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DEVELOPMENT OF WELLS FOR IRRIGATION AND FLUCTUATION OF  
WATER LEVELS IN THE HIGH PLAINS OF TEXAS  
TO JANUARY 1951

By

E. R. Leggat, Geologist  
United States Geological Survey

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# DEVELOPMENT OF WELLS FOR IRRIGATION AND FLUCTUATION OF WATER LEVELS IN THE HIGH PLAINS OF TEXAS TO JANUARY 1951

## INTRODUCTION

Irrigation from wells in the High Plains of Texas was started in 1911. Development of the ground water supply progressed slowly until January 1937, when only 600 wells were in use. During 1937 the number of wells nearly doubled, and during the succeeding 6 years new wells were added at rates ranging from 120 to 480 wells a year. From 1943 to 1950, inclusive, the accelerated rate of drilling new wells was phenomenal. During that 7-year period, 11,550 irrigation wells were added, and the total number of wells in use on January 1, 1951, was about 14,500. This represents more than 85 percent of the wells used for irrigation in Texas during 1950.

About 14,000 of the irrigation wells in the High Plains are within the 21 counties recently designated by the State Board of Water Engineers, under the local option ground-water law passed by the State Legislature in 1949, as "Subdivision No. 1 of the Underground Water Reservoir in the Ogallala formation south of the Canadian River in Texas" (fig. 1). The reservoir subdivision encompasses about 6,815,000 acres of which about 27 percent, or 1,860,000 acres, was irrigated from wells in 1950.

In the remainder of the High Plains, an additional 40,000 acres was irrigated from about 500 wells in counties outside the designated reservoir subdivision. These wells are partly in the north plains and partly in the extreme south plains.

The number of acres irrigated each year, the number of irrigation wells in use each year, the composite average annual precipitation at Dimmitt, Lubbock, Muleshoe, Plainview, and Tulia, and the fluctuation of water levels in wells in the heavily pumped parts of the reservoir during the 14-year period 1937-50, inclusive, are shown graphically in figure 3.

## PRECIPITATION

Records of the United States Weather Bureau show that the average annual precipitation in the High Plains is approximately 20 inches. Precipitation at the five stations in 1949 averaged 24.9 inches, most of which fell during the growing season from April to September. Precipitation at the same stations in all of 1950 averaged 18.00 inches approximately 60 percent of which fell during July and September. (See fig. 2.)

## PUMPAGE

In 1950 approximately 1,600,000 acre-feet of water was pumped from wells in the region. This pumpage represents an increase of about 425,000 acre-feet over that in 1949 and about 350,000 acre-feet over that in 1948. Approximately 97 percent of the pumpage in both 1949 and 1950 was for irrigation.

### FLUCTUATIONS OF WATER LEVELS

Water levels are observed in a network of about 500 observation wells in the spring of each year before pumping begins. The fluctuations in three wells are measured continuously by means of water-stage recorders. The highest monthly levels obtained from the record or charts are shown in figures 4 to 6. The measured depths to water in representative wells in 10 counties are given in tables 1 to 9. Hydrographs showing the fluctuations of water levels in wells in most of the heavily pumped counties are shown in figures 7 to 17. The sites of the wells for which hydrographs are given are shown in figure 1.

The fluctuations of water levels in wells correlate with pumpage and variations in precipitation. For example, in 1941 and 1942, when precipitation was greatly above average and pumping was light, the water levels rose sharply in most of the observation wells. Water levels in many wells reached the highest stages recorded since the start of irrigation. The water levels in wells in the sand hills and in other areas remote from areas of heavy pumping continued to rise in 1943 and 1944, and in some areas were later, indicating that recharge continued for several years after the heavy rainfall (fig. 18).

The average decline of the water levels in about 500 wells in the irrigated portion of the Southern High Plains from March 1949 to February 1950 was 0.8 foot, and the average decline in 432 wells from February 1950 to January 1951 was 1.3 feet. The decline of water levels from 1938 to 1951 is shown on figure 1 and the decline from 1950 to 1951 is shown on figure 2.

The declines in water levels from 1938 to 1951 and the percentage of the total area affected were as follows:

Decline of water table 1938-51	Percentage of reservoir subdivision
5 feet or less	78 percent
5 feet or more	22 percent
10 feet or more	10 percent
20 feet or more	2 percent
30 feet or more	.5 percent
40 feet or more	.17 percent

Although the installation of new wells continued at a rapid rate during the early part of 1951, the unusually heavy rains that fell in May undoubtedly will reduce the demand for ground water and will retard the decline of water levels. However, the net change in water levels during 1951 cannot be foretold; it will depend on the amount of precipitation and pumping during the remainder of the year.

Table 1.- Water levels in representative wells in Bailey County, Tex.  
(Depth to water in feet below land-surface datum)

Date of measurement	WELL NUMBER											
	5-A	25	36	45	49	69	79	92	95	117	131	
1914												18.0
1934 Nov.					24.3						34.6	
1936 May					26.2	16.8	24.1	24.1	24.2	34.9		
Nov.		22.8	19.6		25.1	16.3	23.6	23.3	23.2			
1937 Mar.					24.8		23.5			35.0	21.0	
May		24.8		21.6		15.9	21.1	22.2	23.4	34.9		
Nov.	63.5	21.8	17.9	20.8	23.9	16.4	21.9	22.7	34.8	20.7	20.7	
1938 Mar.		22.0	17.6	20.7	23.9		23.1	22.1	22.9	34.9	20.9	
1939 Mar.	63.2	19.9	17.2	19.9	23.1	15.5	22.3	21.1	22.9	35.1	21.9	
1940 Mar.	63.1	21.4	18.8	21.1	24.2	17.5	23.9	22.0	23.4	35.8	21.5	
1941 Mar.	63.3	23.4	19.7	22.3	25.4	17.8	24.7	23.5	24.4	36.4	22.4	
1942 Mar.	53.6	14.9	12.5	13.2	18.1	8.8	16.6	15.3	17.2	30.5	12.3	
1943 Feb.		15.6	13.1	14.1	17.7	8.8	17.9	15.4	17.2	29.0	12.6	
1944 Feb.	62.4	18.6	16.0	17.0	20.4	12.0	21.4	17.6	19.1	30.1	15.6	
1945 Feb.	62.5	20.1	16.5	17.3	20.8	12.8	21.6	18.2	19.7	30.5	16.8	
1946 Feb.	62.5	23.3	19.4	20.2	23.1				22.1	32.1	19.3	
1947 Mar.		24.7	20.1	21.1	24.1			21.7	23.3	33.7	20.3	
1948 Mar.	64.3	26.9	22.8	25.1	26.8	21.9		24.5	25.5	37.6	23.4	
1949 Mar.	66.1	29.9	26.8	28.6	30.0	27.2			28.4	40.7	26.9	
1950 Feb.	67.4	30.6	27.5	27.1	29.7	29.9		31.9	27.1	42.2	26.7	
1951 Jan.	69.9	33.2	27.5	28.6	30.3	30.8		34.0	30.4	42.7	27.3	

Table 2.- Water levels in representative wells in Castro County, Tex.  
(Depth to water in feet below land-surface datum)

Date of measurement	WELL NUMBER							
	18	32	48	52	58	202	465	587
1936 Apr.		64.7	64.9					
June		64.4	61.9					
1937 May		64.3						
Dec.	65.6	63.3	67.5	71.6				
1938 Mar.	66.7	63.1	60.9	71.3				
1939 Mar.		63.2	59.8		153.2	103.8	98.8	17.8
1940 Mar.		64.0	62.9	71.1	153.0	103.7		
1941 Mar.		65.5	64.4	79.1	153.1	104.0		
1942 Feb.	68.1	62.7	60.8		153.0	102.9		
1943 Feb.	67.3	62.1	58.2	71.3	152.4		95.3	16.1
1944 Feb.	68.5	63.3	59.3	74.1	152.9	101.5	94.8	16.3
1945 Feb.	69.4	64.6	59.0	73.0	151.8	103.6	94.5	16.9
1946 Feb.	70.1	67.3	66.2	75.1	151.8	102.2	94.4	18.2
1947 Mar.	70.1	67.2	64.5	78.2	151.6	102.4	94.9	18.3
1948 Mar.	71.0	66.8	64.0	76.1	151.3	102.8	95.5	
1949 Mar.	72.3	68.8	67.6	79.7	151.2	103.6	95.9	
1950 Feb.		70.6	65.5	83.3	151.3	104.5		
1951 Jan.		71.8	65.0	86.0	151.6	104.6	97.0	

Table 3.- Water levels in representative wells in Deaf Smith County, Tex.  
(Depth to water in feet below land-surface datum)

Date of measurement	WELL NUMBER																
	113	207	212	217	235	237	247	255	281	288	302	311	336	340	431	486	513
1914																	
1934 Nov.										40.7							53.8
1936 Apr.			70.4	83.9							58.0	49.3	54.8	87.3	72.9		
June		53.8	70.6		51.4	40.2							51.0	73.1			
1937 Mar.																66.2	71.2
May		58.4		91.8	55.3			65.3		68.3			47.9	87.6	73.8		
1938 Mar.	98.1	54.1	71.5	92.3	50.7	42.2	21.9	63.1	64.7	61.1	49.3	50.5	86.5	76.9	66.2		74.7
1939 Mar.	98.0	54.2	70.7	87.9	51.1	42.1	22.2	63.3	64.5	59.9	49.5	49.5	85.8	76.5	66.6	71.5	74.8
1940 Mar.	97.9	54.7		90.6	51.7	43.2	23.4	64.4	66.4	63.0	50.2	50.7	86.5				75.2
1941 Mar.	98.3	55.6	74.6	92.0	52.6	44.8	24.1	66.6	69.2	66.1	51.1	51.9	87.6	79.7	69.5	76.4	
1942 Feb.	98.4		71.9	87.9	49.3	43.6	19.8	65.9		64.0	49.5	48.6	86.6	78.8	68.3	75.3	76.0
1943 Feb.	98.2		71.1	87.3	50.0	42.8	22.5	65.9		63.9		48.1	87.0	78.0	68.2		77.1
1944 Feb.	99.4	55.5	71.7	88.8	51.6	43.0	23.7	66.7	68.0	67.1	51.0	49.4	88.0	78.8	69.6	76.9	77.9
1945 Feb.	100.3	55.5	70.3	88.2	51.9	43.2	24.5	67.5	69.5	66.8	51.6	49.8	89.1		70.4	76.3	78.4
1946 Feb.	101.4	55.8	73.5	89.6	52.2	44.5	25.1	69.5	73.0	70.6	52.5	50.3	90.8	81.1	71.5	78.2	79.0
1947 Mar.		58.2		89.8	52.6	46.1	25.6	71.6	74.7	72.6	52.5	50.0	92.5	82.7	72.6		
1948 Mar.	103.6	60.0	76.5	91.5	53.9	47.8	27.4	73.9	76.1	74.5	53.4	52.2	95.3	84.4	73.6	81.6	
1949 Mar.	104.5	61.5	77.0	90.5	54.5	49.0	29.1	75.0	76.0	78.0	54.4	54.0	97.3	86.6	76.1	85.1	82.7
1950 Feb.	105.1	61.8		90.1	53.8	51.5	28.4	80.4*	80.5*	76.2	54.7	54.0	98.6	89.2	75.5		
1951 Jan.	107.1	63.6	84.6	96.0	55.7	51.1		77.5	78.0	77.9	54.9	54.6	101.3	90.4	76.8	90.3	84.9

\* Pumped recently.

Table 4.- Water levels in representative wells in Floyd County, Tex.  
(Depth to water in feet below land-surface datum)

Date of measurement	WELL NUMBER												
	14	32	57	111	143	410	416	441	446	459	463	510	525
1914				46.0	51.2	40.2	48.2						
1934 Apr.										43.9	44.9		
1936 Apr.	53.4		60.3		57.5	47.9							
1937 Apr. May	54.2	91.0	60.1	53.8	61.0	50.3					49.6		40.3
1938 Mar.	54.8			55.7	60.4	50.9		62.1	42.9	47.4	47.9		39.9
1939 Mar.				51.9	60.8	48.1	60.0	62.7	43.2	47.9	48.9	41.8	40.1
1940 Mar.	57.3	90.0	62.0	53.9	62.8	50.0	62.4	63.4	43.7	49.2	50.9	45.5	40.9
1941 Mar.		90.8		56.0		52.5	66.1	64.6	44.6	51.2	53.1	49.4	41.9
1942 Feb.	54.7	90.2		54.2	62.9	49.4	62.5	63.2		48.1	49.2	40.6	37.8
1943 Feb.	55.6	90.0	62.2	54.4	63.2	49.4	62.6	62.7	41.7	48.0	48.9	40.7	36.8
1944 Feb.	58.3		63.1	55.6	64.7	50.8	65.1	63.7	41.9	49.9	50.3	43.3	37.1
1945 Feb.	59.8	91.8	64.2	57.1	67.0	53.4	68.2	65.0	42.9	51.5	53.0	46.5	38.8
1946 Feb.	61.1	92.5	66.7	59.3	70.3	56.2	72.8	66.4	44.7	55.3	55.7	49.5	40.6
1947 Mar.	62.3		69.7	63.3	77.1	61.5	78.9	68.0	46.4	60.1	60.5	52.4	42.6
1948 Mar.	63.6	96.0	72.7	65.4	-	67.3	87.3	72.3	-	66.6	67.2	56.0	44.4
1949 Mar.	65.9	98.2		69.9	88.6	74.5	97.4	79.0	-	-	72.8	59.3	46.2
1950 Feb.	66.9	99.4	77.2	74.2	95.0	-	103.7	-	-	81.3	-	-	49.2
1951 Jan.	66.6	106.8	80.5	77.2		83.5	-	-	-	80.7	83.2	66.6	47.1

Table 5.- Water levels in representative wells in Hale County, Tex.  
(Depth to water in feet below land-surface datum)

Date of measurement	WELL NUMBER																		
	202	210	223	238	259	307	330	338	370	427	428	449	462	467	552	567	834	923	936
1914		61.0		42.0	25.7		42.0	42.0		41.0		57.5	36.5						
1934 Apr.	62.6					60.1									57.4				
1936 Apr.	66.3	62.1	47.9	43.9	21.4		44.6	45.3	41.2	47.0	50.0	57.8			60.3	51.9			43.2
1937 Apr. May										45.7		59.0	41.7		58.9	52.4			44.5
		64.5	53.5							48.6	47.4								
1938 Mar.	63.7	63.0	50.0	45.3	19.8	61.9	45.4	45.3	42.3	45.8	45.3	57.8	39.5	32.8	57.6	51.7	76.6	50.0	44.4
1939 Mar.	64.6	63.5	50.6	45.7	20.6	62.4	-	45.7	42.4	47.2	-	58.3	41.4	33.7	58.3	52.3	76.7	50.4	-
1940 Mar.	65.2	64.3	52.1	46.7	21.9	63.6	46.0	47.0	43.4	48.7	48.1	59.0	43.7	35.0	59.0	53.1	76.9	50.9	47.3
1941 Mar.	66.5	65.5	53.7	48.6	22.8	65.0	46.7	48.4	44.7	50.5	50.0	60.9	46.0	37.5	61.1	53.6	77.3	51.7	49.0
1942 Mar.	65.8	65.1	52.1	47.4	18.3	63.8	46.0	46.2	43.0	47.0	45.6	60.1	37.4	34.0	58.3	52.0	76.3	48.9	45.5
1943 Feb.	65.4	65.3	52.2	47.9	18.8	64.0	46.8	46.4	43.6	46.6	45.9	60.0	38.6	33.2	58.2	52.6	76.0	48.2	44.1
1944 Feb.	66.7	66.8	53.3	49.0	21.5	65.7	47.3	48.5	45.1	48.3	47.7	60.7	41.7	35.2	58.8	53.5	76.1	48.0	45.4
1945 Feb.	67.2	67.6	54.4	50.1	23.0	66.1	48.9	49.9	46.6	51.0	50.0	61.7	44.9	37.6	59.6	54.0	76.2	48.7	46.2
1946 Feb.	68.5	69.8	56.3	52.5	24.9	67.8	50.3	51.6	48.7	52.9	52.1	62.7	47.7	39.7	62.3	54.9	78.2	49.7	48.8
1947 Mar.	70.6	72.8	60.3	55.4	26.0	69.9	53.3	53.1	51.6	55.3	55.1	64.6	51.9	40.0	61.5	55.8	-	50.8	50.4
1948 Feb.	73.7	74.9	64.5	58.1	28.3	72.7	57.0	57.0	53.8	58.9	58.9	65.7	57.7	42.3	63.4	57.9	-	52.5	51.2
1949 Feb.	77.7	76.6	68.8	63.2	32.0	76.4	61.2	57.9	57.6	63.8	64.2	69.6	64.2	44.3	65.7	-	-	54.4	52.1
1950 Feb.	80.2	78.3	70.7	65.3	-	-	62.8	59.2	59.2	66.9	66.6	69.5	-	44.6	-	-	-	54.2	-
1951 Jan.	-	-	73.7	68.4	34.9	77.7	64.7	-	-	-	71.3	69.9	74.9	45.1	69.4	-	-	58.3	-



Table 6.- Water levels in representative wells in Hockley County, Tex.  
(Depth to water in feet below land-surface datum)

Date of measurement	WELL NUMBER			
	5	7	25	434
1938 Jan.			28.6	
Apr.			28.7	133.2
1939 Mar.			28.5	
Oct.	90.6	87.0	28.5	
1940 Mar.	91.1	86.8	28.7	
1941 Mar.			30.0	
1942 Mar.			26.5	
1943 Feb.	88.9		24.0	
1944 Feb.	86.3	84.8	24.0	130.6
1945 Mar.	85.9	84.4	25.7	130.6
1946 Feb.	85.8	83.5		130.2
1947 Mar.	85.4	83.3		
1948 Mar.		84.0		131.4
1949 Mar.				
1950 Feb.				
1951 Jan.				

Table 7.- Water levels in representative wells in Lamb County, Tex.  
(Depth to water in feet below land-surface datum)

Date of measurement	WELL NUMBER			
	3a	60	76	243
1934 Nov.	27.2			
1936 May	33.4			
1937 Mar.				
May		69.1	76.3	78.0
1938 Mar.	29.0		75.5	77.8
1939 Mar.	29.1	69.4	75.7	77.7
1940 Mar.				
1941 Mar.	30.5	70.5	75.2	77.7
1942 Mar.	22.9	68.8	71.7	75.4
1943 Feb.	21.9	66.8	70.4	75.3
1944 Feb.	23.7	68.0	69.8	75.3
1945 Feb.	24.7	68.1		75.3
1946 Feb.	26.4	69.9	68.9	75.6
1947 Mar.	28.6		69.1	74.5
1948 Feb.	30.5	71.8	71.3	74.0
1949 Mar.	33.9	74.6	74.0	
1950 Feb.	34.6	74.6	75.5	75.4
1951 Jan.	35.5			75.5

Table 8.- Water levels in representative wells in Lubbock County, Tex.  
(Depth to water in feet below land-surface datum)

Date of measurement	WELL NUMBER													
	81	107	121	123	128	139	185	188	223	301	339	369	395	403
1936 Dec.	42.5			62.4	42.1					57.7		81.0		
1937 Feb.									46.8					
Mar.							61.3	77.2						
Apr.		50.6				27.2								
Dec.	42.3		73.8	62.0	41.1	25.8					61.7			
1938 Jan.	42.2	50.0				25.9	61.2					80.9	44.0	39.3
June							61.4	78.1	47.4				43.9	39.1
1939 Jan.		50.1				25.8	61.3	77.1	47.4	56.6	61.8			
Mar.	43.5		74.2			25.9	61.3	77.5	47.4	56.5			44.0	38.7
1940 Feb.								76.9				62.5		40.1
Mar.	44.9	49.4	75.7			24.9	62.0		47.5				46.2	
1941 Jan.	44.7		76.3	66.1	43.1			77.6	47.4		63.5		48.0	41.8
Mar.	45.2	49.9	77.8	64.7	46.5	26.2		77.5	47.4	57.3	63.5		47.8	41.7
1942 Mar.		45.7	74.4	62.2	39.3	22.8			42.9		61.1	74.7		35.5
1943 Jan.									42.6				42.1	32.8
Feb.	40.0	43.6	72.7	61.2	37.6	21.4				50.2	59.9	74.4		
1944 Feb.	41.3	44.3	72.2	61.7	37.9	22.3	61.3	75.2	42.6	49.6	59.5	76.1	40.4	34.6
1945 Feb.	40.5	45.4	72.5	62.2	39.3	23.8	61.9	74.3	42.7	50.1	59.5	75.9	45.2	34.5
1946 Feb.	42.0	46.4		63.8	41.7	25.4	63.3	77.7	42.4	51.8	61.5	76.9		37.1
1947 Mar.	42.3		80.1	65.8	44.9	25.7			42.2	53.1	63.1	79.7		39.6
1948 Feb.	43.5	48.7	82.2	68.8	51.1	26.9		76.1	42.5	54.0	66.1	82.3	51.8	40.5
1949 Feb.		49.3	82.0	76.0	48.5	29.3			42.6				53.8	43.7
Mar.	45.4							80.1		59.4	67.2	86.4		
1950 Feb.	46.0	51.4	82.6	71.7	49.9	30.4		77.6	39.7	59.1	67.8	86.3	54.7	44.5
1951 Jan.		51.1	86.1	75.7	54.5	34.2		78.1	41.8		71.3	88.2		45.2

Table 9.- Water levels in representative wells in Swisher County, Tex.  
(Depth to water in feet below land-surface datum)

Date of measurement	WELL NUMBER						
	2	16	38	108	258	370	421
1934 Apr.				70.7			
1936 Apr.					50.6		
June						71.7	
1937 Apr.							59.2
May		61.4	55.0		51.2		
1938 Mar.	77.9	61.8	55.1		51.6	72.5	
1939 Mar.	77.7	61.6	55.7		52.0	72.4	61.1
1940 Mar.	77.8	62.0	56.0		53.3	72.1	
1941 Mar.	78.0	62.3				73.3	62.1
1942 Mar.	77.9	61.2			54.1	73.8	
1943 Feb.	77.7	60.9	55.0	71.5	54.2	74.5	59.4
1944 Feb.	77.7	61.0	54.0		55.1	76.6	60.9
1945 Feb.	77.7	61.2	54.7	72.2	56.5	79.0	61.3
1946 Feb.	77.6	62.4	56.4	73.5	58.4	80.5	63.9
1947 Mar.	77.9	63.4	57.0	74.9		83.3	64.4
1948 Mar.	77.7			75.9		85.5	66.3
1949 Mar.	77.8		63.9	76.3		88.5	68.6
1950 Feb.	77.7			77.3			69.7
1951 Jan.	77.6			78.5		91.7	

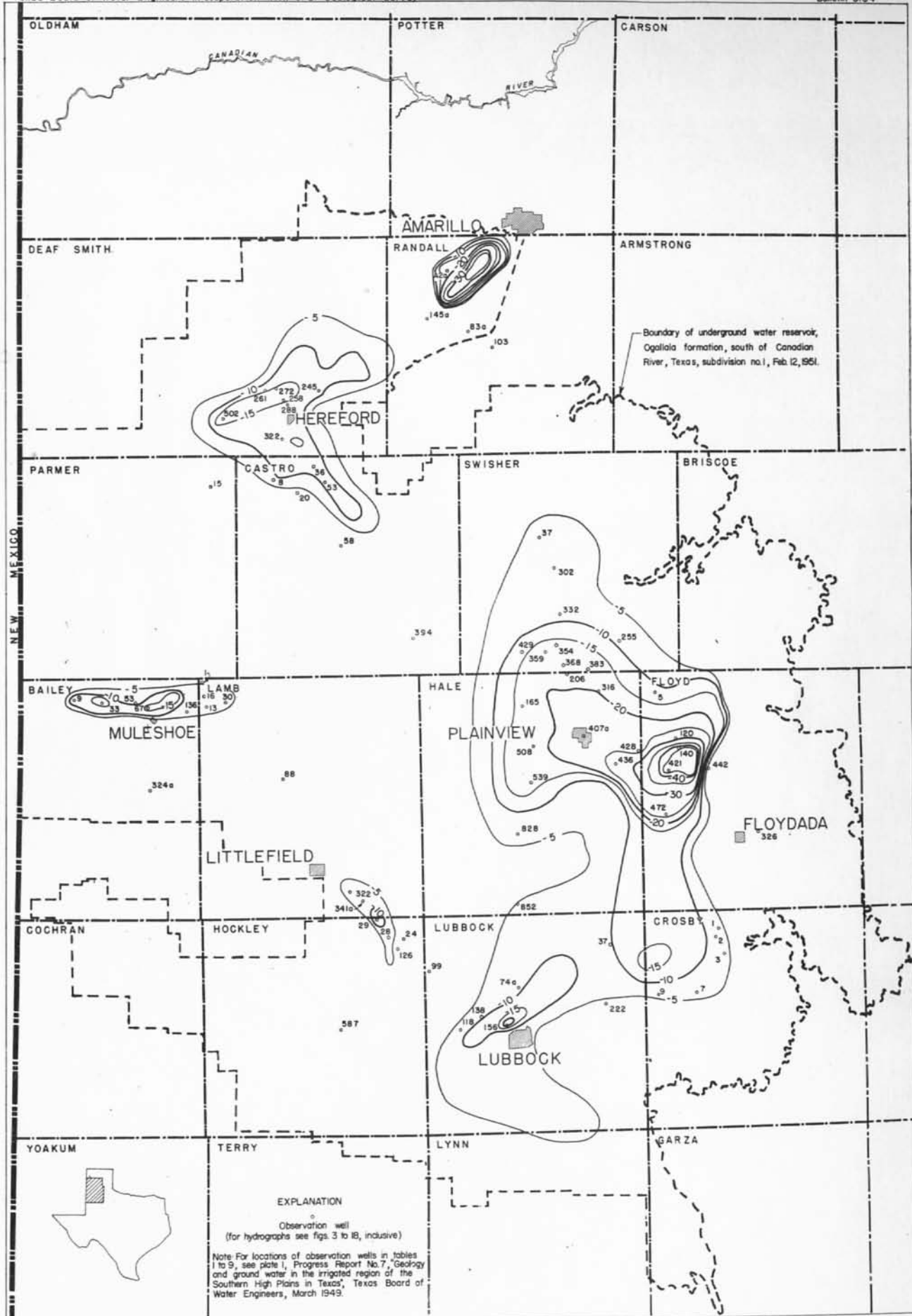


FIGURE 1.- Approximate decline of the water table in the Southern High Plains of Texas, March 1938 to January 1951.

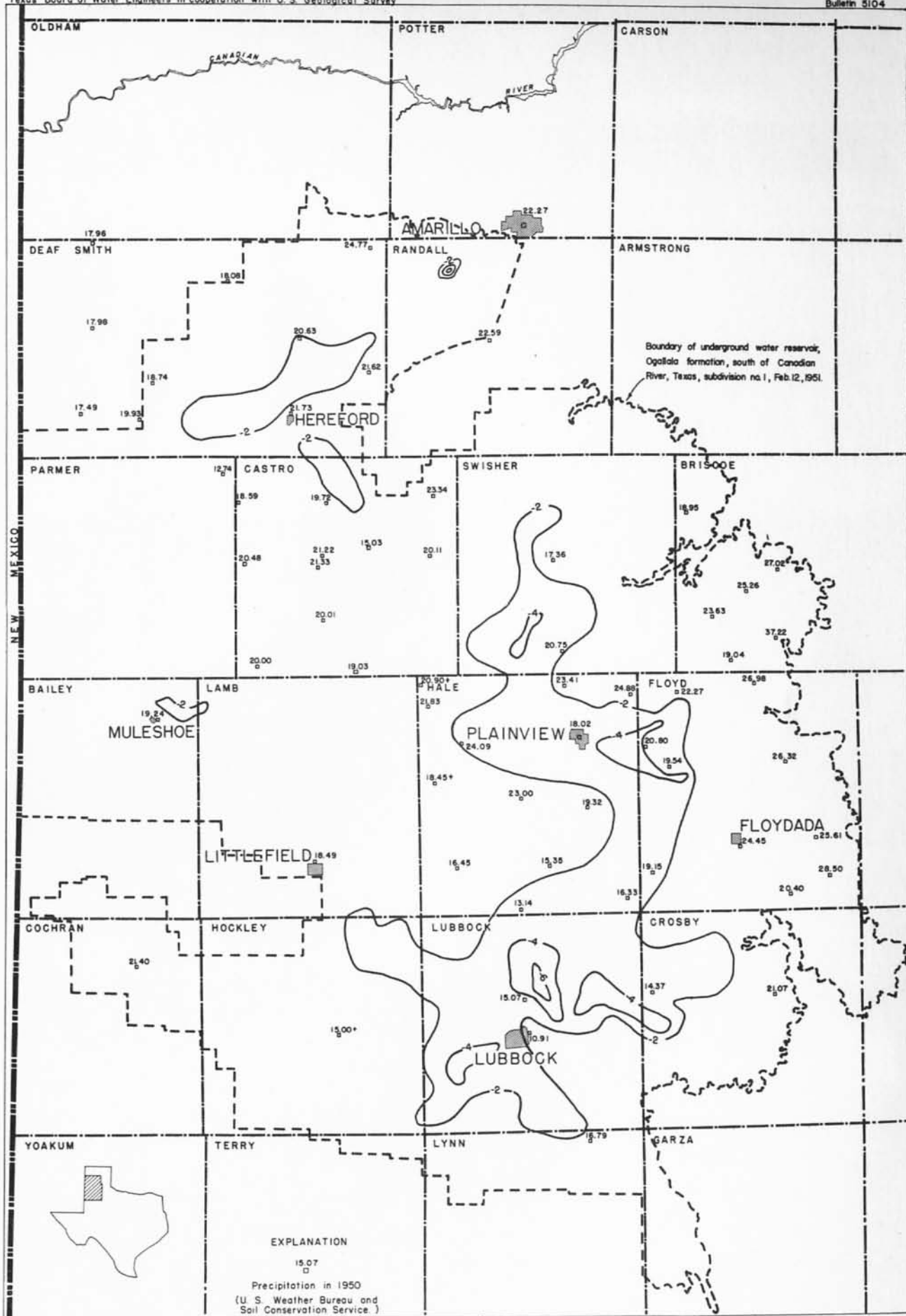


FIGURE 2 - Approximate decline of the water table in the Southern High Plains of Texas, February 1950 to February 1951.

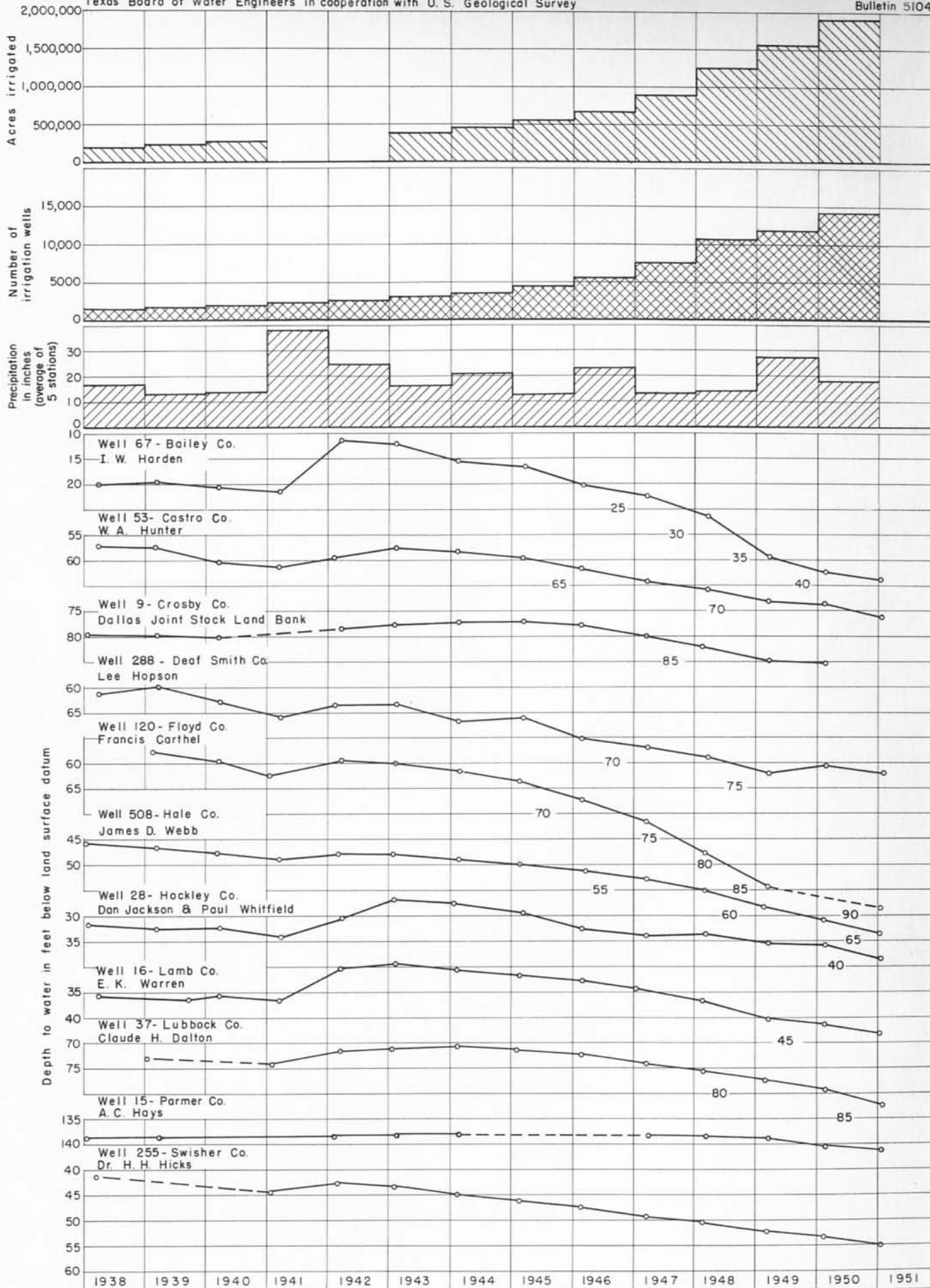


FIGURE 3. Changes in water levels as related to number of acres irrigated, number of irrigation wells, and precipitation, Southern High Plains, Tex.

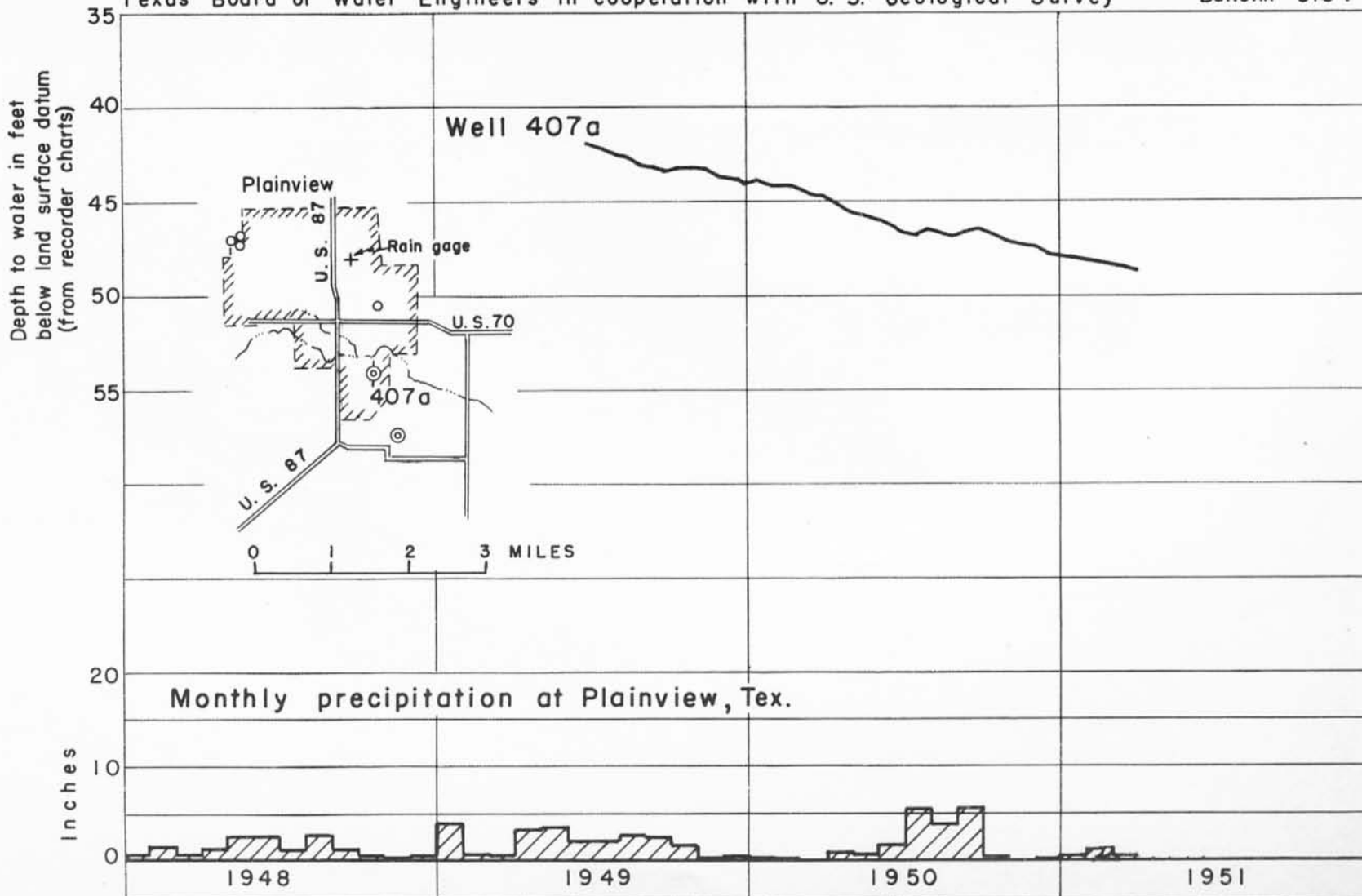


FIGURE 4. - Hydrograph for unused observation well 407a and monthly precipitation, 1948-51, Plainview, Tex.

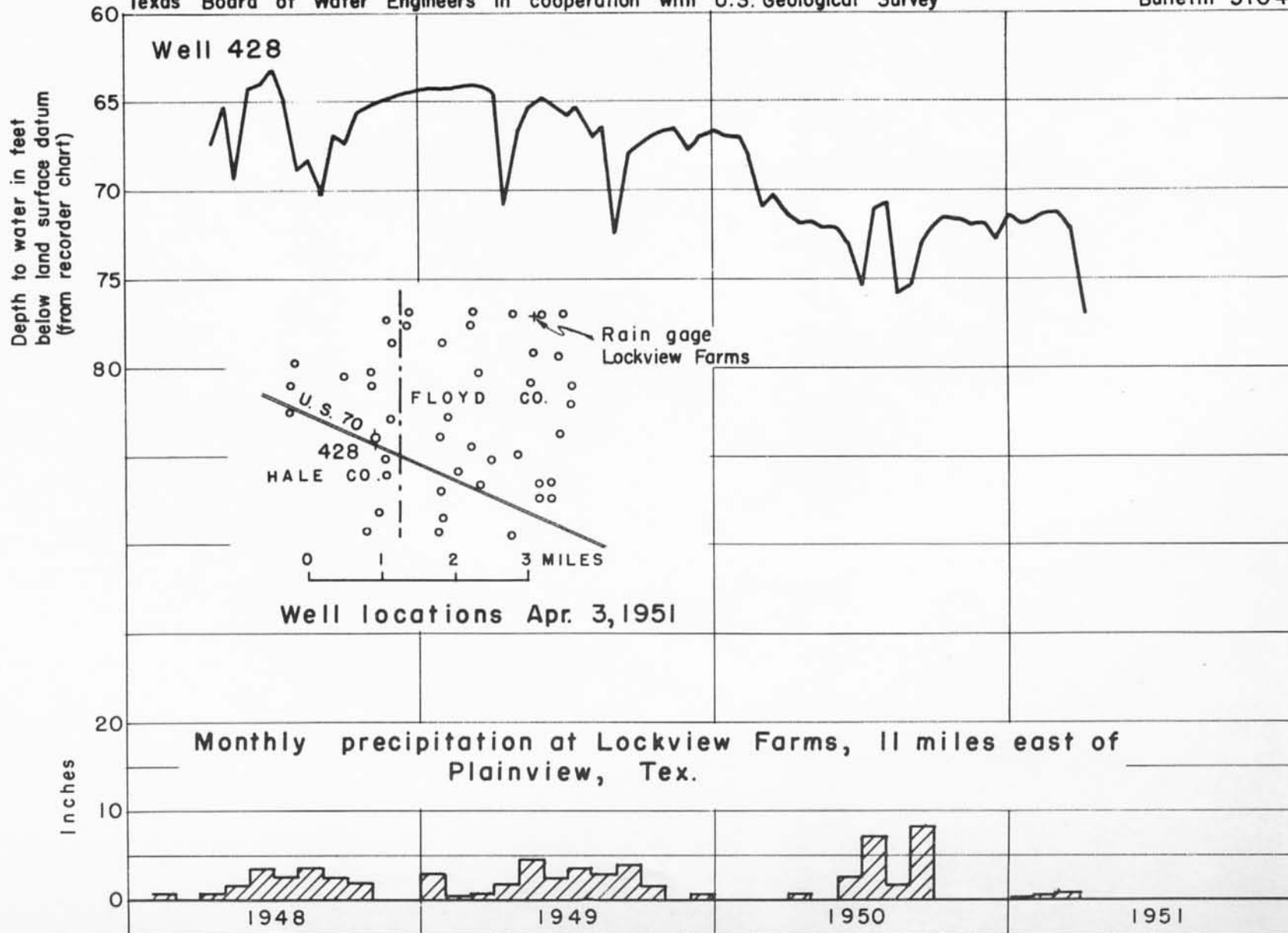


FIGURE 5. - Hydrograph for unused observation well 428 and monthly precipitation, 1948-51, Lockview Farms.

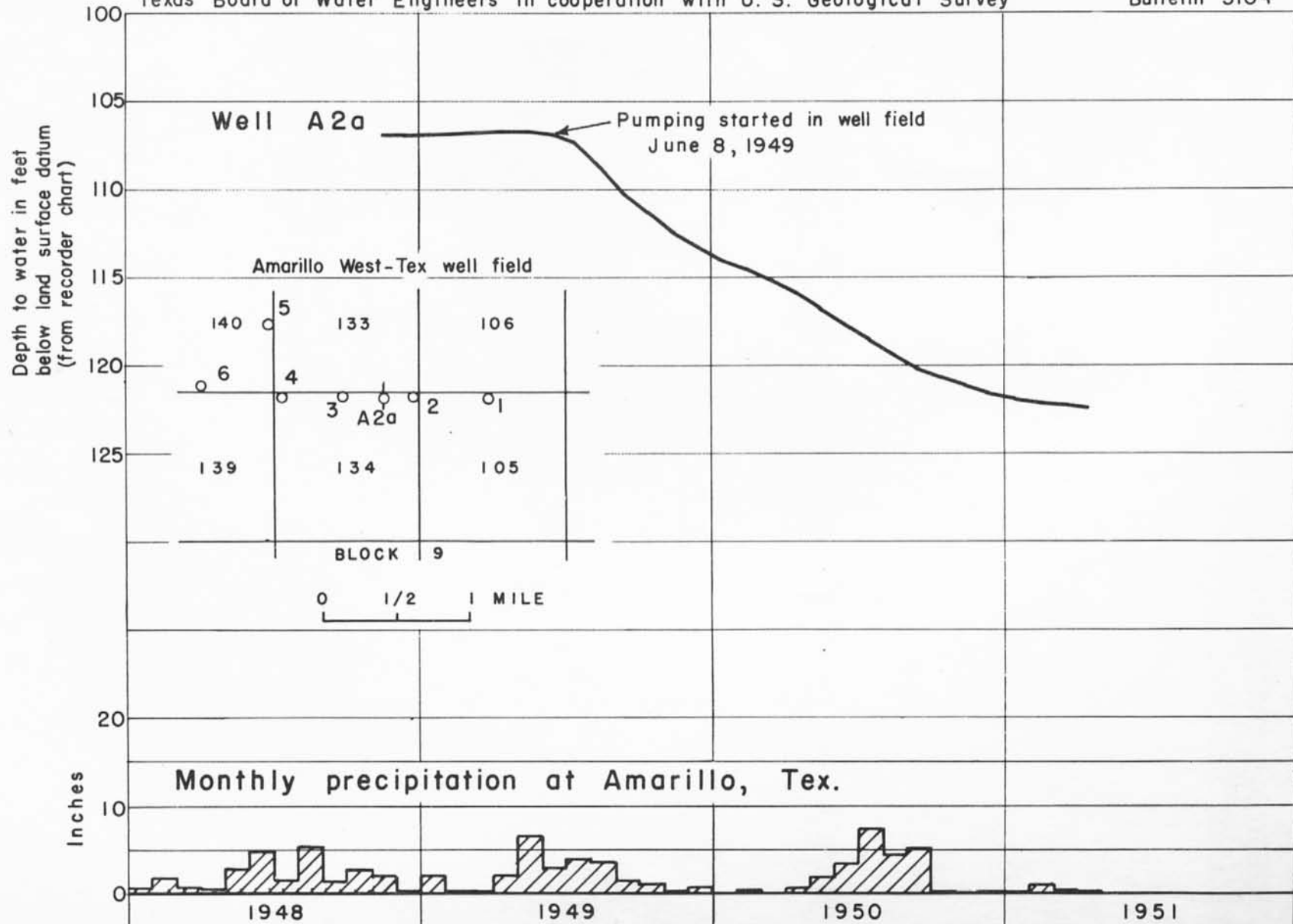


FIGURE 6. - Hydrograph for unused observation well A2a and monthly precipitation, 1948-51, Amarillo, Tex.



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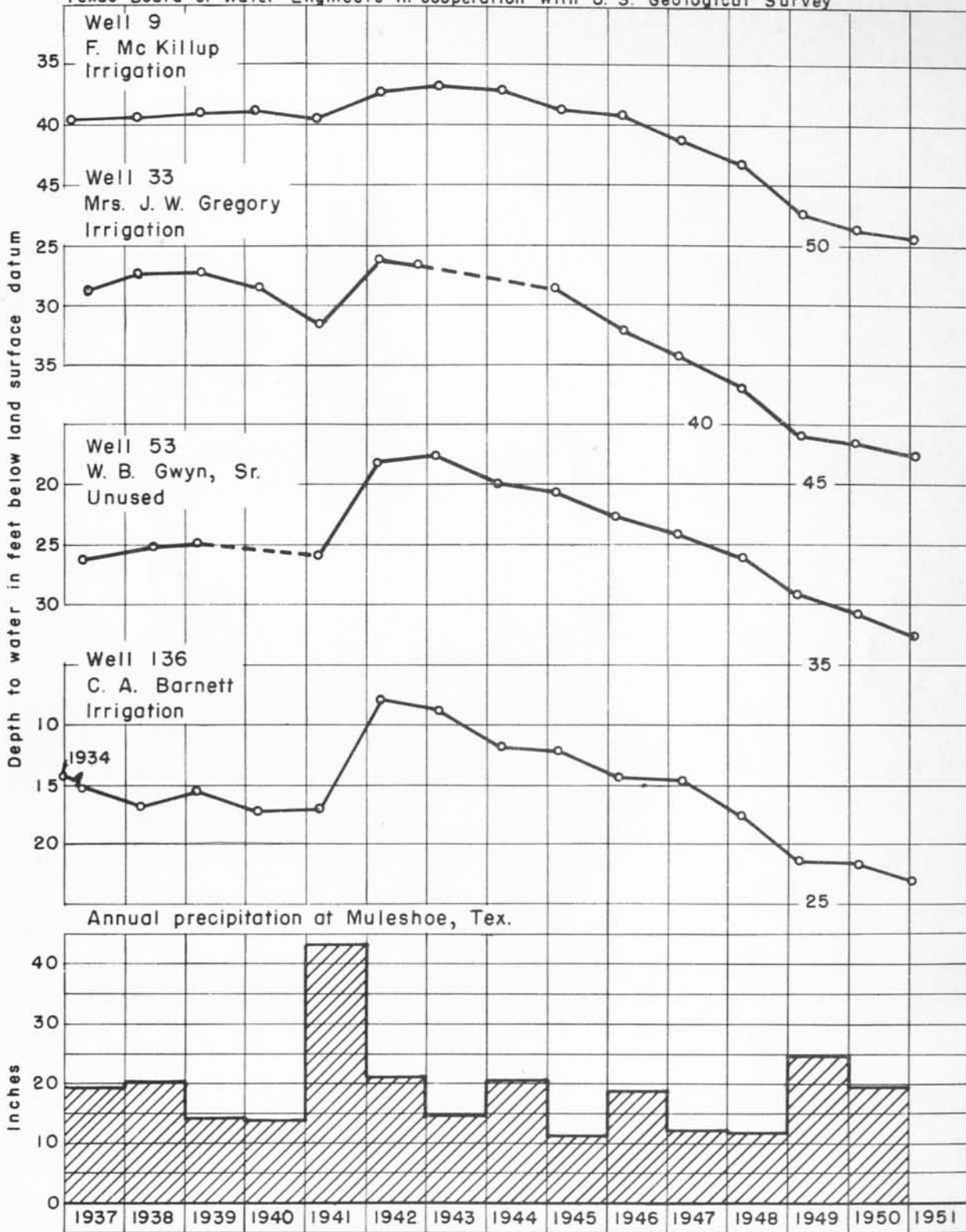


FIGURE 7.- Hydrographs of observation wells in Bailey County and annual precipitation at Muleshoe, Tex., 1937-51.

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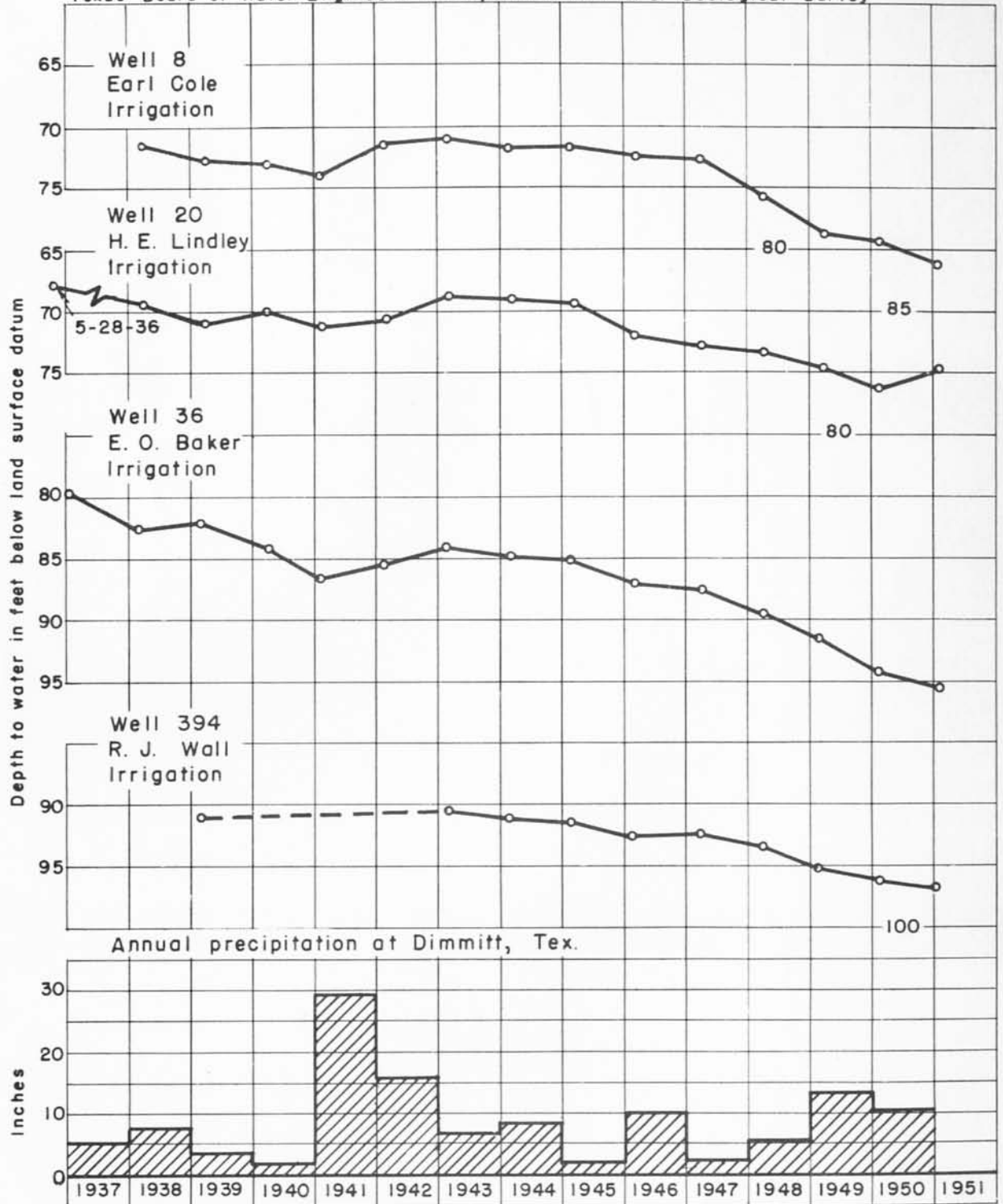


FIGURE 8.- Hydrographs of observation wells in Castro County and annual precipitation at Dimmitt, Tex., 1937-51.

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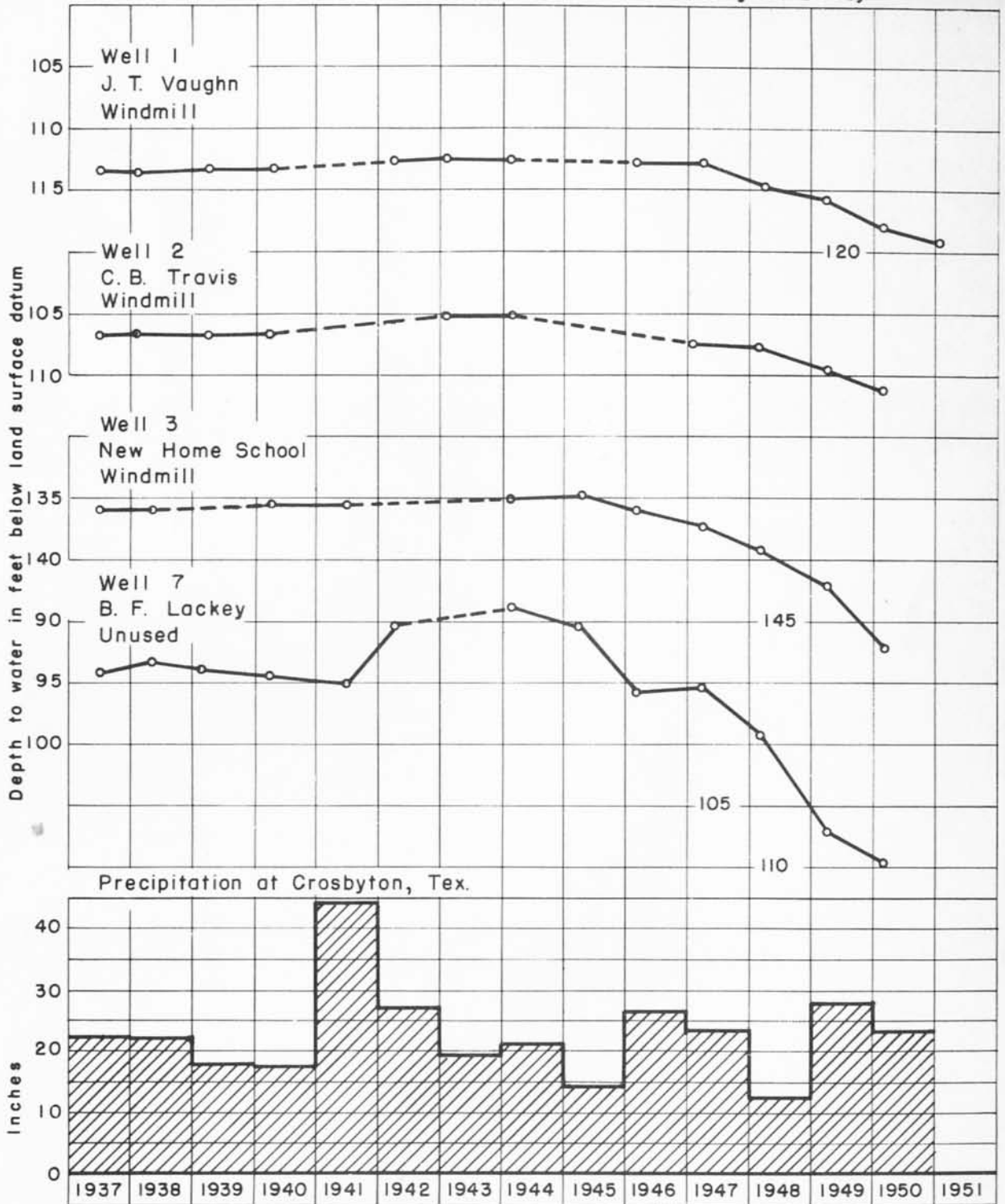


FIGURE 9.- Hydrographs of observation wells in Crosby County and annual precipitation at Crosbyton, Tex., 1937-51.

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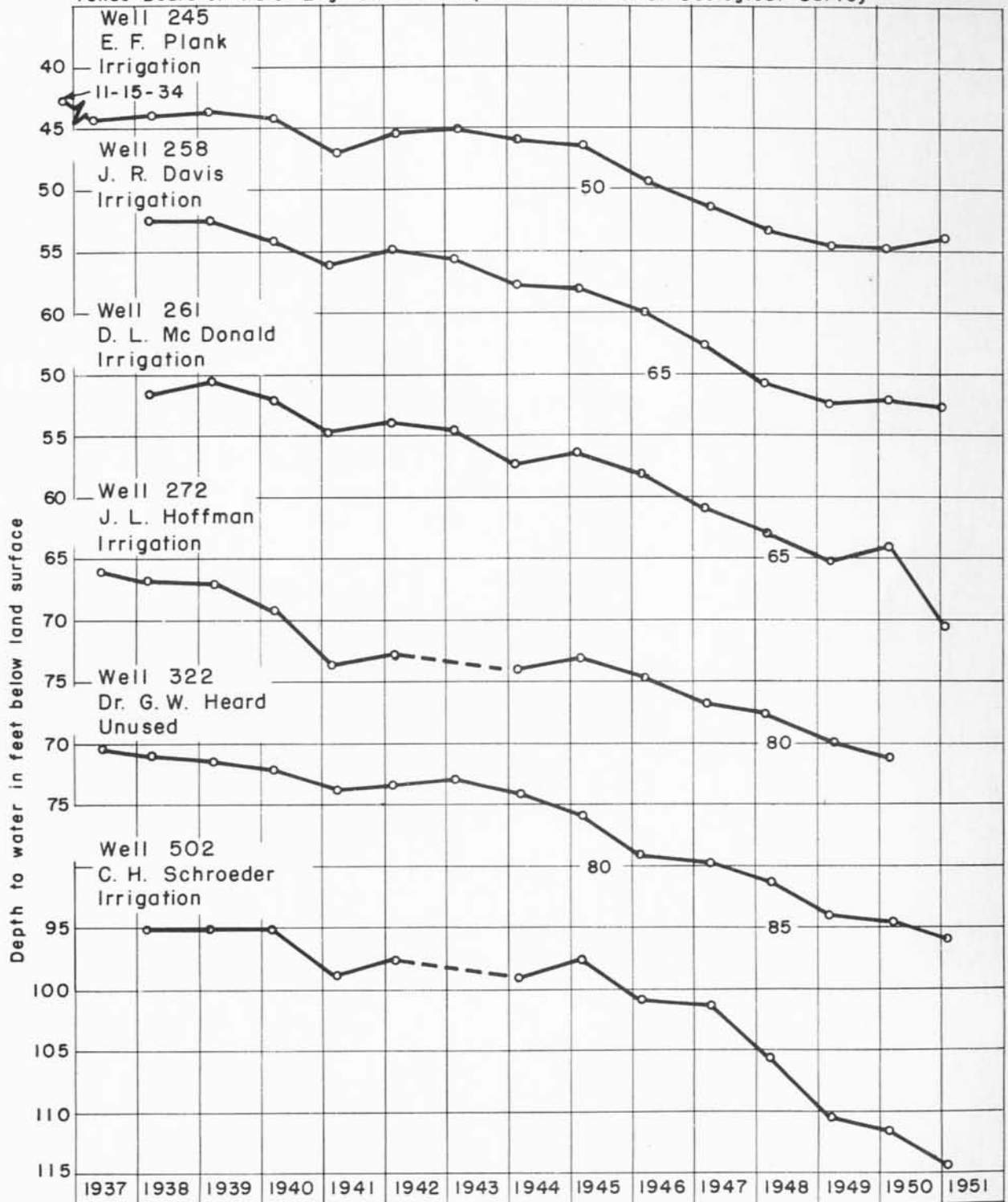


FIGURE 10.- Hydrographs of observation wells in Deaf Smith County, Tex., 1937-51.

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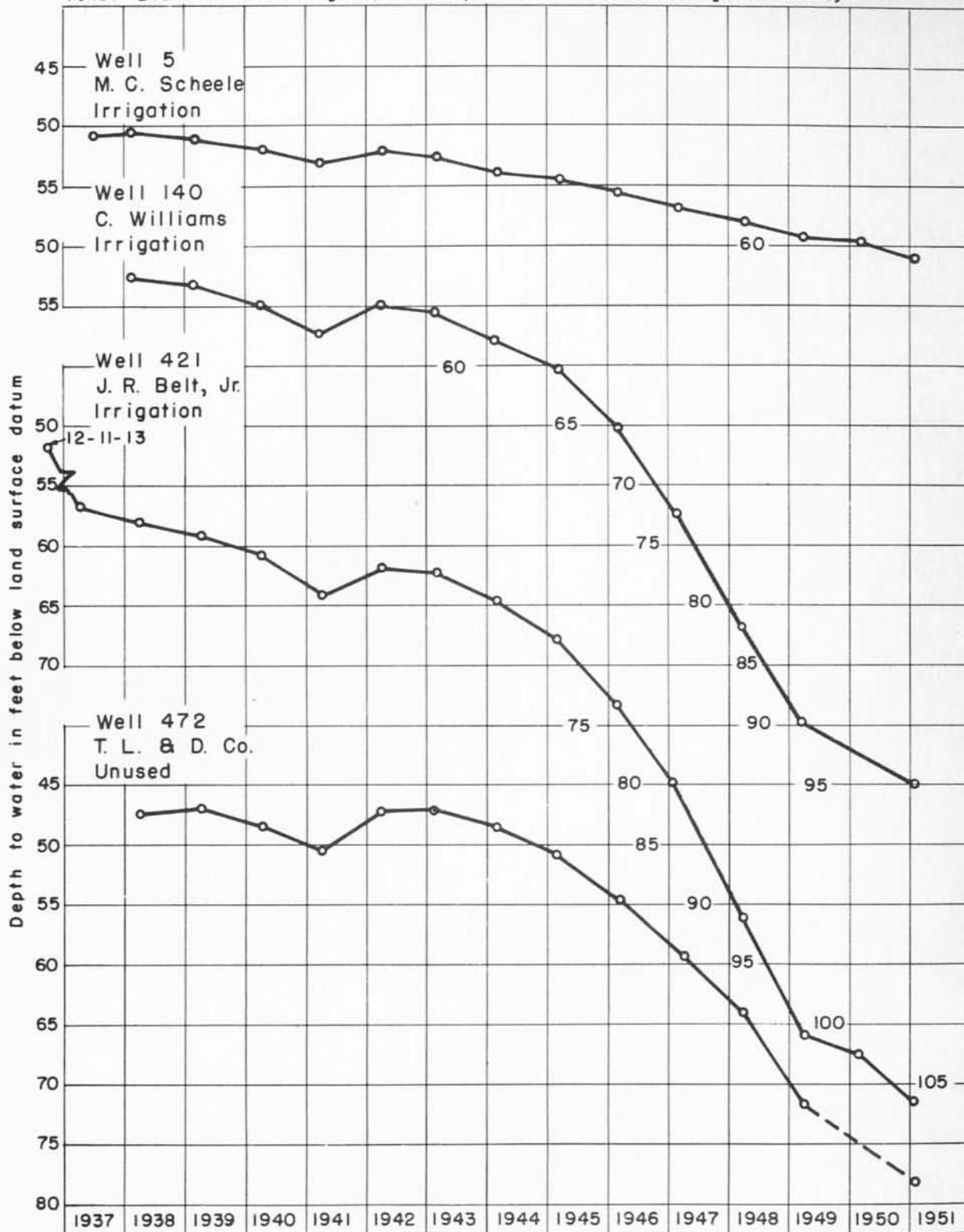


FIGURE II.- Hydrographs of observation wells in Floyd County, Tex., 1937-51.

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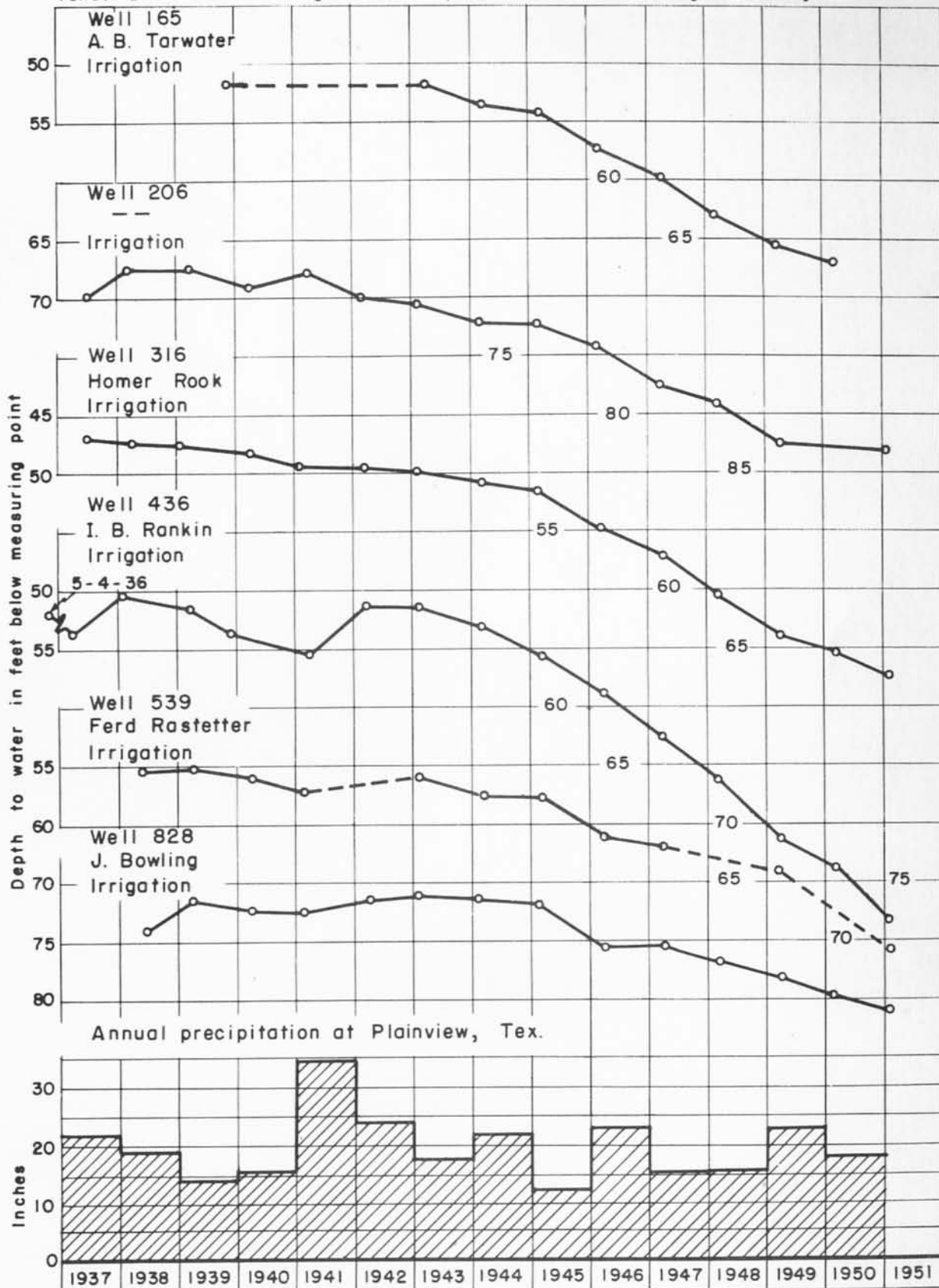


FIGURE 12.- Hydrographs of observation wells in Hale County and annual precipitation at Plainview, Tex., 1937-51.

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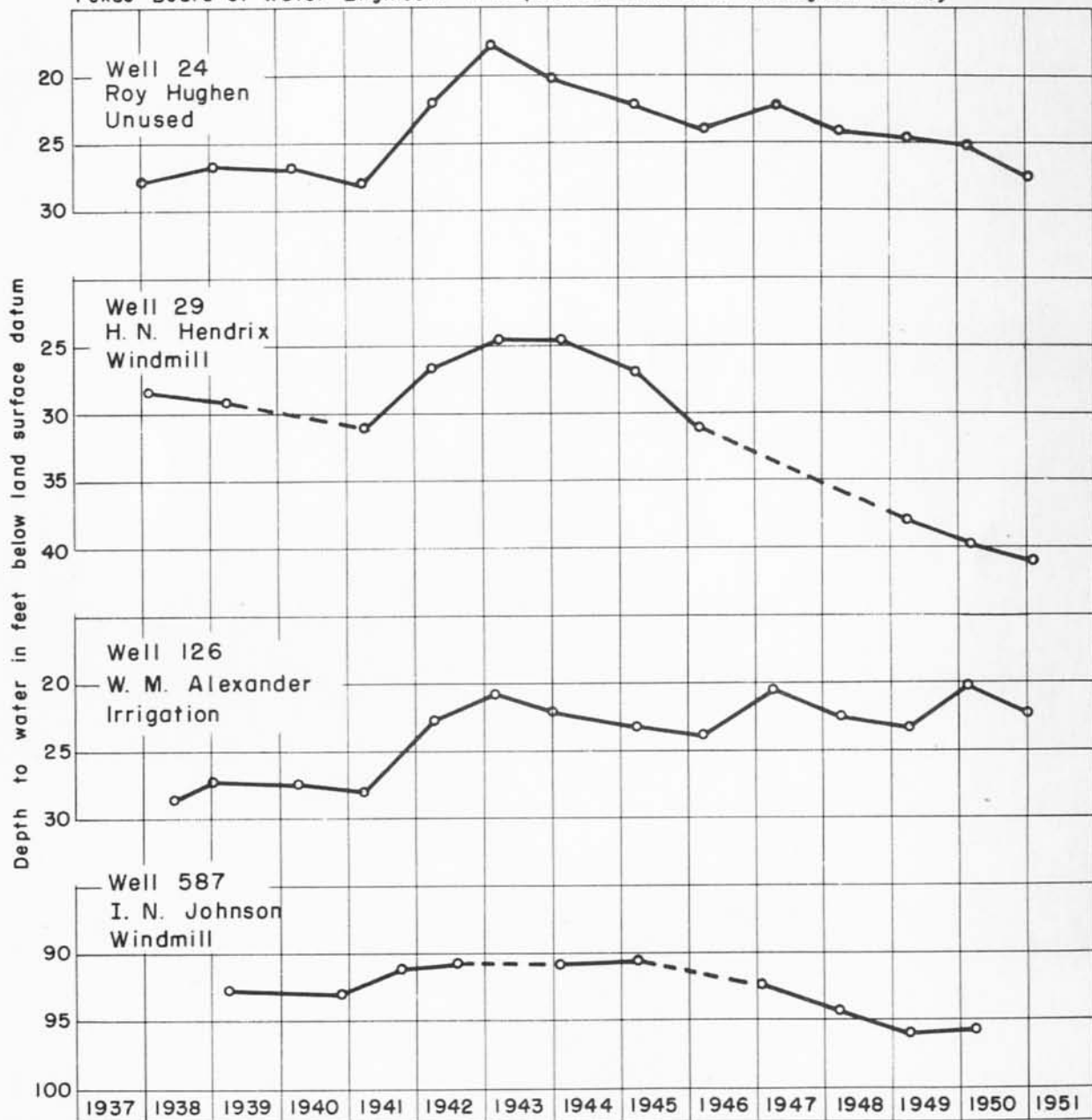


FIGURE 13.- Hydrographs of observation wells in Hockley County, Tex., 1937 - 51.

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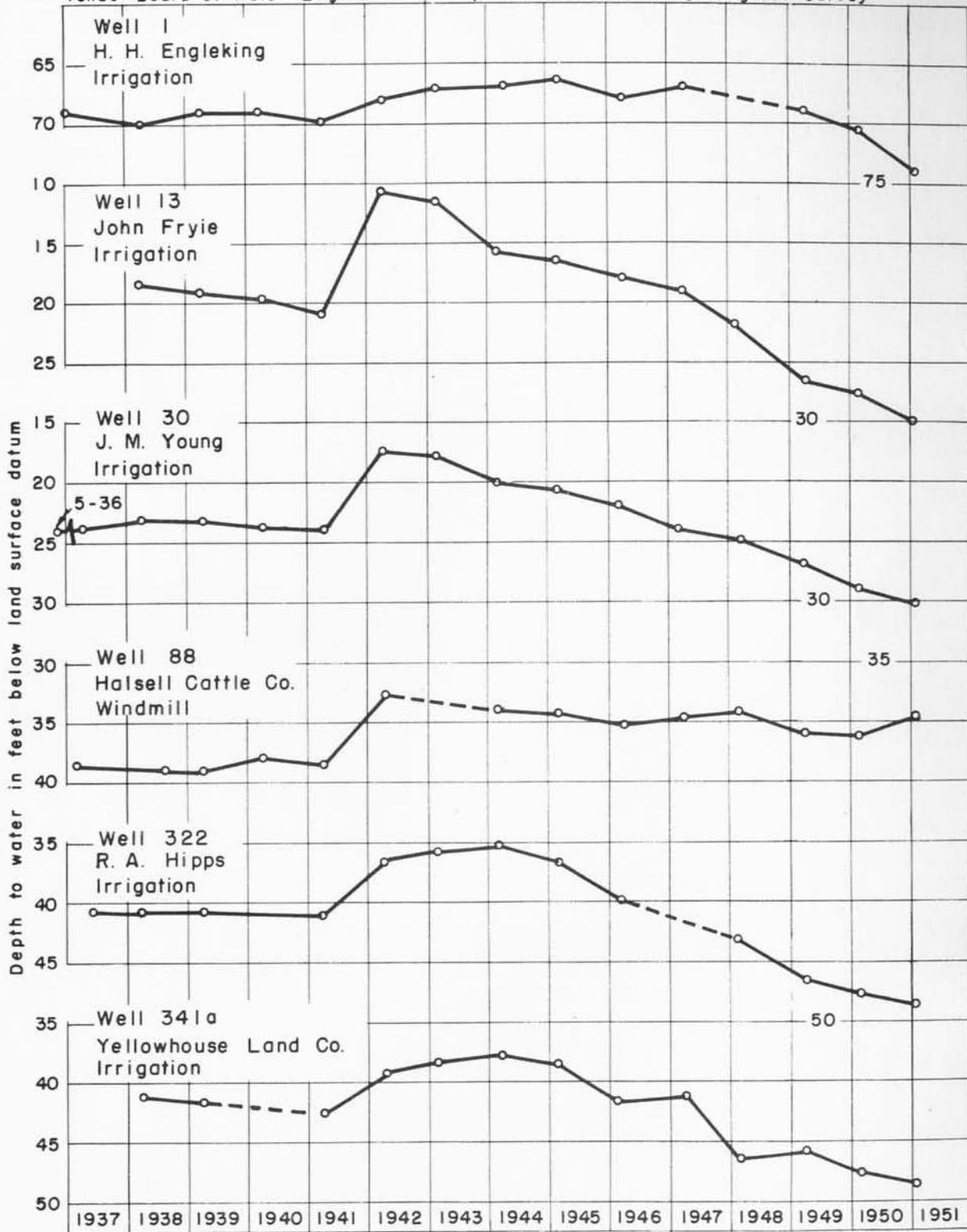


FIGURE 14.- Hydrographs of observation wells in Lamb County, Tex., 1937-51.



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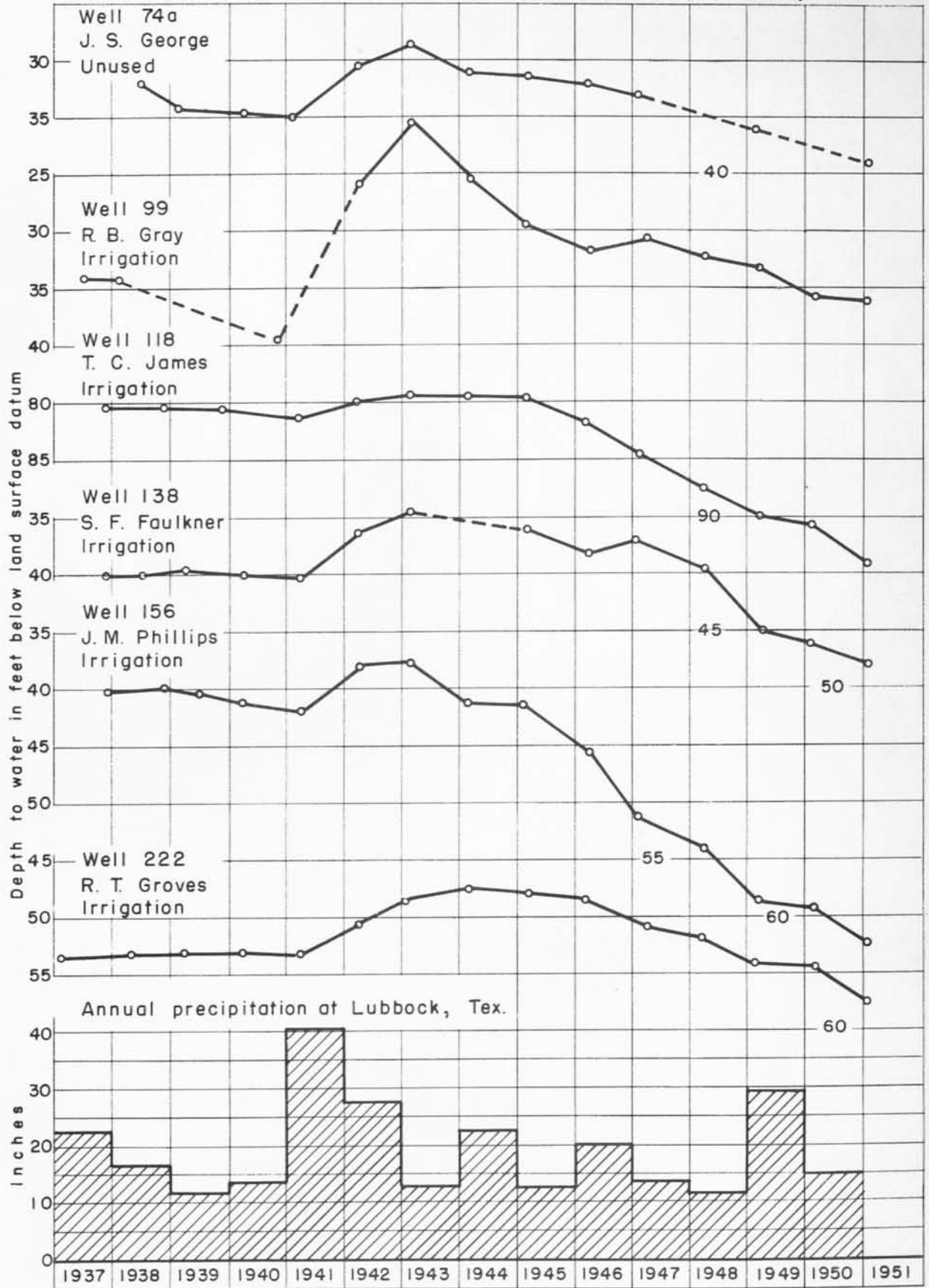


FIGURE 15.- Hydrographs of observation wells in Lubbock County and annual precipitation at Lubbock, Tex., 1937-51.

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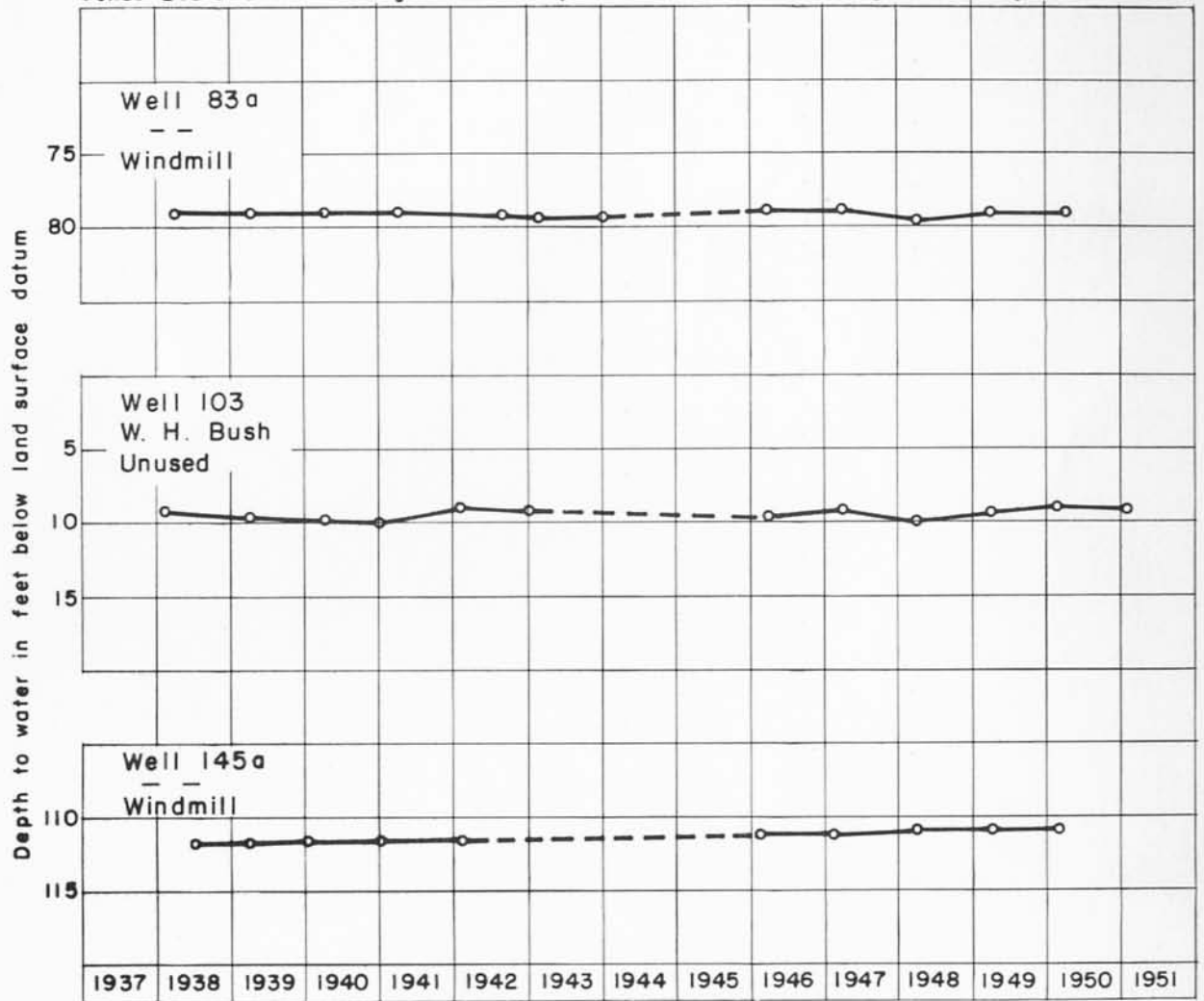


FIGURE 16.- Hydrographs of observation wells in Randall County, Tex., 1937-51.

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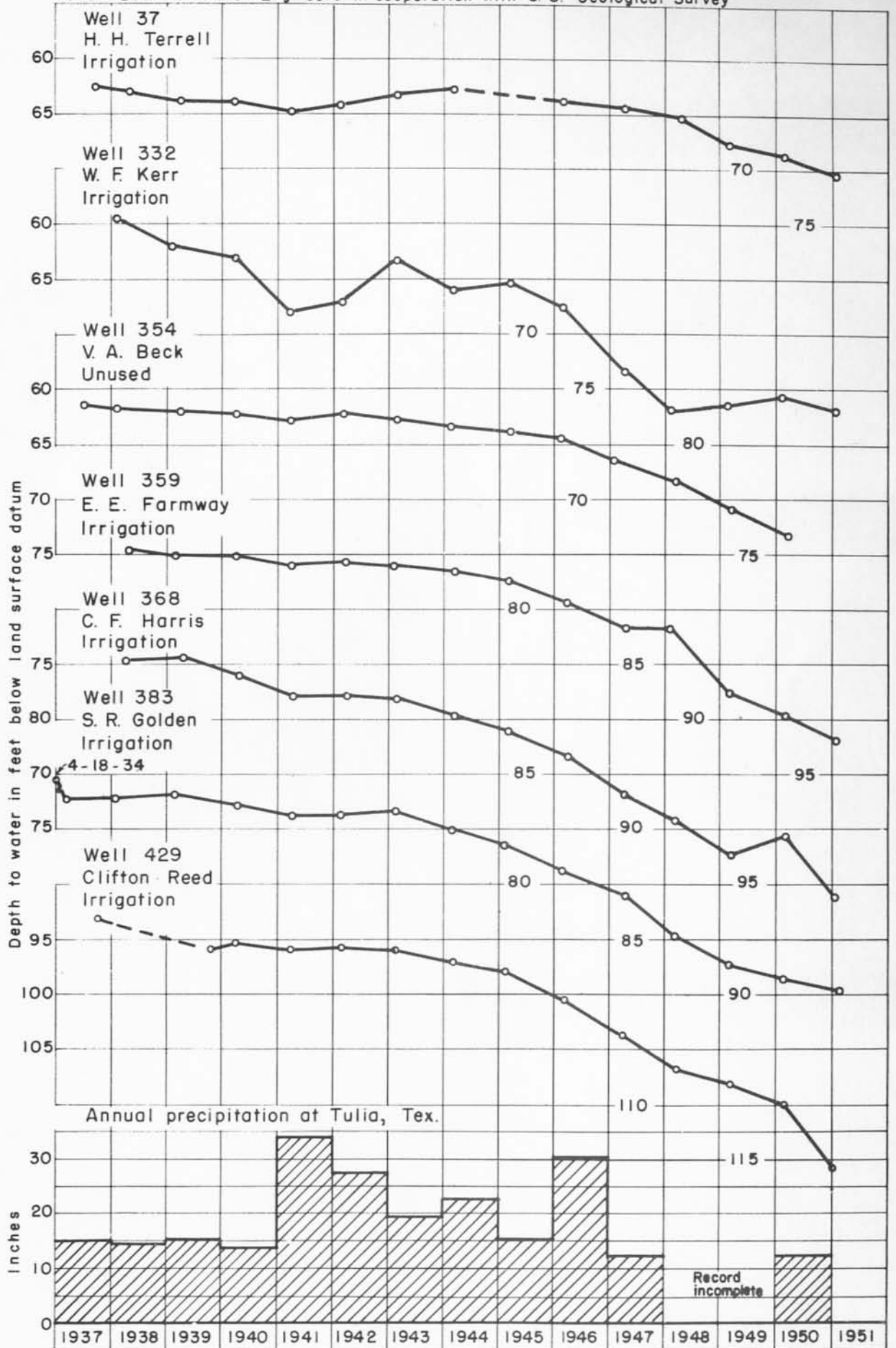


FIGURE 17.- Hydrographs of observation wells in Swisher County and annual precipitation at Tulia, Tex., 1937-51.

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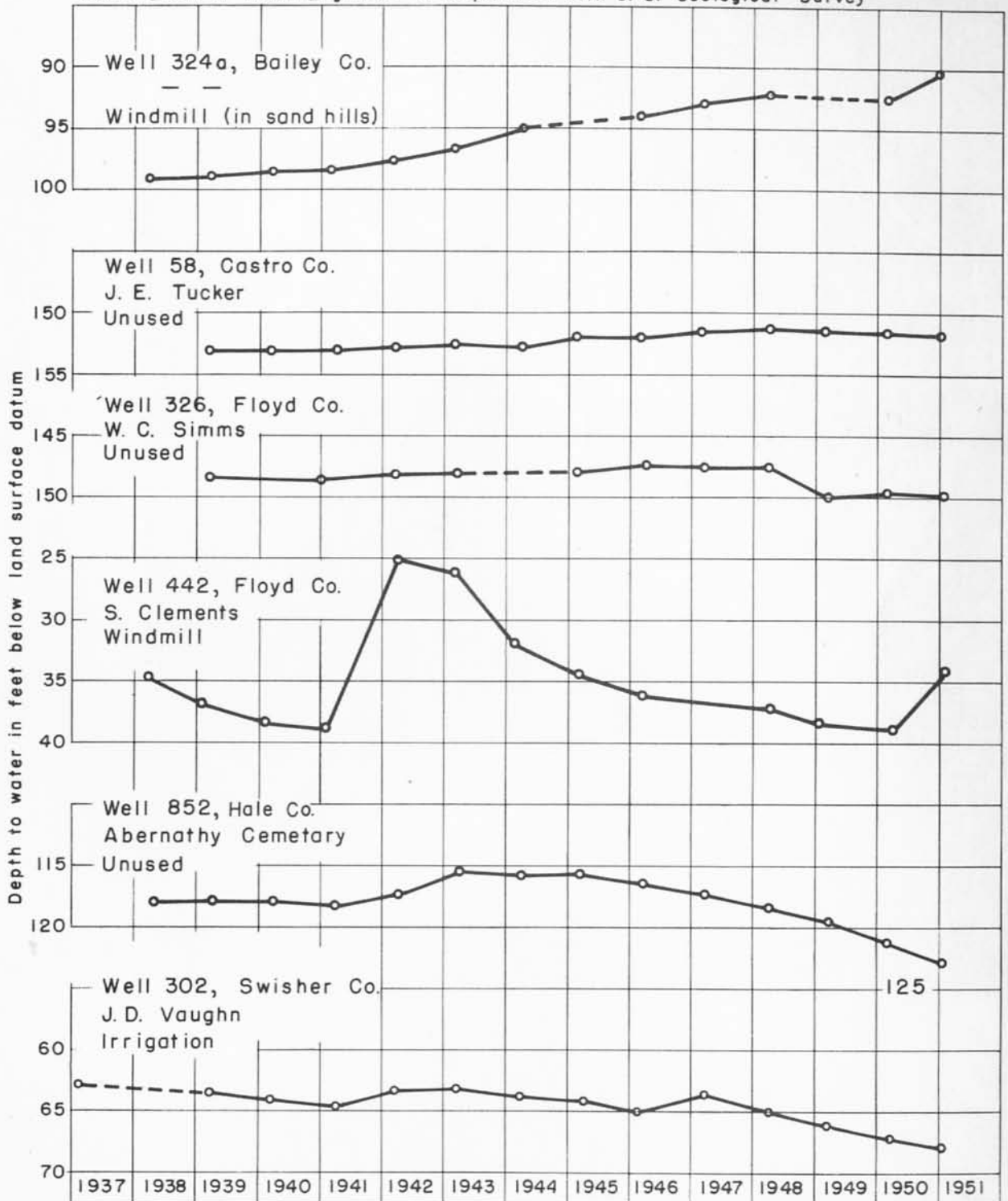


FIGURE 18.- Hydrographs of observation wells remote from area of heavy pumping, 1937-51.