan