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# THE IRRIGATION FRONTIER ON THE TEXAS HIGH PLAINS: 1910-1960

A DISSERTATION

SUBMITTED TO THE GRADUATE FACULTY

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THE IRRIGATION FRONTIER ON THE TEXAS HIGH PLAINS:

1910-1960

APPROVED BY

DISSERTATION COMMITTEE

## PREFACE

The author is grateful to many individuals who were kind enough to furnish valuable assistance in my research and writing.

The personnel of several archival collections were extremely helpful. Jack Haley of the Division of Manuscripts and Mrs. Alice Timmons of the Phillips Collection, both of the University of Oklahoma, opened their facilities to this researcher. Mrs. Faye Bell Crain pointed me to several useful collections and works in the Panhandle-Plains Historical Museum at Canyon, Texas. Without the excellent help furnished by R. Sylvan Dunn, David B. Gracy, II, and Jimmy R. Skaggs of the Southwest Collection, Texas Technological College, research for this work would have been far more difficult.

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Many persons also furnished valuable aid in making available private and company files, in supplying rare photographs, and in sharing technological knowledge with me. Among them were: John and Bill McDonald, McDonald Drilling Company, Amarillo, Texas; Jerry Thomas and George Seay, Layne and Bowler Pump Company, Memphis, Tennessee; Miss Winnie Karrh, Bill Carter, Wendell Green and other members of the Green family associated with the concern of Green Machinery Company, Plainview, Texas; Roland I. Cross, Agricultural Agent for the Santa Fe Railroad, Amarillo, Texas; Mrs. Mary Louise Loyd of the Bivins Memorial Library, Amarillo, Texas; and Mrs. Tom Suits, Petersburg, Texas.

In addition, I must acknowledge my gratitude to several others who share my interest in the history of irrigation. The staff of the new Irrigation Age, including Publisher Palmer Norton, Editor John Mette, and Business Manager Hoyt E. West, called my attention to certain materials and individuals long associated with irrigation on the Texas High Plains. Garry Nall of West Texas State University uncovered and made available to me helpful materials during the course of his own research on agricultural history of the Texas Panhandle. David B. Gracy, II, archivist of the Southwest Collection at Texas Technological College, not only shared with me knowledge of primary source materials relating to the early twentieth century history of the Texas High Plains, but also put at

my disposal the Littlefield Lands Company Papers in his private possession.

Finally, I an indebted to the members of my dissertation committee, Dr. Donald J. Berthrong, Dr. Arrell M. Gibson, Dr. Richard S. Wells and Dr. Jonathan W. Spurgeon, for their suggestions. I am especially grateful to Dr. Gilbert C. Fite, chairman of my committee, whose encouragement, criticism and patience have been invaluable.

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INTRODUCTION

Walter Prescott Webb, in his classic, The Great Plains, relates a humorous anecdote which illustrates the historical economic quandary of the region. A new settler observed of the Plains: "This would be a fine country if we just had water." A farmer who was retreating from the area in his eastward-bound wagon responded: "Yes, so would hell."[1] Water has been the most important natural resource of the American West. Inhabitants of the arid and mountainous West ultimately harnessed their great rivers to supply irrigation water for their parched lands. But the Great Plainsman's "search for water," as Webb has referred to the quest, required water resources other than mighty surface streams. With the exception of the Arkansas, the Platte, and the upper Missouri, the Plains had no great rivers. And even the waters of those streams were, for the most part, appropriated by irrigators near the mountains of their origin leaving little irrigation water for their eastern neighbors.

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[1]Walter Prescott Webb, The Great Plains (New York: Grosset and Dunlap, 1931), p. 320.

The scarcity of surface water which has so marked the Great Plains is even more characteristic of its subdivision--the Texas High Plains. Spaniards referred to this region which stretches into eastern New Mexico as the Llano Estacado and early travelers avoided the plateau because of the almost total absence of streams flowing across its surface. Consequently, settlers were forced to use pump technology to tap the vast ground water resources beneath its flat surface.

The evolution from windmills which could deliver a few hundred gallons of water per day for livestock and human consumption to the modern high speed irrigation pump capable of spewing out 600 to 1000 gallons or more per minute took place over approximately half a century. Spurred on by periodic drouths and made possible by technological developments in pumps, power sources and well-drilling techniques, irrigation gradually emerged as economic conditions and the appearance of cash crops suitable to the unstable climate of the High Plains appeared on the scene. Moreover, national developments at one time contributed to retarding irrigation, but during a later period important factors on the national scene significantly aided the movement.

Irrigation development on the Texas High Plains may be divided into two phases. In the first phase, during the period 1910-1920, large-scale pump irrigation plants first appeared in the region primarily through the efforts of urban speculators. But due to national and regional circumstances the movement was abortive. The second phase began about 1934 and continued into the 1960's, aided by a complex of favorable conditions.

The irrigation frontier of the High Plains resembled the mining frontier of the American West in at least two ways. First, like the miners' frontier which began in the West and worked its way back toward the East, the High Plains irrigation frontier adapted pump irrigation from its western neighbor, New Mexico. Second, and more important, High Plainsmen looked upon ground water as a resource to be exploited rather than to be conserved. Like the westerner who viewed gold and silver as mineral commodities to be taken from the earth rather than to be replaced, the plainsman was primarily concerned with extracting his liquid wealth.

The conscience of the plains irrigator was somewhat eased in his refusal to adhere to water conservation by a myth which had long been present among High Plainsmen--the myth of the "inexhaustible supply" of ground water. Henry Nash Smith pointed out in his <u>Virgin Land</u> that when settlers began moving into the Great Plains after the Civil War, the myth of the Great American Desert was supplanted by the "myth of the garden," a belief that the climate of the region was becoming more humid.[2] High Plainsmen in the twentieth century discarded the "myth of the garden" and embraced the myth of the "inexhaustible supply," a belief that ground water in the High Plains flowed underground from distant sources and could not be exhausted by massive irrigation pumping. Consequently, local interests became concerned with conservation only when a significant decline in ground water levels began to occur in the late 1940's.

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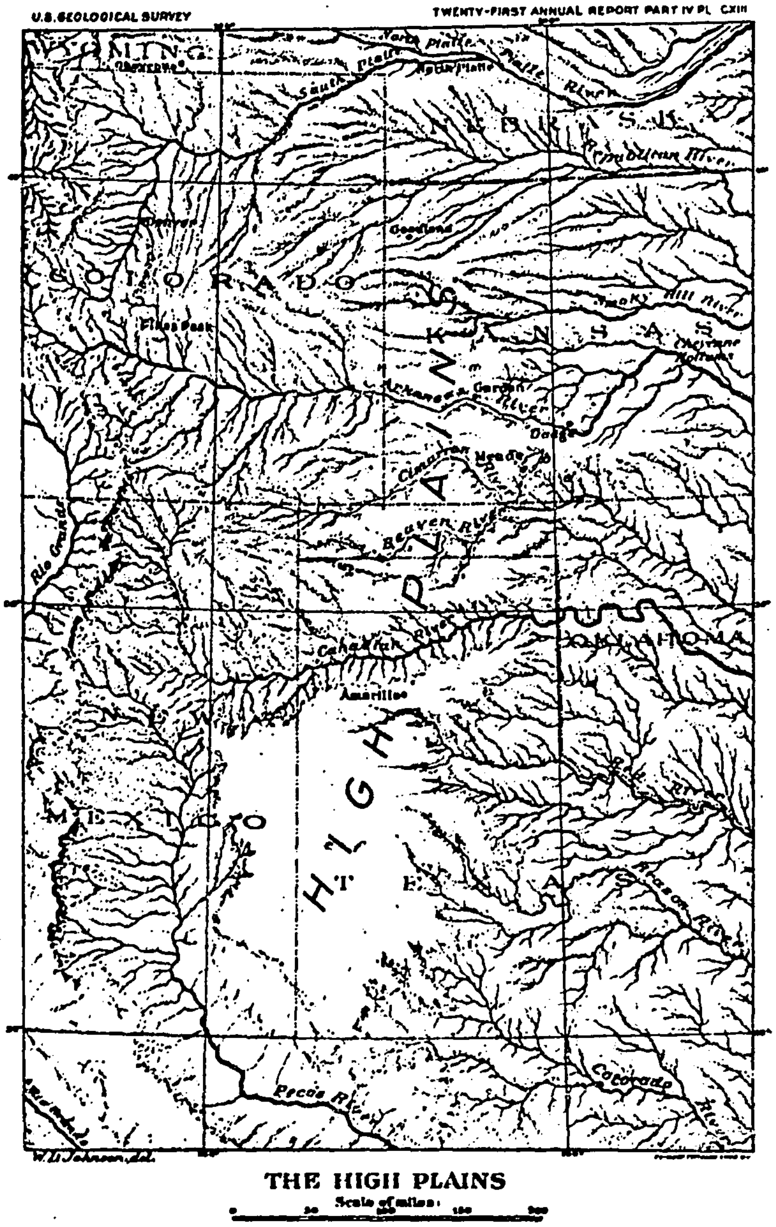
[2]Henry Nash Smith, Virgin Land: The American West as Symbol and Myth (Cambridge: Harvard University, 1950), pp. 174-83.




THE HIGH PLAINS

THE HIGH PLAINS SUBDIVISION OF THE GREAT PLAINS

From: W. D. Johnson, "The High Plains and their Utilization," United States Geological Survey Twenty-first Annual Report.

THE IRRIGATION FRONTIER ON THE TEXAS HIGH PLAINS:

1910-1960

# CHAPTER I

## THE BARRIER TO SETTLEMENT

Upon viewing the Texas High Plains for the first time, one observer in the early 1880's responded: "What a clean stretch of land! Why I could start a plowpoint into the soil at the south line and turn a furrow two hundred miles long without a break. . . ."[1] During years of sufficient rainfall, one could stand on a slight rise of land in the spring and see thousands of acres of lush green buffalo grass covering the dark rich sod stretching out in all directions. The absence of stone, trees and eroded soil must have appeared to many during such years as a farmer's paradise. But settlers did not rush into the area.

The High Plains region itself presented as difficult an obstacle to settlement as the imposing escarpment which separates it from streams and rolling landscape

[1] J. Evetts Haley, The XIT Ranch of Texas and the Early Days of the Llano Estacado (Norman: University of Oklahoma, 1953), p. 204.

along much of its eastern edge. Comanche Indians did not present the only obstacle to settlement. Even after buffalo hunters had deprived the Indian of his means of subsistence, and the blue-coated soldiers had wrested his land from him, there would be no land-rush into the region for another quarter of a century. Perhaps more important than the Indian "barrier" was the geographic barrier itself. The scarcity of water, the semiarid nature of the area, and the almost total absence of wood on the flat-surfaced High Plains were more serious obstacles to the western movement of American farmers.

It is significant that the first settlers who moved into the region did not settle on the plains.[2] Numerous canyons formed from the headwaters of such important Texas rivers as the Brazos, the Red, and the Colorado, are carved into the eastern escarpment. In addition, the Canadian River cuts a wide, jagged valley through the northern Texas High Plains. Stands of cottonwood and cedar grew along the edges of the streams, and water, although somewhat brackish, was sufficient for watering stock and for human consumption. The first trickle of settlers built homes along these streams. Mexican sheepmen led by Casimero Romero drifted down the

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[2]This observation was made by George Tyng, an official of the White Deer Lands Company in 1889. Quoted in Lester Fields Sheffy, The Francklyn Land and Cattle Company: A Panhandle Enterprise, 1882-1957 (Austin: University of Texas, 1963), pp. 292-93.

Canadian River from New Mexico Territory as early as 1876 and established a village in the valley of the Canadian which became known as Tascosa.[3] That same year Charles Goodnight drove a herd of cattle up the Prairie Dog Fork of the Red River into Palo Duro Canyon.[4] Mobeetie, reported to be the first permanent settlement in the Panhandle, was established in 1875 on Sweetwater Creek in Wheeler County. And in 1878, a group of Methodists founded a religious colony at Clarendon on the Salt Fork of Red River.[5] The first settler into the "South Plains" region, the southern part of the Texas High Plains, was H. C. "Hank" Smith who established a ranch in Blanco Canyon along the banks of the White River, an upper fork of the Brazos.[6]

The fear of the plains shared by early inhabitants is illustrated by the problem faced by Arthur B. Duncan. Arriving in upper Blanco Canyon in June, 1884, Duncan expected to file on school land in the canyon. But upon his

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[3]José Ynoncio Romero, "Spanish Sheepmen on the Canadian at Old Tascosa," as told to Ernest R. Archambeau, Panhandle-Plains Historical Review, XIX (1946), 46-47.

[4]Haley, The XIT Ranch of Texas, p. 40.

[5]Rupert N. Richardson, Texas, the Lone Star State (2d ed.; Englewood Cliffs, New Jersey: Prentice-Hall, 1958), p. 297. J. D. Tinsley, "Agricultural Development of the Texas Panhandle," Panhandle-Plains Historical Review, VIII (1935), 56.

[6]Roger A. Burgess, "Pioneer Quaker Farmers of the South Plains," Panhandle-Plains Historical Review, I (1928), 116.

arrival he learned that the lands had already been leased to cattlemen. Rather than "file and settle on a dry section" on the plains, he chose a 160-acre "watered homestead claim" in the Canyon which had not been leased.[7]

During the 1880's cattlemen continued to dominate the region. And although their vast herds of livestock grazed upon the High Plains, the ranchers, who came to the region in the 1870's and early 1880's, usually built their "headquarters" below the Cap Rock. For example, the LX Ranch, north of the present site of Amarillo, had its headquarters on Pitcher Creek. George W. Littlefield turned a herd of several thousand cattle loose and constructed his buildings and corrals on the Canadian a few miles from Tascosa. Other ranches located along the Canadian east of Tascosa were those belonging to Hank W. Cresswell and Robert Moody. Farther south, L. G. Coleman established his ranch in the Tule Canyon. For several years, the only ranch west of Goodnight was that of Leigh Dyer who built a log cabin in the extreme upper end of the Palo Duro.[8]

It was not until the middle 1880's that cattlemen began to push their herds farther west upon the High Plains with its few running streams. This expansion was

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[7]Claude V. Hall, "The Early History of Floyd County," Panhandle-Plains Historical Review, XX (1947), 69-70.

[8]Haley, The XIT Ranch of Texas, pp. 40-43.

made possible by the erection of windmills over wells, and the construction of "tanks," ponds of rainwater formed by small earthen dams. In 1887 the vast XIT Ranch, which stretched across a large area of the western High Plains, began drilling wells. Two small artesian wells were drilled in Yellow House Canyon. And several wells were dug by hand on the south range. Before windmills were installed, horses supplied the power for an endless chain-bucket pump used on several of the wells.[9] In 1882, B. B. Groom began drilling wells and constructing "tanks" on lands of the Francklyn Land and Cattle Company located between the Canadian and the Palo Duro.[10]

Farmers began to settle in the Panhandle first in the area east of the High Plains along small streams and on uplands between the streams in Childress, Wheeler, Collingsworth, Donley and Hall counties. But a spearhead of the farmers' frontier pierced the High Plains as early as 1878 when a Quaker named Paris Cox, acting as treasurer for a group of his brethren from Indiana, bought some fifty thousand acres of land in Crosby County for twenty-five cents an acre. Cox paid "Hank" Smith $400 to dig a well on the land, and the next year four Quaker families formed the colony of Estacado on the flat,

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[9] Ibid., pp. 89-96.

[10] Sheffy, The Francklyn Land and Cattle Company, pp. 50-54.

wind-swept High Plains. In 1880, after the first winter, three families returned to Indiana, leaving only Cox, his family, and one hired hand. That spring the hardy Quaker planted a variety of crops. A physician who visited Cox's farm in the late summer of 1880 later recalled: "The first crops ever planted on the Staked Plains were then growing. I saw--corn, oats, millet, sorghum, melons, Irish potatoes, (fair) sweet potatoes, and garden vegetables--all did well."[11] The successful crop encouraged a number of Cox's brethren to join him. By 1882, ten families were living in the colony. That year the settlers organized a town which was first called Marietta but then changed to Estacado in 1886. By 1888, there were twenty-three farms containing twelve hundred acres around Estacado.[12] In 1890 the Quaker colony contained a population of 200.[13]

Other farmers, encouraged by the more liberal Texas land law of 1883 which tended to favor the farmer more than the cattleman, began moving into the region in greater numbers after the Santa Fe and the Fort Worth and Denver City railroads broke the isolation of the

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[11]Reprinted in Texas Almanac (1883), p. 117. Quoted in Burgess, "Pioneer Quaker Farmers of the South Plains," 118-19.

[12]Ibid., p. 121.

[13]Burgess, "Pioneer Quaker Farmers of the South Plains," 119.

region in 1887 and 1888, respectively.[14] The editor of the Tascosa Pioneer noted in the late spring of 1888: "Wagons and wagons with white tops, rope-bottomed chairs, tow-heads, brindle cows, yellow dogs and a pervading air of restlessness have poured through this week in the direction suggested by Horace Greeley."[15]

Another indication of increased migration was the number of new towns which appeared on the High Plains during the late 1880's and early 1890's. Amarillo was established in 1887, and quickly became the most populous town. Plainview appeared that same year. In neighboring Floyd County, Lockney was organized in 1889 and Floydada sprang up the next year. Farther south, Lubbock was established in 1891. By the end of the 1890's, Canyon City, Hereford, and many other towns, some ephemeral and some permanent, had appeared in the region.[16]

By 1886 the winds of change began to sweep across the Great Plains. Blistering Southwesterly winds swept

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[14]Haley, The XIT Ranch of Texas, p. 204. The land law of July, 1883, raised the minimum price for school lands from one dollar to two or three dollars per acre depending upon the locality, and required that lands be sold by public auction in local land districts. Liberal credit was also provided. In addition, the minimum price of public lands leased by cattlemen was also raised. Richardson, Texas, the Lone Star State, pp. 298-99.

[15]The Tascosa Pioneer, June 9, 1888. Quoted in Haley, The XIT Ranch of Texas, p. 210.

[16]Sheffy, The Francklyn Land and Cattle Company, pp. 302-03. Jean Alexander Paul, "The Farmer's Frontier on the South Plains" (unpublished M.A. thesis, Texas Technological College, 1959), p. 121.

through West Texas signaling the beginning of a disastrous drouth which sucked the little remaining moisture from the soil and shriveled the native short-grass almost as soon as its spring shoots had pierced the earth's crust. Because of over-stocking the range, ranchers were forced to throw their herds on an already glutted market, forcing cattle prices to disastrous lows. Moreover, in 1886 and 1887 arctic blizzards left the rigid frozen corpses of thousands of cattle against fence rows.[17] By the late 1880's the cattleman, like the buffalo and the Indian who had preceded him, was vanishing from the plains.

Some far-sighted ranchers realized that the cattleman's frontier was coming to a close. For example, at a cowmen's meeting at Dallas in February, 1887, Colonel William E. Hughes, a prominent rancher and businessman, stated:

> The ranchman of the plains was not to be a permanence. He never so considered himself. His mission was to precede the agriculturist and stock farmers, and until a changed order to things should make agriculture profitable, or possible, it was his to establish and maintain . . . a valuable industry. He represented as it were, an era--an epoch--a step in social progress.[18]

To encourage the transition to the next "step in social progress"--the farm--some large ranches set up

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[17]Arrell M. Gibson, "Ranching on the Southern Great Plains," Journal of the West, VI (January, 1967), 149-50.

[18]Quoted in Sheffy, The Francklyn Land and Cattle Company, p. 259.

agricultural demonstration plots. As early as 1885 the XIT turned over the sod on a few acres and planted corn and millet. The success of the crops encouraged the ranch officials to put two hundred acres under cultivation in 1886. The acreage was planted in alfalfa, oats, and grain sorghums as well as corn and millet. At the State Fair in 1887, the ranch exhibited vegetables such as cabbages, onions, beets and even a few barrels of pickles, grown on a two-acre truck patch.[19]

The White Deer Lands Company, formerly the Francklyn Land and Cattle Company, prepared in 1888 to plat much of its land into farms in expectation of a mass movement of settlers into the region. One official wrote in early 1888: "It is the opinion of almost all who are acquainted with the land that it will be sold in small quantities to actual settlers rather than in bulk to speculators. The coming Spring [sic] will unquestionably bring to all of the Panhandle counties of Texas a heavy influx of settlers."[20] The Santa Fe Railroad, which crossed its lands just south of the Canadian River, cooperated with the company to bring in "land seekers." But so many prospective buyers decided not to buy after seeing the land, that one official, George Tyng, suggested

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[19]Haley, The XIT Ranch of Texas, pp. 207-08.

[20]Sheffy, The Francklyn Land and Cattle Company, p. 265.

the company put in a demonstration farm located close to the railroad and "in sight of all passers." Tyng noted that "land seekers . . . require palpable visible demonstration" of water and crops. Subsequently, in late 1888, the White Deer Lands Company put in an exhibition farm.[21]

In addition to encouragement by ranchers, earlier settlers and railroads, as well as that familiar frontier phenomena--the booster newspaper editor--attempted to attract more settlers. The Panhandle Immigration Convention met at Canadian in early 1888. The editor of the <u>Tascosa Pioneer</u> in an open letter to the convention stated:

> What we want is a development of productive possibilities . . . an attention to those twin industries of farming and live stock raising . . . which would give the Panhandle an unexampled prosperity . . . we want . . . to encourage . . . immigration, not of city people, not of professional men, for they can come afterwards, but our efforts should reach the populous rural districts of the states north and east, and we will get the population that we want.[22]

In addition, the Fort Worth and Denver City Railroad began a program to attract settlers. In the spring of 1888, the immigration agent for the railroad, R. A. Cameron, stated: "We propose to advertise extensively in the east and seek

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[21] <u>Ibid</u>., pp. 267-77.

[22] The <u>Tascosa Pioneer</u>, December 24, 1887. Quoted in Haley, <u>The XIT Ranch of Texas</u>, p. 209.

to settle our line by colonization."[23] And at least one newspaper editor encouraged immigration by classifying the Panhandle-High Plains as a veritable paradise. He wrote:

> Come to the Panhandle for cheap lands; come for rich and productive soil; come for health; come for seasonable summers and balmy winters; come and raise cereals, fruits, vegetables, sorghum, grains, grasses and forage; come and raise cattle, horses, mules, sheep, hogs, goats or poultry . . . come prepared to make your home with us and lands, openings and opportunities of one kind and another will not be wanting. For there is no longer such another country as the Panhandle awaiting development, and no such country destined to the same degree and rapidity of development.[24]

By the end of 1888 farmers were located in Randall, Deaf Smith, Potter, Parmer and other counties. Some large ranches began selling this land to farmers. The XIT by 1890 had platted farms out of more than 80,000 acres.[25] In 1888, Hale County had ten farms and over two hundred acres under cultivation. Crops were wheat, sorghum, prairie hay, millet, and a few vegetables. Crosby County reported twenty-three farms that same year with more than 550 acres. Among the crops were corn, oats, potatoes, sorghum, and millet.[26]

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[23]Quoted in Haley, The XIT Ranch of Texas, p. 208.

[24]Quoted in ibid., pp. 212-13.

[25]Haley, The XIT Ranch of Texas, pp. 210-11.

[26]Paul, "The Farmer's Frontier on the South Plains," p. 125.

Much of the early crop land was devoted to raising hay crops which farmers fed either to their own livestock, or sold to ranchers. Most of the 255 acres under cultivation in Floyd County in 1890 was planted to livestock feed. Feed crops also predominated in Hale, Crosby and other counties.[27] By 1890 there were about 6,900 people living in the High Plains.[28] Of this number only about 1,700 lived in the South Plains.[29] Hale County was the most populous, although it was certainly not crowded with 721 souls. Floyd and Crosby counties had 529 and 346, respectively.[30]

Many of this small number were whittled away in the drouth which began in the late 1880's and stretched through the early 1890's. Many of the shallow, sandy-bottomed streams stopped flowing, and settlers experienced the full blast of "sandstorms." In September, 1889, it was reported that, "the Canadian River has reached the condition where it is not now running at all, and in this condition it has not previously been . . . since April or May of '83. . . . It is certainly a dry stream

[27]Ibid., pp. 125-26.

[28]Eleventh Census Compendium: 1890, Part I, Population (Washington, 1892), pp. 41-42.

[29]Paul, "The Farmer's Frontier on the South Plains," p. 112.

[30]Ibid., p. 110.

now--as dry as a Tascosa citizen would get if starting on a fifty mile journey with no more than a quart."[31] Then in the spring of the next year a "sandstorm" hit Tascosa during the middle of the night and raked the town for two days. The newspaper reported that it

> was the hardest windstorm the oldest inhabitant knows anything of. It just naturally blew and blew and blew, and blowed and blowed and blowed, and swept the country all up in one great big continuous sweep. . . . It piled dust heaps everywhere, and sent it [dust] through and into the tightest buildings, and rattled the roofs and shook the fences and scattered the loose boards and boxes and barrels and bent the trees and roared and howled and shrieked and hissed till nothing else could be heard. It was frightful.[32]

Consequently, many farmers began to withdraw from the region, especially after 1891. That year Floyd County had 176 farms. By the end of the next year, only fifty-five farms remained. The drouth also created a greater number of mortgages on the remaining farms on the High Plains. For example, Crosby County reportedly had only four mortgages on its forty-two farms in 1891, but by the end of the next year ten mortgages were recorded for the remaining farms.[33]

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[31] Quoted in John L. McCarty, Maverick Town: The Story of Old Tascosa (Norman: University of Oklahoma, 1946), p. 241.

[32] Quoted in ibid.

[33] Paul, "The Farmer's Frontier on the South Plains," p. 127.

The drouth, however, did not altogether stop migration. As many farmers drove their wagons loaded with household goods back to the more humid regions of the East, they passed other wagons driving west toward the Cap Rock. In the period 1890-1894, the number of applications filed in the Texas General Land Office for school lands in the region exceeded the number of applications of the 1880's. Floyd County reported 466 applicants, and Hale County had 340. Although more than 90 per cent of the land filed on by settlers during the period reverted back to the State, this percentage did not necessarily indicate that 90 per cent of those who filed on land left the region. Influenced to some extent by the severe drouth, the Texas legislature in 1895 enacted a more liberal land law--the "Four Section" Act--under which a settler could file on four sections of land (2,560 acres) for two dollars per acre for the first section and one dollar per acre for the remaining three. Credit terms were also very favorable for the farmer. A down payment of only one-fortieth of the price was required, and payments extended over a forty-year period at a mere 3 per cent interest. In order to take advantage of the provisions of this act, a technicality of the law required that those who had filed under earlier laws relinquish their claims before taking advantage of the new law. Consequently, many of the 90 per cent gave up their first claim in exchange for more land. One historian estimates that as high as "forty per cent of the total forfeitures recorded did not reflect a withdrawal of settlement."[34]

Those farmers who remained during the 1890's existed by raising drouth-resistant grain sorghums to feed to their small herds of beef cattle and milch cows. In addition, it was reported that settlers in Blanco Canyon irrigated orchards and gardens through a system of canals from the White River.[35] Moreover, there were undoubtedly many farmers who used their windmills to water a few rows of garden crops. Thus, the early farmers who remained did so by concentrating upon stock farming and by irrigating a few rows of vegetables for the family larder.

By the middle 1890's no irrigation movement had appeared on the Texas High Plains. The few settlers living in the region were primarily stock farmers. The inrush of immigration anticipated by the large ranches had not materialized because of the drouth. By the middle 1890's, the escarpment along the eastern edge topped off with the yellowish-white Cap Rock continued to symbolize a barrier to permanent farming settlements on the drouth-stricken, semiarid High Plains.

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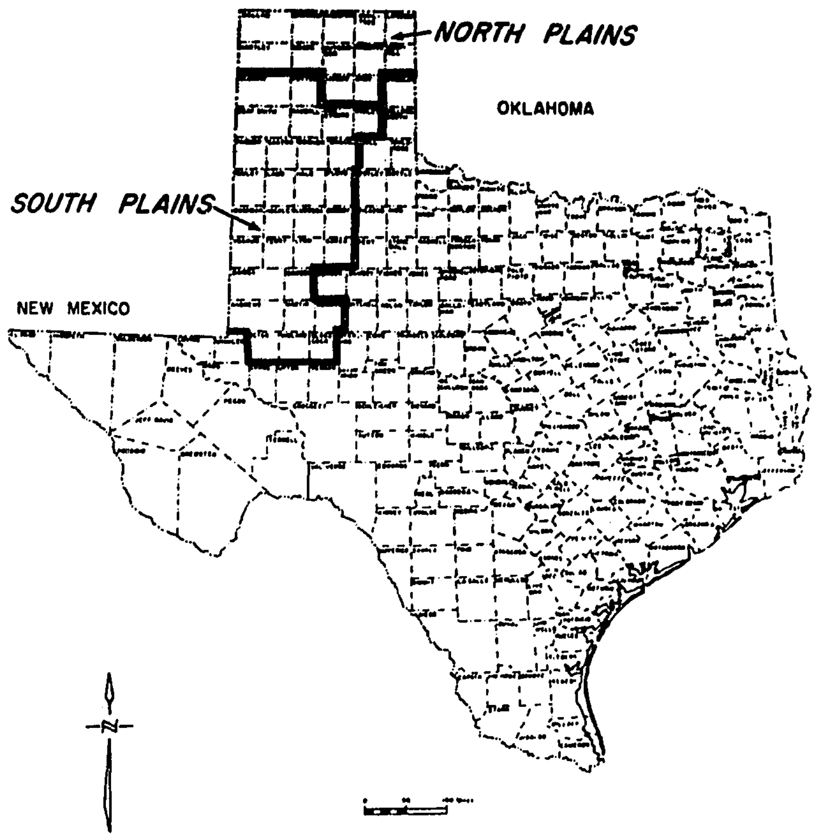
[34]Ibid., pp. 97-99, 136.

[35]Ibid., pp. 126-27.




TEXAS HIGH PLAINS 42-COUNTY AREA

THE TEXAS HIGH PLAINS

From: Herbert W. Grubb, Importance of Irrigation Water to the Economy of the Texas High Plains, Texas Water Development Board Report No. 11.

## CHAPTER II

## THE WESTERN IRRIGATION MOVEMENT AND THE GREAT PLAINS

While farmers were struggling to establish permanent settlements on the semiarid High Plains of West Texas, a national irrigation movement was developing throughout the American West. Some attempts had been made earlier to irrigate the rivers which flowed across the Great Plains, but most of the effort in the 1880's and 1890's centered around expanding irrigation facilities in the arid West where irrigation on a small scale had a long history. Few people as late as 1890 believed that irrigation on the semiarid Great Plains was either desirable or possible. Nevertheless, interest in irrigation on the Great Plains was a kind of by-product of the wider campaign to find methods and financial support for enlarged irrigation facilities throughout the vast region west of the ninety-eighth meridian.

More than a thousand years earlier aborigines had dug ditches to carry the waters of the Salt River of Arizona to parched fields along its banks. In the vicinity of Clear Creek, Arizona, primitive red-skinned farmers may have watered as much as 1,200 acres from a single stream. The Coronado expedition failed to discover any fabled cities of gold, but its members did find Indian fields of corn, beans and squashes produced by irrigation.[1]

When Spanish missionaries carried the gospel to the Southwest, they also brought with them their Iberian irrigation techniques which the Moors had introduced from North Africa. By the middle of the eighteenth century, missions from El Paso to Los Angeles were being supported by artificially watered crops. Near San Antonio, Spanish engineers erected Persian-type water wheels which lifted water from streams to the benchlands above.[2] But the Spanish introduced not only advances in irrigation technology; they also inaugurated concepts of water regulation and conservation. By 1841 the Mexicans of the Los Angeles area had empowered a "ditch commissioner" to repair irrigation canals and to enforce rules of water conservation.[3]

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[1]John T. Ganoe, "The Beginnings of Irrigation in the United States," Mississippi Valley Historical Review, XXV (June, 1938), 62-63. Ralph H. Hess, "The Beginnings of Irrigation in the United States," Journal of Political Economy, XX (October, 1912), 807-09, ftn. 809.

[2]Ganoe, "Beginnings of Irrigation," 63-64. Hess, "Beginnings of Irrigation," 810-11. Edwin P. Arneson, "Early Irrigation in Texas," Southwestern Historical Quarterly, XXV (October, 1921), 130.

[3]Ganoe, "Beginnings of Irrigation," 63. John Q. Ressler, "Indian and Spanish Water-Control on New Spain's

Before 1847, however, extensive irrigation works were unknown among English-speaking peoples of North America. American settlement had been confined primarily to the humid areas east of the 98th meridian where water problems for farmers were usually restricted to overabundance rather than to scarcity. But in the 1840's, as American expansionism rolled over the Spanish Southwest, migrating farmers from the East were forced to adapt their agricultural methods to the realities of the arid West.

The Mormons led the way. While still at Nauvoo, Illinois, they studied the report of John C. Frémont concerning the Great Salt Lake Valley in the Great Basin region. Moreover, Mormon leaders actually studied irrigation techniques before beginning their mass exodus to the West. Upon reaching their promised land in 1847, the people of Zion planted crops and dug their first irrigation ditches. They developed their water engineering techniques and laws through experience rather than through contact with Spanish methods.[4]

The Saints constructed an elaborate system of canals and diversion dams in the higher elevations of

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Northwest Frontier," Journal of the West, VII (January, 1968), 10-17.

[4]Leonard J. Arrington, Great Basin Kingdom: An Economic History of the Latter-day Saints, 1830-1900 (Lincoln: University of Nebraska Press, 1958), p. 41. Ganoe, "Beginnings of Irrigation," 66-67. Hess, "Beginnings of Irrigation," 811-12.

the Wasatch Range in order to channel water to fields by gravity. Plans were drawn up in 1848 to build the first large canal--the Big Cottonwood Creek Canal.[5] Obviously the building of complex irrigation works could not be undertaken by individuals. The expenses and labor involved in such projects could only be met by corporate or cooperative action. The Mormons chose the latter course.

Church leaders planned irrigation policies for their communities. Brigham Young laid down the basic philosophy for water control when he stated, "there shall be no private ownership of the streams that come out of the canyons. . . . These belong to the people: all the people."[6] Using that premise--community ownership of water rights--a code of customs and law evolved during the first few years of Mormon experience in the Salt Lake Valley. Bishops determined the needs of their wards and supervised the construction of "laterals" and ditches. Each farmer furnished labor for the project in direct proportion to the area of land which he proposed to irrigate. Upon completion of the project, a "watermaster" for the community was appointed to control the amount of water to which each farmer was entitled.[7]

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[5]Arrington, Great Basin Kingdom, p. 51.

[6]Quoted in ibid., p. 52.

[7]Arrington, Great Basin Kingdom, pp. 52-53.

The Great Basin settlers demonstrated the complexity of irrigation problems. The construction of an extensive system of canals was not only too expensive for the individual, but the need for governmental or community regulation of water was imperative if the farmer was to survive in the arid West.

Following the Mormon example, other cooperative enterprises were founded. For example, Nathan C. Meeker of the New York Tribune staff brought a group of settlers to northern Colorado in 1870. With the support of Horace Greeley, Meeker's publisher, the little society colonized an area of land at the fork of the Cache la Poudre and Platte Rivers. Its success encouraged similar cooperative settlements at Boulder, Loveland, Longmont and Fort Collins, Colorado.[8]

Individual irrigation was also practiced where water was easily available, and an economic need existed. For example, a demand for fresh foodstuffs existed in mining camps and along the Overland Trail. To meet the need, farmers and ex-miners diverted the waters of streams

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[8]Hess, "Beginnings of Irrigation," 820-21. Ganoe, "Beginnings of Irrigation," 69-70. Elwood Mead, "Rise and Future of Irrigation in the United States," United States Department of Agriculture Yearbook, 1899 (Washington, 1900), pp. 593-94. Ray Palmer Teele, "The Financing of Non-Governmental Irrigation Enterprises," The Journal of Land and Public Utility Economics, II (October, 1926), 429-30. Robert G. Dunbar, "The Origins of the Colorado System of Water-Right Control," Colorado Magazine, XXVII (October, 1950), 241-62.

onto small truck patches. In 1858 David K. Wall built a crude ditch to channel the waters of Clear Creek, Colorado into his two-acre vegetable garden. Miners paid high prices for the fresh produce, and Wall made a profit of two thousand dollars.[9] As early as 1857 similar farming ventures were found along the Platte River Valley to furnish foodstuffs for emigrants bound for California and Oregon.[10]

This type of irrigation enterprise, however, had its limitations. The average farmer lacked the capital to build a reservoir for storing water. When individuals appropriated enough water to cut off the supply for irrigators farther downstream, conflict inevitably resulted between the two groups. The latter problem spurred the irrigation colonies of Colorado into leading the movement for state water-regulation which culminated in the "Colorado doctrine" of water appropriation.[11] The solution to the problem required organization as well as regulation. Corporately-owned canals attempted to fill this need.

The construction of corporate canals began as a response to the American speculative urge as well as to the demand for irrigated farms. Water increased not only

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[9] Hess, "Beginnings of Irrigation," 819-20.

[10] Ganoe, "Beginnings of Irrigation," 68.

[11] Dunbar, "Colorado System of Water-Right Control," 241-62.

the productive capacity of the land, but its value as well. Businessmen consequently formed water users' companies during the last half of the nineteenth century to construct diversion dams, storage works and large canals. Farmers initially paid from five to five hundred dollars per acre for water rights from such companies. They then continued to pay an annual rental fee. Some canal companies required an exceptionally large investment. For example, the Wyoming Development Company near Laramie built a tunnel which reportedly cost more than all the canals of the Greeley Union Colony combined. And the Bear River Canal of Utah cost more than $1 million to construct.[12]

Corporate canal investments, however, were very risky. Elwood Mead, one of America's foremost irrigation engineers, reported in 1899: "Nearly all [canal companies] have been a success [*sic*] so far as the section interested was concerned, but the benefits have gone to the public and not to the investors."[13] Why did so many of these enterprises fall into bankruptcy? Mead gave the following reasons: (1) the time lag between constructing the project and settling people on the land, (2) the initial small number of settlers paying for water, (3) "unsuitability of the public-land laws to irrigation development,"

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[12]Mead, "Rise and Future of Irrigation," pp. 594-95.

[13]*Ibid.*, p. 596.

(4) speculators who acquired lands near projects without improving them, and (5) expenses of litigation over water rights between companies.[14]

A later irrigation economist noted that, "almost without exception . . . such enterprises were failures because of the mistaken idea that the water almost alone created the increase in value, while, as a matter of fact, the development of the farms . . . had as much to do with the new value as did the water supply."[15] Companies also tended to overestimate "the demand for water."[16] Thus, by and large, water users' companies failed to yield a profit on investments because of the relatively slow progress of land reclamation, and because of the lack of effective governmental regulation of water rights. Settlers themselves added to the problem by underestimating the cost of reclaiming land while overestimating the return on their investment. But even in this instance the companies were not blameless. Their land agents were not above painting an overly optimistic picture of irrigation farming in order to attract farmers to their projects.[17]

Except for a few irrigation projects along the major rivers flowing through the Great Plains, most of the

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[14]Ibid., pp. 596-97.

[15]Teele, "Financing of Non-Governmental Irrigation Enterprises," 430.

[16]Ibid. [17]Ibid.

concern for irrigation had centered in the arid West. Western migration had "jumped over" the Great Plains to settle on lands in California, Oregon or along the attractive banks of strong-flowing rivers in the mountains or the arid region because early observers had pronounced the area as being unfit for human habitation.

Explorers of the early nineteenth century, such as Zebulon Pike and Stephen Long, referred to the Great Plains as part of the "Great American Desert." They had crossed the region during one of its drouths, and their impression remained the dominant American attitude toward the area until settlers began moving into western Kansas and Nebraska. Then public opinion toward the treeless plains changed.

Henry Nash Smith pointed out that, "as settlement moved up the valleys of the Platte and the Kansas rivers, the myth of the desert was destroyed and in its stead the myth of the garden of the world was projected out across the plains."[18] Settlers who moved into the region in the 1870's and 1880's insisted that the average annual rainfall was increasing. The myth was further propagated by some contemporary scientists. Ferdinand V. Hayden, who directed one of the great surveys of the West, reported in 1867 that the planting of trees tended to increase rainfall along the

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[18]Henry Nash Smith, Virgin Land: The American West as Symbol and Myth (Cambridge: Harvard University, 1950), p. 179.

area bordering on the Missouri River.[19] Samuel Aughey, an associate of Hayden and a professor at the new University of Nebraska, collaborated with a land speculator named Charles Dana Wilber in attempting to prove that rainfall was on the increase. It was Wilber who coined the phrase, "rain follows the plough."[20]

Most settlers probably felt the same about the weather as did H. C. "Hank" Smith of Crosby County, Texas. He stated that, "rain has increased very notably ever since I moved to this place."[21] Whether the increase in rainfall was due to more timber, the plough or more inhabitants, settlers convinced themselves that the climate pattern had changed, and discarded the idea that the Great Plains was an area of only marginal rainfall.

Both the "myth of the garden" and the "myth of the desert" were misconceptions of the nature of the Great Plains. The region was neither humid nor arid; it was semiarid. The complexity of its unique pattern of climate has been emphasized by Carl Frederick Kraenzel who stated that the climate was not

> halfway between humid and arid. They [the Great Plains] are not semiarid in that the climate is halfway between humid and arid. They are not half

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[19] Ibid., pp. 180-81. [20] Ibid., p. 181.

[21] Quoted in Richard R. Hinton, Irrigation in the United States, Senate Miscellaneous Document No. 15, 49th Cong., 2d sess., Serial No. 2450 (Washington, 1887), p. 119.

> dry and half wet; rather, some years they are dry and even arid; other years they are very wet; and still other years they are wet or dry at the wrong times from the standpoint of agricultural production and yields. It is this undefinable aspect of semiaridity that gives the Plains their distinctiveness [italics mine].[22]

Settlers were confronted with this "undefinable aspect of semiaridity" when a severe drouth struck the Great Plains in 1886 and extended through the remainder of the 1880's and early 1890's. Numerous emigrants who had recently settled in the "garden," began pointing their wagons toward the east. In 1891, some 18,000 wagons reportedly entered Iowa from Nebraska. Western Kansas lost half its population between 1888 and 1892. The feeling of farmers leaving the region was perhaps best expressed by signs painted on the sides of some eastward-moving emigrant wagons which stated: "In God we trusted, in Kansas we busted."[23] From the Texas High Plains to Canada the drouth severely set back population gains of the previous decade. Those who remained were forced to adapt their institutions to the realities of the semiarid Great Plains.

In seeking new institutions to meet the problem, some citizens of the region and other interested parties

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[22]Carl F. Kraenzel, The Great Plains in Transition (Norman: University of Oklahoma, 1955), p. 12.

[23]Fred A. Shannon, The Farmer's Last Frontier: Agriculture, 1860-1897, Vol. V of The Economic History of the United States, ed. by Henry David, et al. (New York: Holt, Rinehart and Winston, 1945), pp. 307-08.

channeled their energies into a new crusade--the cause of irrigation. Foremost among the leaders of this movement was William E. Smythe.

Smythe migrated to the West from Massachusetts settling at Kearney, Nebraska, in 1888. The next year he became acquainted with irrigation by means of a tour through California and New Mexico. In 1890 he became an editorial writer for the Omaha Bee, and the following year he became interested in the utilization of water resources as a solution to the agricultural dilemma of the Great Plains. "I suppose I had heard or read the word 'irrigation,'" he wrote, "though I have no recollection of it. Certainly, the word meant nothing to me until the drought struck Nebraska. . . ."[24]

Other leaders in Kansas, Nebraska and Texas became interested in irrigation and furnished much of the initial stimulus for the movement. Smythe recounted that the irrigation movement actually began in meetings in western Nebraska which, in turn, led to a state-wide meeting at Lincoln in February, 1891. The Lincoln group, led by Smythe, then arranged for the first National Irrigation Congress to meet at Salt Lake City on September 15, 1891.[25]

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[24]William E. Smythe, The Conquest of Arid America (2d ed.; New York: Macmillan, 1905), p. 266. There is no biography of Smythe but a useful biographical article is Martin E. Carlson, "William E. Smythe: Irrigation Crusader," Journal of the West, VII (January, 1968), 41-47.

[25]Smythe, Conquest of Arid America, p. 267. Carlson, "William E. Smythe," 45.

Joseph L. Bristow, a newspaperman from Kansas, organized the Interstate Irrigation Association at Salina, Kansas, in 1893, and the following year began publishing The Irrigation Farmer.[26]

Men from states which were at least partly in the Great Plains were especially prominent among the leaders of the irrigation movement at the Los Angeles Irrigation Congress of 1893. For example, Bristow attended the conference, Smythe called the Congress to order, Judge J. W. Gregory of Garden City, Kansas, introduced the Governor of California to the Congress, and one of the two speakers on the first day of the session was James S. Emery of Lawrence, Kansas.[27]

In spite of the enthusiasm shown by men like Bristow, Gregory and Smythe, the Federal Government showed little interest in promoting irrigation on the Great Plains. Two important investigations into western water resources were conducted before 1890. Neither focused attention on the unique irrigation problems of the Plains.

The first was conducted in 1886 subsequent to a Senate resolution of that year to the Department of Agriculture. Richard R. Hinton, who was in charge of the

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[26]A. Bower Sageser, "Joseph L. Bristow: The Editor's Road to Politics," Kansas Historical Quarterly, X (summer, 1964), 158-59.

[27]A. Bower Sageser, "Los Angeles Hosts an International Irrigation Congress," Journal of the West, IV (July, 1965), 419-20.

survey of existing irrigation facilities, published his findings the next year. In addition to scattered, small acreages irrigated by windmills and streams, he found very few irrigation works on the Great Plains except for some canal companies on the Arkansas River in Finney County. The bulk of the report was devoted to the arid West.[28]

The second, and more important, investigation was initiated by a joint resolution of Congress in 1888 to the Secretary of the Interior for the purpose of finding possible reservoir sites in the West.[29] The task of conducting the survey fell to John Wesley Powell, Director of the United States Geological Survey who had long been interested in irrigation and land reform. Ten years before, the one-armed explorer of the Colorado River had submitted his famous _Report on the Lands of the Arid Region of the United States_. In that document he had called for the construction of reservoirs in mountainous areas in order to irrigate farms in the valleys.[30]

In his survey, Powell concentrated on the arid and mountainous West. But in 1890 he was forced to halt his

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[28]Hinton, _Irrigation in the United States_, pp. 3, 18.

[29]Everett W. Sterling, "The Powell Irrigation Survey, 1888-1893," _Mississippi Valley Historical Review_, XXVII (December, 1940), 422.

[30]J. W. Powell, _Report on the Lands of the Arid Region of the United States_, ed. by Wallace Stegner (Cambridge: Harvard University Press, 1962), pp. 22-23.

investigation, partly because of western opposition to his attempt to withdraw public lands from entry near his reservoir sites, but also because of the reaction of Great Plains congressmen to Powell's lack of enthusiasm over an investigation of artesian[31] well possibilities.[32] In June of that year, Powell appeared before the House Appropriations Committee where Senator Gideon Moody of South Dakota asked him what he thought of the possibilities of developing artesian water for irrigation. The scientist replied that all the flowing wells that could be bored in the Dakotas would be insufficient to irrigate one single county of the area. Moody consequently opposed appropriating any more money to the survey.[33]

The clash between Powell and Moody was more than a conflict between a scientist and a westerner. The clash represented a cleavage between those whose interests were centered on the arid and mountainous West and those who felt that the Great Plains were being ignored in the

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[31]Although the word "artesian" is sometimes applied to any deep well in which water tends to rise above the level of its original stratum, the term as used in this study will apply only to those wells in which water flows to the surface under hydrostatic pressure, unaided by pumping devices.

[32]Wallace Stegner, Beyond the Hundredth Meridian: John Wesley Powell and the Second Opening of the West (Boston: Houghton Mifflin, 1954), pp. 300-42. Sterling, "Powell Irrigation Survey," 421-34.

[33]Stegner, Beyond the Hundredth Meridian, pp. 329-31.

irrigation survey. As subsequent investigations would reveal, Powell was undoubtedly correct about the rarity of artesian water, but to Moody and other plainsmen, artesian wells seemed to be the last hope for a significant irrigation development on the Great Plains with its few surface water resources and even fewer reservoir sites.[34]

Consequently, in 1890, plainsmen gathered enough support in Congress to appropriate $70,000 for the investigation of "artesian and underflow waters."[35] Significantly, the inquiry was placed in the Department of Agriculture rather than under Powell's supervision in the United States Geological Survey. Richard R. Hinton, who had conducted the first irrigation investigation in 1886, headed the project. He launched the inquiry in 1890 after enlisting the assistance of local geologists throughout the West such as Robert T. Hill of Texas, Lewis E. Hicks of Nebraska and Garry E. Culver of South Dakota.[36] Moreover, Hinton organized an Office of Irrigation Inquiry within the Department of Agriculture in 1891 to facilitate

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[34]For a discussion of the problems of utilizing water resources of the Great Plains as well as of the Texas High Plains, see Chapter III.

[35]Congress appropriated the sums under acts passed on April 4 and September 30, 1890, and on March 3, 1891. See Report of the Secretary of Agriculture, 1891 (Washington, 1892), p. 53.

[36][Richard R. Hinton], "Report of the Special Agent in Charge of the Artesian and Underflow Investigations and of the Irrigation Inquiry," Report of the Secretary of Agriculture, 1891 (Washington, 1892), p. 440.

the work.[37] The final report of 1892 glowed with the optimism which Hinton exhibited throughout the investigation. He found that there were 13,695 artesian wells west of the ninety-seventh meridian. But it should be noted that of this number, few were located in the large central area of the Great Plains. Most were either along the eastern periphery or along the western edge of the plains near the Rocky Mountains. For example, the two largest artesian basins known in the world by 1891 were the James River Valley of the Dakotas, and the central Texas area south of Fort Worth. Both basins were east of the ninety-eighth meridian.[38]

Between the Rocky Mountains and the eastern peripheral river valleys there were few artesian wells because the prerequisite geological formations did not exist. Such formations were usually found in natural basins or in areas adjacent to mountains, foothills or highlands. The Great Plains would have to depend upon sources other than artesian wells for irrigation water.[39]

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[37]Report of the Secretary of Agriculture, 1891, p. 444. Herbert S. Schell, "Drouth and Agriculture in Eastern South Dakota," Agricultural History, V (October, 1931), 167.

[38][Richard R. Hinton], Irrigation: The Final Report of the Artesian and Underflow Investigation and of the Irrigation Inquiry, Senate Executive Document No. 41, 52d Cong., 1st sess., Serial No. 2899 (Washington, 1892), p. 16. Report of the Secretary of Agriculture, 1891, p. 54.

[39]Referring to the movement to put down artesian wells, Willard D. Johnson stated, "No flowing wells were

Visionary crusaders continued to keep the issue of irrigation alive. William E. Smythe continued as editor of Irrigation Age until 1896. Essentially a Jeffersonian, he thought that irrigation would lead to the establishment of the small farm of ten to twenty acres as the basic unit of society throughout the West.[40] "Tell the people of Nebraska," he informed a newspaper reporter in 1894, "that we are going to make homes for millions of men; that in these homes irrigation shall guarantee industrial independence and the small farm unit a reasonable degree of human equality."[41] That same year he wrote: "To make homes where the common people shall realize the highest average prosperity--this is the lofty purpose of those who are directing the irrigation movement in Western America."[42]

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secured from any borings upon the High Plains proper, and only a few, and these of small yield, in the valleys [of the High Plains]." See Willard D. Johnson, "The High Plains and their Utilization," Twenty-first Annual Report of the United States Geological Survey, IV (Washington, 1899), 698. For an account of the artesian well movement in South Dakota see Schell, "Drouth and Agriculture in Eastern South Dakota," 162-80. Also see Marc M. Cleworth, "Artesian-Well Irrigation: Its History in Brown County, South Dakota," Agricultural History, XV (1941), 195-201.

[40]Carlson, "William E. Smythe," 42-43. Smythe, Conquest of Arid America, pp. 45-46.

[41]Nebraska State Journal, September 3, 1894, quoted in Carlson, "William E. Smythe," 42.

[42]William E. Smythe, "Progress of Irrigation Thought in the West," The Review of Reviews, X (October, 1894), 396.

Joseph L. Bristow also remained an important leader in the irrigation movement of the 1890's. Unlike Smythe who publicized the need for irrigation throughout the West, Bristow's interest centered on the Great Plains and his native Kansas. In the first issue of his Irrigation Farmer in February, 1894, the Kansas editor stated that his periodical would champion "irrigation for the Great Plains."[43] For the next two years Bristow attended state, regional and national irrigation conferences, examined new types of pumping machinery, campaigned for establishment of a state board of irrigation, and kept farmers informed of the latest developments in irrigation equipment, techniques and crops.[44] He was particularly interested in possibilities for pump irrigation. For example, Bristow planned the program for the Interstate Irrigation Association meeting at North Platte, Nebraska, in 1893. At the meeting delegates heard reports and viewed exhibits devoted to windmill and gasoline pumps, as well as to artesian wells.[45] And in 1895, the Governor of Kansas, at least partly influenced by his private secretary, Joseph Bristow, was responsible for subsequent legislation which established

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[43]Quoted in A. Bower Sageser, Joseph L. Bristow: Kansas Progressive (Lawrence and London: University of Kansas, 1968), p. 15.

[44]Sageser, Joseph L. Bristow: Kansas Progressive, pp. 15-25.

[45]Ibid., p. 18.

a Board of Irrigation Survey and Experiment to test pumping plants.[46]

While irrigation leaders such as Bristow and Smythe continued to publicize the cause, farmers began to experiment with irrigation water from wells. For example, east of the Missouri River in South Dakota, farmers drilled wells in an artesian basin. Before Hinton's investigation began in 1890, there were more than 100 artesian wells in the James River Valley. By 1896, in spite of the high cost of $3,000 to $5,000 for drilling and casing each well for irrigation purposes, some one hundred farms were being irrigated from such wells in eastern South Dakota.[47]

Artesian water, however, was rarely found on the Great Plains. But the region did contain vast resources of sub-surface water. To utilize these resources, some plains farmers began using windmill-powered pumps to irrigate small acreages. In Nebraska some farmers reportedly made more money from their small irrigated truck patches than from their unwatered field crops. Both "homemade" and manufactured windmills could be seen dotting the Platte, Republican and Loup River valleys of that

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[46]Ibid., p. 23.

[47]Schell, "Drought and Agriculture in Eastern South Dakota," 165-70. For a detailed account of the artesian movement in one county, see Cleworth, "Artesian-Well Irrigation: Its History in Brown County, South Dakota, 1889-1900," 195-201.

state.[48] Small earthen reservoirs were usually scooped out near the windmills. Water constantly pumped into the reservoirs was then ditched to the fields. Some windmill irrigation projects were very ambitious. For example, near Garden City, Kansas, a farmer erected a mill fourteen feet in diameter to provide power for an eight-inch pump. The 4,400 barrels of water per day which the pump provided was enough to fill two large reservoirs. And, in 1894, this unit furnished enough water for fifteen acres.[49] Interest was further reflected when in 1895, the Kansas Board of Irrigation Survey and Experiment launched an extensive experimentation program devoted primarily to windmill irrigation.[50]

Windmill irrigation both stimulated state experiments in pump irrigation and provided the farmer with a means to subsist on the Great Plains during periods of drouth.[51] But, like the artesian well, the windmill

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[48] E. H. Barbour, Wells and Windmills in Nebraska, United States Geological Survey Water-Supply and Irrigation Paper No. 29, House Document No. 299, 55th Cong., 3d sess., Serial No. 3815 (Washington, 1899), p. 31.

[49] A. Bower Sageser, "Windmill and Pump Irrigation on the Great Plains, 1890-1910," Nebraska History, XLVIII (summer, 1967), 111-12.

[50] The Board of Irrigation Survey and Experiment, Report of the Board of Irrigation Survey and Experiment for 1895-1896, To the Legislature of Kansas (Topeka, 1897).

[51] Sageser, "Windmill and Pump Irrigation on the Great Plains," 114.

symbolized the frustration of Great Plains farmers who were still unable to utilize on any vast scale their sub-surface water resources for irrigation purposes.

While farmers experimented with artesian wells and windmills, the main thrust of the Federal government's irrigation investigations after the Hinton inquiry continued to be toward the mountainous and arid West. In 1897, Hiram M. Chittenden published his famous report on irrigation reservoir sites in Wyoming and Colorado. Chittenden called for the direct financing of dams and other irrigation works by the Federal government.[52] Moreover, an energetic Californian named George W. Maxwell, using the government report, organized the National Irrigation Association in 1897, and began an intensive campaign to publicize the need for acceptance of Chittenden's plan. Within the next few years Maxwell started a number of journals and set up an office in Washington, D. C., to release articles to the national press. In addition, he remained in communication with numerous national political figures and eventually enlisted the support of railroad officials and eastern business interests.[53]

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[52]John T. Ganoe, "The Origin of a National Reclamation Policy," Mississippi Valley Historical Review, XVII (June, 1931), 40. Hiram M. Chittenden, Preliminary Examination of Reservoir Sites in Wyoming and Colorado, House Document No. 141, 55th Cong., 2d sess., Serial No. 3666 (Washington, 1897).

[53]Ganoe, "The Origin of a National Reclamation Policy," 39-42.

The climax to Maxwell's campaign and the Federal government's interest in the irrigation problems of the arid and mountainous West was the Newlands Act of 1902 which established a national reclamation policy. Under the provisions of the act, the Federal government would use money from the sale of public lands to construct dams, reservoirs and other irrigation works.[54]

At about the time that Maxwell was reading the Chittenden report, citizens of the Great Plains were losing interest in irrigation. By 1896 rains had once again descended on the plains and people became indifferent to irrigation. Even discussion of irrigation became unpopular among promoters. Boosters insisted that their region was neither "arid" nor did it require irrigation. In 1896 a South Dakota newspaper reported: "We have passed from the drouth period and have entered an era of old time moisture supply. We will now stop talking about irrigation."[55] The next year South Dakota did away with the office of State Engineer of Irrigation. Real estate brokers who hoped to swell the tide of immigration also insisted that artificial watering was not needed.[56] Another South Dakota

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[54]Ibid., 50-51.

[55]Press and Dakotan (Yankton), November 12, 1896. Quoted in Schell, "Drought and Agriculture in Eastern South Dakota," 171.

[56]Schell, "Drought and Agriculture in Eastern South Dakota," 172, 174.

newspaper summed up the booster attitude in declaring that, "the 'irrigation papers' in the state are doing more harm to this country than all the blizzards, mortgages and corrupt politicians ever did."[57] In Kansas the Board of Irrigation Survey and Experiment was stripped of any meaningful function in 1896.[58] And in the Texas Panhandle the editor of an Amarillo newspaper referred to irrigation as "a humbug. Like the 16 to 1 silver--with the bug under the chip--put there by interested sharpers."[59] Even more significant, Joseph L. Bristow ceased publication of The Irrigation Farmer in November, 1896.[60]

The Western irrigation movement which, to a great extent, had originated on the Great Plains and for which the region had provided much of the early leadership, was successful in getting a national reclamation policy formulated primarily for the benefit of the mountainous and arid West, rather than for the semiarid region. Several factors were responsible for diverting attention from the peculiar irrigation needs of the Plains. Scientists like Powell believed that water resources of the Great Plains

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[57] Parkston Advance, April 23, 1894. Quoted in ibid.

[58] Sageser, Joseph L. Bristow: Kansas Progressive, pp. 24-25.

[59] Amarillo News, February 9, 1895, p. 4.

[60] Sageser, Joseph L. Bristow: Kansas Progressive, p. 25.

could not be effectively utilized on any large scale. Moreover, inhabitants of the semiarid West changed their attitudes toward irrigation from enthusiasm to downright opposition as the climate changed from dry to wet. Citizens of the arid region, on the other hand, kept the issue of Federal support for irrigation works before the nation after the plainsmen had left the movement.

Perhaps the most important reason that irrigation failed to become firmly implanted within the economic and social structures of the Great Plains was because of the nature of water resources in the region. Artesian wells and windmills simply could not utilize those resources on the scale needed for irrigation.

## CHAPTER III

## WATER RESOURCES OF THE SOUTHERN HIGH PLAINS

The most important reason the semiarid West failed to derive substantial benefits from the irrigation movement of the late nineteenth century was because of the nature of its water resources. The most influential government documents on irrigation between 1870 and 1900 were those of John Wesley Powell and Hiram M. Chittenden, both of which focused attention on the importance of reservoir sites. Suitable locations for dams existed primarily in the mountainous and arid regions, rather than on the shallow rivers which snaked across the Great Plains. Streams for reservoir sites required deep canyons to impound a large volume of water; relatively silt-free, continuously flowing waters; and a high elevation so that the impounded water could flow by gravity to farmlands on a lower elevation.

Few such sites existed in semiarid America. Frederick H. Newell, Chief Hydrographer of the United States Geological Survey, wrote in 1896:

> In the arid regions the arable lands are mainly in the valleys or partly surrounded by mountains from

> which perennial streams issue with rapid fall. This facilitates the construction of canals built above the level of the fields, furnishing by gravity a relatively large amount of water. On the other hand, on the Great Plains are boundless tracts of fertile soil with no water within sight except at rare intervals after heavy storms.[1]

Newell conceded that "a few perennial streams" existed on the plains, but he also recognized that "these attain notable size mainly at points where the conditions are such that the water cannot be diverted and used economically or efficiently."[2] The Chief Hydrographer also cautioned that the streams of the Great Plains which had headwaters in the Rocky Mountains would furnish little water to irrigators on the plains because farmers near the mountains already utilized much of the flow.[3]

To augment Newell's position another official of the United States Geological Survey, Willard D. Johnson, warned that the rivers which flowed across the plains were "not strong-flowing rivers." Moreover, he agreed with Newell in emphasizing that "there is not water enough from the Rocky Mountains completely to utilize even the extreme western and arid subdivision of the Great Plains."[4]

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[1]Frederick H. Newell, "Irrigation on the Great Plains," United States Department of Agriculture Yearbook, 1896 (Washington, 1897), p. 169.

[2]Ibid., p. 172. [3]Ibid., pp. 175-76.

[4]Willard D. Johnson, "The High Plains and their Utilization," Twenty-first Annual Report of the United States Geological Survey, IV (Washington, 1900), 694.

And Johnson reiterated that large reservoirs were impractical in the region, not only because of the scarcity of suitable sites, but also because the accumulation of silt would shorten the usefulness of such storage facilities.[5]

The primary problem of irrigating the Great Plains was that its surface waters could be utilized to water very little of its land. Early settlers did, however, channel stream water directly upon their acreage if they had bottom land fields adjacent to streams. By 1890 some four hundred miles of canals and ditches drawing water from the Arkansas River were in use in the vicinity of Garden City, Kansas. But such cases were not common on the plains. In his survey on irrigation published in 1887, Richard R. Hinton mentioned only the Garden City area as being extensive enough to warrant a report. Other areas of the Great Plains, such as Nebraska, the Dakotas and the Texas High Plains, were represented in the survey only by the accounts of isolated individuals irrigating from small streams or using windmill-powered pumps to irrigate a few acres.[6]

The lack of surface water resources, so characteristic of the Great Plains, was even more of a problem in

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[5] Ibid., 693.

[6] Richard R. Hinton, Irrigation in the United States, Senate Misc. Document No. 15, 49th Cong., 2d sess., Serial No. 2450 (Washington, 1887), p. 118. And Hinton, "Report of the Special Agent in Charge of the Artesian and Underflow Investigations and of the Irrigation Inquiry," in Report of the Secretary of Agriculture, 1891 (Washington, 1892), pp. 448-49.

one of its sub-divisions--the Texas High Plains. That region, covering some 35,000 square miles of the eastern two-thirds of the Llano Estacado, stretched along the western half of the Texas Panhandle to the Pecos Valley in the southwest and the Cap Rock escarpment on the east. Only the Canadian River cut across the flat terrain in the northern part of the area. Its course had eroded a valley which in some places reached a depth of one thousand feet below the rim of the plains and ranged from five to twenty miles wide.[7]

The Texas High Plains is the southern part of the High Plains plateau which stretches along the western edge of the vast Great Plains region, extending from the Dakotas through Texas.[8] Its geological origin began with an extensive fluvial plain laid down in the late Tertiary period, and which extended from the mountains on the west to the Central Lowland on the east. Ancient streams flowing from the mountains fanned out across the face of the area gradually laying down a rich sedimentary deposit in the same way that rivers form deltas at their mouths. Gradually

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[7]Nevin M. Fenneman, Physiography of the Western United States (New York: McGraw-Hill, 1931), pp. 14-15. E. R. Leggat, Ground Water Development in the Southern High Plains of Texas, 1953, Bulletin No. 5410 of the Texas Board of Water Engineers (Austin, 1954), p. 1.

[8]Fenneman, Physiography of the Western United States, p. 11.

the eastern and western edges of the plain were eroded away leaving the upraised High Plains.[9]

The Texas High Plains, like the remainder of the High Plains region, has suffered little water erosion. Very few streams flow in the area, although the headwaters of such important Texas rivers as the Brazos, the Red and the Colorado are found along the edge of the eastern escarpment. The typical stream is called a "draw." Its features consist of a tough turf and a flat bottom rather than the V-shaped bottom so characteristic of eastern gullies. A few of the "draws" run a small stream of water, but most are dry and serve only to carry away rainwater.[10]

Although the High Plains have few surface water resources, like much of the Great Plains, the region has abundant underground water. The geological movement which laid down the rich soil of the plateau also interlaced the sub-surface with deposits of sand and gravel lying on top of the Triassic "red beds"--an impervious layer of clay. The porous level sod subsequently trapped the rainfall which percolated down into the formation. Thus, a veritable lake of underground water ranging in

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[9] Ibid., pp. 11-12. Walter P. Webb, The Great Plains (New York: Grosset and Dunlap, 1931), pp. 10-17.

[10] Fenneman, Physiography of the Western United States, p. 11.

some places from 200 to 300 feet thick, which geologists later named the "Ogallala formation," underlay a large area of the Texas High Plains before the advent of irrigation.[11]

Existence of the sub-surface water beneath the High Plains was discovered by early railroad men, ranchers and farmers. But as early as 1854, a Swiss geologist named Jules Marcou, who had accompanied a United States Army Topographical expedition across the region, wrote that underground water "on the Llano Estacado . . . may be found everywhere."[12] The Union Pacific Railroad installed windmills on the northern High Plains to furnish water for its locomotives.[13] In 1887, one of the early farmers of the Texas High Plains, H. C. "Hank" Smith of Crosby County, Texas, reported, "Water can be got by digging or boring at a depth of 10 to 100 feet. . . . The farther northwest of here the more shallow the

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[11]Ibid., pp. 13-14. Charles N. Gould, The Geology and Water Resources of the Western Portion of the Panhandle of Texas, United States Geological Survey Water-Supply and Irrigation Paper No. 191 (1907), pp. 37-38. United States Department of Agriculture Soil Conservation Service, Ground Water and Irrigation in the High Plains of Texas (Fort Worth, Texas: U.S. Department of Agriculture, 1947), p. 7.

[12]Marcou was mistaken, however, in assuming that wells drilled in the region would be artesian or self-flowing wells. Marcou to Captain John Pope, September 21, 1854, Boston, reprinted in Marcou, Geology of North America (New York: Wiley and Halsted, 1858), p. 30.

[13]Webb, The Great Plains, p. 339.

wells."[14] That same year the huge XIT Ranch began digging and drilling wells to supply water for livestock. The first pumps consisted of buckets fastened to endless chains which ran from the bottom to the surface of shallow wells. Horses supplied the power. But windmill pumps averaging some 125 feet in depth soon replaced these crude devices. By 1900, 335 wells pumped by windmills pierced the surface of XIT land.[15] In 1891, C. C. Perrin of "Tullia [sic]" reported to the United States Department of Agriculture that water in Swisher County, Texas, could be found at depths of 12 to 50 feet.[16]

In the early 1890's the United States Government, stimulated by a general drouth covering the Great Plains and by the irrigation movement of that period, launched an investigation of underground water resources, particularly those of the Great Plains. The Hinton investigation publicized the existence of thick, non-artesian strata of water which underlay much of the High Plains. In 1890,

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[14] H. C. Smith to U.S. Department of Agriculture, [ca. 1887] Mount Blanco, Texas, in Hinton, Irrigation in the United States, p. 118.

[15] J. Evetts Haley, The XIT Ranch of Texas and the Early Days of the Llano Estacado (Norman: University of Oklahoma Press, 1953), p. 95.

[16] C. C. Perrin to U.S. Department of Agriculture, September 25, 1891, Tullia [sic], Texas, in [Richard R. Hinton], Irrigation: The Final Report of the Artesian and Underflow Investigation and of the Irrigation Inquiry, Senate Executive Document No. 41, 52d Cong., 1st sess., Serial No. 2899 (Washington, 1892), p. 297.

Hinton stated:

> One of the most remarkable of the series of facts which the investigation has so far brought together relates to the existence of great deposits of drainage water at a moderate depth below the alluvium . . . quite well established at different points within the central division of the Great Plains [the High Plains area].[17]

By 1900, the existence of sub-surface water resources lying at shallow depths beneath the Texas High Plains was well-known. The editor of The Earth, an agricultural magazine published by the Santa Fe Railroad, stated in 1905, "There is a water-sheet underlying much, if not all, of the Texas Pan-Handle. . . . There are districts already known as 'shallow water districts.'"[18]

The United States Geological Survey conducted an investigation of the geology of the Texas Panhandle in 1906 and 1907 under the able leadership of Charles N. Gould, geologist from the University of Oklahoma. Gould confirmed the existence of the water and noted that north of the Canadian River the depth to water was greater than that south of Amarillo. In the former area the depth varied from fifty to four hundred feet, but in the southern part of the Texas High Plains, water was found in many areas as little as seventy-five feet or less from the

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[17]Richard R. Hinton, "Report of the Special Agent in Charge of the Artesian and Underflow Investigations and of the Irrigation Inquiry," in Report of the Secretary of Agriculture, 1890, p. 484.

[18]The Earth (Chicago), II (August, 1905), 3.

surface. And in Deaf Smith County there were many wells no deeper than sixty feet.[19]

Consequently, the answer to the problem of irrigating the High Plains consisted of finding a cheap method of pumping large volumes of the sub-surface water to the surface. At least one leader of the irrigation movement of the 1890's called for the Federal Government to carry on experiments to develop suitable irrigation pumps. J. W. Gregory of Garden City, Kansas, in a speech at the Los Angeles Irrigation Congress of 1893, asked for extensive experimentation by the Federal Government to determine ways of utilizing the "under-flow."[20]

Meanwhile, a few far-fetched schemes were drawing some attention. For example, Eli Newsom, a former immigration agent for the Santa Fe Railroad, delivered an address before the Nebraska State Irrigation Association in 1896 entitled, "How to Irrigate All the Arible [sic] Lands in the Arid West." Newsom, who referred to himself as "the Elias Howe of the Irrigation Methods," outlined a plan to tap the "underflow" waters. Huge underground reservoirs with lateral tunnels would be constructed. The tunnels in turn would drain sub-surface water into

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[19] Gould, The Geology and Water Resources of the Western Portion of the Panhandle of Texas, p. 40.

[20] A. Bower Sageser, "Los Angeles Hosts an International Irrigation Congress," Journal of the West, IV (July, 1965), 420.

subterranean recepticles. Discharge tunnels from the reservoirs would then emerge from the ground at a lower elevation to water the thirsty soil. According to Newsom, this system could be used to irrigate the entire West, including the Great Plains.[21]

Proposals like that of Newsom were based partly on the thinking of some contemporary scientists, including Hinton, who believed that underground water--the "under-flow"--was actually a moving body of water which "flowed" to the sea. But more significantly, such schemes arose to fill a vacuum which technology had not yet filled. The means for pumping large volumes of water cheaply from wells had not yet been perfected. Newsom himself summed up the problem by stating, " . . . to-day we find the pump too limited and too expensive, too uncertain and troublesome, to practically serve the increasing demand of the practical irrigator. . . . Throw the old pump away and substitute nature's forces. Gravity . . . like charity, never faileth."[22]

The artesian well boom of the 1890's was a more realistic effort to use the forces of nature as a substitute for an irrigation pump. Artesian water, however,

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[21]Text of address in XIT Ranch Papers, Misc. West Texas, Panhandle-Plains Museum, Canyon, Texas.

[22]*Ibid*., p. 4.

was rare and found primarily in islands along the periphery of the High Plains.[23]

As the Federal government continued to explore the problem of water resources in the 1890's, several government irrigation experts recognized the problem. Hinton understood the complex problems of irrigating the Great Plains better than most of his contemporaries. Speaking before the North Dakota Agricultural College in March, 1891, he said:

> For my purpose I assume . . . that the reclamation of the great plains [sic] is not to be accomplished by any great system of water storage. . . . [It] is to be accomplished by a multitude of small detailed works, and must in the end be largely the result of neighborhood and individual exertion. . . . by the impounding of the little streams, by the utilization of springs, and by the restoration to the surface through artesian drills or by the mechanical lifting from other bored wells, of the waters that are stored below the surface soil in the earth itself. [italics mine] The strata below that soil are for great distances a series of huge sponges, wherein the lost, imbibed, and percolated rainfall will be found to be stored.[24]

One of Hinton's assistants in the "under-flow" investigation of the 1890's observed that "the whole question of the occupancy of this arid region [is reduced] to a powerful pump and a properly laid out ditch."[25] In 1896, the

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[23]For a discussion of the artesian well movement, see pp. 36-38.

[24][Hinton], Irrigation: The Final Report of the Artesian and Underflow Investigation and of the Irrigation Inquiry, p. 8.

[25]The "arid region" referred to is really the semi-arid region of western Kansas and eastern Colorado. Howard

irrigation engineer, Frederick H. Newell, summed up the problem in this way:

> The great problem, then, of obtaining water is that of pumping it at a cost so low that this operation can be performed with profit. . . . the question is not simply to lift the water. It must be lifted in large quantities, and, more than this, the cost of so doing must be extremely low--so low that it shall bear but a small proportion to the value of the crops produced. [italics mine] This last requirement is really the obstacle to the widespread development of agriculture by irrigation upon the Great Plains.[26]

By the end of the nineteenth century it was clear that if the High Plains, resting on a rich sub-surface lake of water, was destined to enjoy the blessings of irrigation, new technology in drilling and pumping would be essential.

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Miller, "Preliminary Report on the Possibilities of the Reclamation of the Arid Regions of Kansas and Colorado by Utilizing the Underlying Waters," in [Hinton], Irrigation, The Final Report of the Artesian and Underflow Investigation and of the Irrigation Inquiry, p. 305.

[26]Newell, "Irrigation on the Great Plains," pp. 180-81.

# CHAPTER IV

## THE PROBLEMS AND PROGRESS OF EARLY IRRIGATION TECHNOLOGY FOR THE GREAT PLAINS

The thesis of Walter Prescott Webb's The Great Plains is that Americans from the humid East were able to utilize the resources of the semiarid plains through the use of technological innovations. As some examples Webb cites the Colt revolver, barbed wire, and the windmill. But he fails to discuss man's adaptation to the Great Plains of a more complex invention which would have a significant impact upon the economy--the irrigation pumping plant.[1] When Webb published his classic in 1931, such pumps had been in use on the High Plains of his native Texas for over twenty years. But they were not yet in general use for reasons which will be discussed in a later chapter. It is ironic, however, that the technological innovations for pumping water to the surface in large enough quantities for purposes of irrigation were

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[1]Webb mentioned the windmill-powered pump as important in irrigating one or two acres of foodstuffs for settlers, but he recognized the limitations of windmills for purposes of irrigation. See The Great Plains (New York: Grosset and Dunlap, 1931), p. 346.

not mentioned in the classic interpretation of the Great Plains. Webb himself admitted that "the windmill mitigated the thirst of the Great Plains but did not assuage it. The search for water had to go on."[2]

By 1900 the existence of sub-surface water on much of the Great Plains was widely known. The "under-flow" and artesian investigations by Richard R. Hinton and the Water-Supply and Irrigation Papers of the United States Geological Survey did much in the 1890's not only to map the sub-surface water, but also to publicize its existence. The "search for water," therefore, was largely a search for technological means to bring the water to the surface in large enough quantity for irrigation purposes.

There were several technological problems to be solved. Not only was there a need to invent a pump which could pull large volumes of water from wells which were relatively deep, but a suitable and cheap power plant was also necessary. Moreover, that power plant required a cheap source of fuel. Finally, a pump capable of delivering a large volume of water would need a relatively large diameter well. New techniques in water-well drilling had to be devised to meet that challenge. Thus, the problems of technology were complex and interdependent upon one another for solutions. Those solutions would only be reached through years of experimentation and adaptation.

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[2] Ibid., p. 348.

Throughout the 1890's and the first decade of the twentieth century, efforts were made to adapt the windmill to irrigation.[3] In 1896 Frederick H. Newell, Chief Hydrographer of the United States Geological Survey, stated: "Of the devices for operating pumps for irrigation upon the Great Plains, windmills are undoubtedly the most important, and they will always remain so from the fact that the winds blow almost incessantly over this vast country."[4] The overly enthusiastic William E. Smythe, a leader in the irrigation movement of the decade, noted that windmill irrigation was being practiced in the Arkansas Valley around Garden City, Kansas. "From Canada to Mexico," he wrote, "the revolution on the Great Plains is now in full tide. It is the most dramatic page in the history of American irrigation. It has saved an enormous district [the Garden City area] from lapsing into a condition of semi-barbarism."[5]

Irrigation crusaders such as Smythe might overestimate the potential for windmill irrigation, but the windmill

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[3]For an account of windmill irrigation during the period, see A. Bower Sageser, "Windmill and Pump Irrigation on the Great Plains, 1890-1910," Nebraska History, XLVIII (summer, 1967), 107-18; and A. Bower Sageser, "Editor Bristow and the Great Plains Irrigation Revival of the 1890's," Journal of the West, III (January, 1964), 75-89.

[4]Frederick H. Newell, "Irrigation on the Great Plains," United States Department of Agriculture Yearbook, 1896 (Washington, 1897), p. 184.

[5]William E. Smythe, The Conquest of Arid America (2d ed.; New York: Macmillan, 1905), p. 118.

of Kansas, like the artesian well of the Dakotas, was an attempt to adapt existing technology, or a lack of it, to the needs of irrigation on the Great Plains. The windmill furnished cheap power for a relatively cheap pump. The ever-present wind blew through turbine-shaped or paddle-shaped vanes. This revolving motion was converted into reciprocating (up and down) motion by means of a direct connection or gearbox connection to a "sucker-rod." The "sucker-rod" was connected to a piston pump at the bottom of the well. A cylinder with brass check valves and leather rings slid up and down in a "working-barrel" beneath the water-level of the well. Water was forced into the "working-barrel" and up the pipe surrounding the "sucker-rod" with each up and down motion of the piston. The amount of water this type of pump could produce depended upon the size and stroke of the piston. Thus the larger the cylinder and the longer the stroke, the greater the volume of water which could be pumped. Also, the larger pump required a larger diameter windmill.

But the windmill pump by itself was not sufficient to irrigate more than a few short rows of vegetables or fruit trees. A reservoir had to be constructed in order to conserve all the water which the windmill pumped day and night throughout the year.[6]

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[6]Newell, "Irrigation on the Great Plains," pp. 187-90 describes the construction of such earthen reservoirs.

Windmills, however, were cheap. One with a wheel eight feet in diameter pumping from a depth of from twenty to forty feet could be purchased and installed in 1896 for a price which ranged from $70 to $125. A unit with a twelve-foot wheel cost from $100 to $200 and a sixteen-foot unit ranged from $175 to $300.[7] Some farmers built their own windmills at a fraction of the cost of the manufactured units. One observer noted in 1897 that the Platte River Valley of Nebraska was dotted with homemade windmills.[8] In 1895, Dr. W. J. Workman of western Kansas built what he claimed to be "the largest 'Jumbo' yet attempted." This Jumbo windmill was twenty-one feet in diameter. He intended to use the mill to power a pump with a cylinder fifteen inches in diameter and a twenty-four inch stroke to lift water fourteen feet. He expected the unit to deliver 800 gallons per minute.[9] But it is not known if he achieved his expectations.

Although windmill pumps were inexpensive, cost very little to operate, and had a seemingly inexhaustible supply

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[7] Ibid., p. 185.

[8] Erwin H. Barbour, Wells and Windmills in Nebraska, United States Geological Survey Water-Supply and Irrigation Paper No. 29, House Document No. 299, 55th Cong., 3d sess., Serial No. 3815 (Washington, 1899), pp. 34-35.

[9] A. B. Montgomery, "Irrigation Possibilities Upon the Higher Lands of Western Kansas," Ninth Biennial Report of the Kansas State Board of Agriculture, XIV (Topeka, 1895), 337-38.

of wind for power, there were serious weaknesses to windmill irrigation. First, windmills at that time failed to function satisfactorily if the lift exceeded an estimated seventy or eighty feet. One irrigation expert noted:

> As the matter of windmill irrigation is agitated the receptive mind of the progressive farmer seizes the idea. Not having experience and placing too confident reliance in the claim of the local [windmill manufacturer's] agent, who is not a wholly disinterested party, he undertakes to raise water for irrigation from impossible depths.[10]

Thus windmill irrigation by the middle 1890's had to be confined to the river valleys and relatively shallow ground water areas of the uplands.

The second problem with windmill irrigation was that it could not produce enough water for more than a few acres.[11] Finally, the wind was not always dependable, even on the Great Plains. One farmer believed that the wind could be depended upon to run the pump only about one-fourth of the time. "I know," he stated, "that Kansas had the reputation of being a windy state, but I have found, when it comes to making use of that wind, it is not there."[12]

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[10] Barbour, "Wells and Windmills in Nebraska," p. 30.

[11] A. Bower Sageser believes that "estimates on pumping capacity and acres irrigated were often over-optimistic." Two to five acres is Sageser's estimate. See "Windmill and Pump Irrigation on the Great Plains," 112.

[12] C. H. Longstreth, "Fruit and Vegetable Growing Under Irrigation," Ninth Biennial Report of the Kansas State Board of Agriculture, XIV (Topeka, 1895), 370.

The windmill did provide a method for the farmer to remain on the Great Plains. During periods of drouth he could produce enough vegetables and fruit to feed his family, and perhaps sell some to his neighbors.[13] One historian of windmill irrigation has noted, however, that "the windmill did not bring large scale irrigation."[14]

Interest in the possibilities for pump irrigation on the Great Plains remained high through the drouth of the early 1890's. The Interstate Irrigation Association which convened at North Platte, Nebraska, in December, 1893, met primarily to investigate various methods of recovering underground water--by artesian flow and by pump. The Omaha Irrigation Convention of 1894 convened for the same purpose. The Finney County Agricultural Society and Fair of Garden City, Kansas, had a special exhibit of various kinds of pump equipment in 1894. And at the Kansas Irrigation Association meeting of the same year, a representative of the Fiarbanks-Morse Company read a paper on pump equipment.[15] In 1895 the Kansas Board of Irrigation

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[13]"The prerequisite [to prevent emigration from the semiarid plains] is the irrigation of one acre on which to raise garden truck for the family, and this the windmill renders possible." Barbour, Wells and Windmills in Nebraska, p. 31.

[14]Sageser, "Windmill and Pump Irrigation on the Great Plains," 114.

[15]A. Bower Sageser, "Editor Bristow and the Great Plains Irrigation Revival of the 1890's," Journal of the West, III (January, 1964), 81-82.

Survey and Experiment made a detailed report of its investigations and experiments with windmill irrigation.[16] The widespread interest indicated that farmers of the plains were still groping for economical methods to irrigate their crops.

To become a commercial, rather than a subsistent irrigation farmer, irrigators on the Great Plains needed a large volume pump capable of lifting water from deep wells. Such a pump evolved from several different circumstances. The first step in the process occurred when in 1875 a greatly improved model of a centrifugal pump was patented in England. Centrifugal pumps had been built as early as 1754 but were generally regarded as highly inefficient. Then, in 1875, the impeller was designed with diffusion vanes surrounding it. By 1900 this greatly improved pump was widely used in Europe and in the United States. The centrifugal pump consisted of a revolving impeller of special design housed inside a close-fitting circular chamber. Water entered the chamber at the center of the impeller, and was thrown to the outside of the impeller by the force of the centrifugal motion which, in turn, forced the liquid out through a discharge pipe. This type of pump was capable of delivering a large

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[16] Report of the Board of Irrigation Survey and Experiment for 1895-1896, to the Legislature of Kansas (Topeka, Kansa, 1897).

volume of water--several hundred gallons per minute or more depending upon the size of the pump--and it contained no valves which could easily become clogged. The pump was much larger in diameter than a piston-type pump, and it had to be set near the water level. Theoretically, water could be sucked from a depth of thirty-three feet at sea level, but practical farmers and pump engineers used twenty feet as a rule of thumb. Thus, the pump could be located no farther than twenty feet higher than the water level.[17] Consequently, a large-diameter pit had to be dug down to the water level in order to use the centrifugal pump.

Two types of centrifugals were in use by the middle 1880's in areas where the ground water was shallow in the West--the horizontal and the vertical pump. The horizontal centrifugal designed for relatively shallow wells had a horizontal impeller-shaft. It was powered by either an electric motor located in the pit and connected directly to the shaft, or by a steam or internal-combustion engine located at the surface and connected to the shaft by means of a long belt and a pulley. In the latter instance, an inclined trench for the belt had to be dug from the bottom of the pit to the pump.

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[17]E. W. Bennison, Ground Water: Its Development, Use and Conservation (St. Paul, Minnesota: Edward E. Johnson, 1947), pp. 197, 373-76. B. A. Etcheverry, Irrigation Practice and Engineering (3 vols.; New York: McGraw-Hill, 1915), I, 182.

The vertical centrifugal was identified by its vertical shaft which reached from the pump to the surface. As on the horizontal centrifugal, a long belt connected an engine on the surface to a pulley on the shaft. A wooden framework complete with shaft-bearings was required for the pump but the unit needed no trench for the belt. The vertical centrifugal was used in areas in which ground water was more than fifteen or twenty feet from the surface. Its greatest weakness was the difficulty of perfectly aligning its long, vertical shaft in order to prevent undue wear on the bearings located at different elevations within the wooden framework in the pit.

By the late nineteenth century, the centrifugal pump was being used for irrigation purposes in the West. In 1885, E. F. Hurdle installed a centrifugal pump east of Eaton, Colorado, and powered it with a steam engine.[18] In 1896, irrigators in the vicinity of Garden City, Kansas, began experimenting with centrifugals. They dug no pits because water was reported to be eight and one-half feet from the surface. Sand points were driven into the water supply and the horizontal centrifugals sucked the liquid to the surface. Using steam power, a No. 2 pump delivered 245 gallons per minute through a six-inch pipe, and a No. 3 pump delivered 625 gallons per minute. At Hutchison,

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[18] Alvin T. Steinel, History of Agriculture in Colorado, 1858 to 1926 (Fort Collins, Colorado: State Agricultural College, 1926), p. 232.

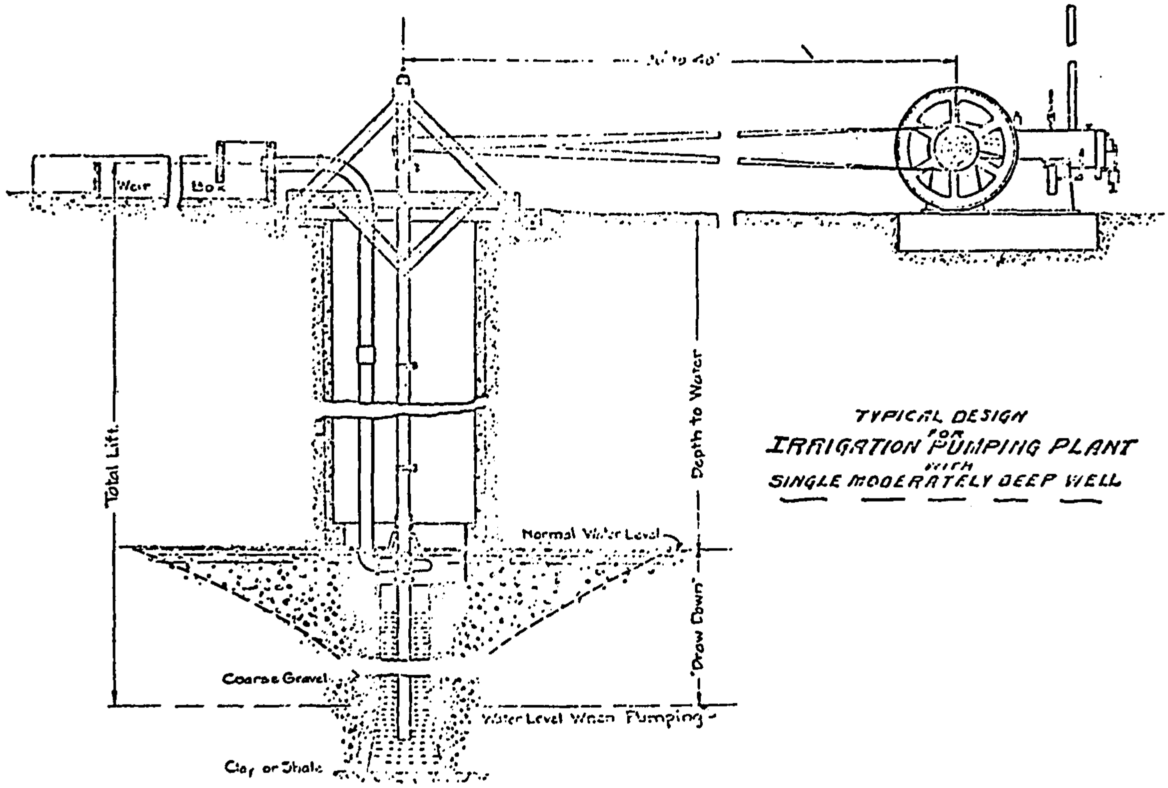


FIG. 48. A plan for a single irrigation well.

A VERTICAL CENTRIFUGAL PUMP SHOWING
PUMP, ENGINE AND BELT

From: J. B. Marcellus, "Selection and Installation of a Pumping Plant for Irrigation," <u>Twenty-first Biennial Report of the Kansas State Board of Agriculture</u>.

Kansas, a packing company was operating several No. 6 pumps, each of which was reported to be pumping 1,300 gallons per minute.[19] As early as 1891, centrifugals were in use in the Sacramento Valley of California, and at least one of these was powered by the pulley on a steam traction engine.[20] In 1900 S. J. Murphy, after failing to find artesian water on his farm near Mesa, Arizona, installed a large centrifugal capable of delivering 4,000 gallons per minute through a twelve-inch discharge pipe from a lift of twenty-two and one-half feet.[21]

By 1900 centrifugal pumps were being used for irrigation purposes in many areas of the West, but in a Federal report of 1898 entitled New Tests of Certain Pumps and Water Lifts Used in Irrigation, the author makes no mention of centrifugal pumps.[22] This type of pump was not yet in general use because it was too

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[19] D. M. Frost, "Underground Water," Report of the Board of Irrigation Survey and Experiment for 1895-1896, to the Legislature of Kansas, pp. 187-88.

[20] C. E. Grunsky, "Methods of Applying Water to Land, As Practiced in the Central Portions of California," Irrigation: The Final Report of the Artesian and Under-flow Investigation and of the Irrigation Inquiry, 1892 (Serial No. 2899), pp. 319-20, plate 15 opposite 320.

[21] Elwood Mead, ed., Report of Irrigation Investigation for 1901, United States Department of Agriculture Experiment Stations Bulletin No. 119 (Washington, 1902), p. 65.

[22] Ozni Porter Hood in United States Geological Survey Water-Supply and Irrigation Paper No. 14 (Washington, 1898).

expensive for the average farmer. In 1901 a No. 2 centrifugal pump capable of delivering from 150 to 200 gallons per minute cost from $230 to $390.[23] This price did not include the power plant, nor the cost of digging the well. Frederick Haynes Newell reported that centrifugal pump irrigation was,

> considerably higher than the amount yearly paid for the maintenance of canals and ditches in the arid region, or the amount paid annually to a canal company for delivering water. It is rarely below $2 per acre irrigated, and from this as a minimum, may rise to $5 or even $10 an acre. This method of obtaining water will not be profitably employed for general crops, except . . . rice. . . .[24]

Aside from the problem of cost, the centrifugal pump did not meet the demands of Great Plains irrigators except in areas of shallow ground water such as river valleys because of the necessity of digging a pit down to the water level. This presented no great problem if the water was not more than twenty or thirty feet deep. But in areas where the water was fifty feet or more below the surface, the process of constructing such a pit was not only expensive, but dangerous as well. And installing the pump in the pit was only the beginning of problems for the irrigator. Daily, someone had to climb down into the pit to lubricate the pump and the shaft bearings while the shaft or the belt continued in motion. It was also

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[23]Mead, "Irrigation Investigation for 1901," p. 33.

[24]Frederick Haynes Newell, <u>Irrigation in the United States</u> (New York: Thomas Y. Crowell, 1902), p. 271.

periodically necessary to re-pack the bearings of the shaft and impeller, and to splice belts.

The need for a "pit-less pump" was especially acute around the turn of the century to provide water for Gulf Coast rice and the California fruit and vegetable industry as well as for Great Plains farming. In 1907 it was reported that about 750,000 acres were under pump irrigation. Of this total, California had 200,000 acres and the rice fields of the Louisiana and Texas coastal area had some 400,000 acres. Inventors in both areas were attempting to design a better deep-well pump.[25] As early as 1897 an inventor named P. K. Wood designed a type of deep-well apparatus known as a propeller pump.[26] As the name implied, the pump consisted of a propeller-like impeller which fit closely in a pipe. The impeller was connected to a shaft which was turned by a power plant at the surface. But the Wood pump was very inefficient.

By coincidence, Byron Jackson in San Francisco and Mahlon E. Layne at Houston, Texas, invented similar pumps independently at about the same time. In 1901 Jackson designed and constructed a special type of deep-well

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[25]Elwood Mead, "Irrigation Engineering and Practice," Cyclopedia of American Agriculture: A Popular Survey of Agricultural Conditions, Practices and Ideals in the United States and Canada, ed. by Liberty H. Bailey (4 vols.; New York: Macmillan, 1907), I, 425.

[26]Letter, Walter N. Moline of Byron Jackson Pump Division of Borg Warner Company to author, July 2, 1968, Los Angeles, California.

centrifugal pump with the shaft pre-aligned in its own tubular housing for the Pabst Brewing Company of Milwaukee, Wisconsin. It was powered by an electric motor connected directly to the vertical shaft of the pump. Elwood Mead, an irrigation engineer who would later become head of the Bureau of Reclamation, acted as consulting engineer. As far as can be determined, however, Jackson did not put this pump into production for several years. The Layne & Bowler Company actually installed the first pump of this type at Chino, California, in 1907.[27]

But the greatest need for this type of pump probably existed in the Gulf rice belt. From 1894 through 1897 the production of American rice in Louisiana alone fell from 182 million pounds to 56 million pounds annually. Two factors were responsible for this decrease. First, the Wilson-Gorman tariff of 1894 lowered the import duty on the better qualities of rice to a point that American-grown rice had to compete with Oriental rice. Secondly, a drouth struck the lower Mississippi Valley during the same period. Consequently, surface water supplies from canals and rivers were greatly diminished. But a drastic change in the fortunes of the rice industry set the stage for new developments along the Gulf Coast.

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[27]Ibid. W. H. Holcomb, "The Development of the Deep-Well Turbine Pump," Mechanical Engineering, LI (November, 1929), 833. Holcomb is mistaken in stating that the pump for Pabst was installed at Chicago.

The Republicans returned to power as a consequence of the election of 1896. The McKinley Administration approved the higher Dingley Tariff in 1897 which, in turn, raised the rates on rice back to a protective level. And on the international scene, as a result of territorial acquisitions of the Spanish-American War, the prospect of new rice markets in Latin America and in Asia appeared on the horizon. Subsequently, rice production began to climb especially after rice farmers began to tap their reservoirs of ground water.[28]

In the spring of 1901, an imaginative well-driller from South Dakota named Mahlon E. Layne arrived in East Texas to observe the Spindle Top oil boom. Deciding that the economic prospects for drillers were very attractive in the area, he moved to Beaumont, Texas, in 1902, bringing with him a young engineer named O. P. Woodburn. Layne designed and Woodburn built a heavy-duty screen to be placed at the bottom of oil well casings. The men were particularly successful in extracting petroleum from geological formations which contained fine sand. Then Layne turned to the problem of rice irrigation.[29]

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[28]Joseph Cannon Bailey, Seaman A. Knapp, Schoolmaster of American Agriculture (New York: Columbia University, 1945), pp. 127-29. Edward Hoke Phillips, "The Gulf Coast Rice Industry," Agricultural History, XXV (April, 1951), 95.

[29]Manuscript memoirs of O. P. Woodburn (1944), pages not numbered. In files of Layne and Bowler Company, Memphis, Tennessee. Hereafter cited as O. P. Woodburn

During the spring and summer of 1902, Layne and Woodburn dug and drilled four wells near Pierce, Texas for a rice planter named Milner. They dug pits eight to ten feet in diameter and usually thirty to forty feet deep to water. Then they drilled a hole sixteen to twenty-four inches in diameter at the bottom of each pit, casing it as they drilled, for a hundred or more feet in order to draw upon deeper strata of water. At the bottom of the well they installed a Layne Keystone Screen in order to obtain water from formations of fine sand.[30]

Layne installed horizontal centrifugal pumps in three of the wells and a vertical centrifugal in one. The three horizontals were Fairbanks Morse pumps powered by Fairbanks Morse oil-burning engines. Rope, used as belting in grooved pulleys, ran from the engine over idlers and down into the pit. Tension was maintained by using several fifty-pound weights which dangled at the top of the pits. O. P. Woodburn later vividly recalled the problems of servicing those pumps. "Imagine getting down into the pit to oil the pump with the mess of rope running at the velocity of the outside diameter of the 54" fly wheel with 6 or 8 50# [pound] weights dancing on the

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manuscript memoirs. Layne Water Facts (Houston, Texas and Memphis, Tennessee, 1914), in possession of Carl Gelin, Lubbock, Texas, p. 152. Magner White, "Layne Founded His Business on Seeping Sands," American Magazine, CII (November, 1926), 152.

[30] O. P. Woodburn manuscript memoirs.

tightener above your head. <u>BAD DREAMS</u>."[31] Woodburn further recalled that during periods of dry weather the pumps, which could not be easily adjusted to a drop in the water level, would sometimes lose their prime. When it rained, the pits would cave in or fill partly with water, and the rope belts frayed and disintegrated.[32]

During that summer of 1902 when Layne was climbing in and out of the pits, he conceived the idea of a "pit-less pump." Woodburn recalled: "One day he got me off to the side of a building, sketched a pit on the wall with a pump at the bottom and shaft running to the top." Layne's idea was really a sophistication of the vertical centrifugal pump. The shaft was enclosed in a pipe which was flanged onto the pump. The whole thing was enclosed in a steel casing. Bearings were lubricated by oilers at the surface, and the pump could be raised or lowered from the surface. In the spring of 1903, Layne built his first deep-well "pit-less" pump. He bought some turbine pump bowls from a Chicago manufacturer, and constructed his first crude model, which he installed in a rice field near El Campo. There were many weaknesses in this first pump. The impeller blades were too short, there were leaks, and the bearings needed considerable modification. But the apparatus did pump water. Layne then decided to

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[31] <u>Ibid</u>.

[32] <u>Ibid</u>.

manufacture his own pump.[33] In 1904 he formed a partnership with Woodburn, and a salesman named P. D. Bowler. Layne continued to improve the pump, and in 1906 he patented it. With headquarters first located at Houston, the partners formed the Layne and Bowler Company in 1907.[34]

The company enjoyed a phenomenal growth because of the need for such a pump in the rice belt. Depending upon the supply of water, the Layne pump could easily deliver 1,000 gallons or more per minute. One Layne user broke out into verse over the development. R. D. Ratliff of Ganado, Texas, sent the following rhyme to the Layne and Bowler Company in 1908:

> That old fashion [sic] Pump!
> That old wooden pit,
> When I dream of them now
> I most have a fit.
>
> But then in my dreams,
> I realize at last

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[33] Ibid. A different account is given by J. E. Harmon who began working with the Layne and Bowler Company in 1908 or 1909. Harmon recalled that the first Layne pump was installed on the farm of H. B. Allen Sickel near Louise, Texas, and that he (Harmon) bought the second pump. Letter, J. E. Harmon to A. O. Fabrin, Columbus, Ohio, December 28, 1943. Files of Layne and Bowler Company, Memphis, Tennessee. But Harmon did not install his pump until December, 1905. Letter, J. E. Harmon to Layne and Bowler Company, Ganado, Texas, December 15, 1908 in Southern Pacific Irrigation Well Experts ([Houston, Texas, ca. 1909]), p. 37, in files of Layne and Bowler Company, Memphis, Tennessee. Order Number One in the file of Layne and Bowler Company is dated June, 1905 and made out to R. F. Kreiter, Katy, Texas. Layne and Woodburn undoubtedly built and installed several crude pumps before they began keeping records of pumps purchased.

[34] Ibid., and Layne Water Facts, 1952-53.

That the old Pumping [sic] outfit
Is a thing of the past.

My soul fills with joy
And my heart gives a jump,
When I remember with pleasure
My "Layne Pit and Pump."[35]

By 1909 Layne and Bowler was boasting that more than five hundred of its pumps were being used to irrigate more than 75,000 acres of rice.[36] Cost of the pump was approximately $500, not including the cost of the well and power plant.[37] Thus, by 1907, a pump capable of lifting great volumes of water from underneath the Great Plains was in production.

Walter Prescott Webb and Fred A. Shannon noted that many of the innovations which helped man to subdue the Great Plains were invented in the East before being adapted to the plains environment. Barbed wire was first used on the middle western prairies. By 1870 windmills were being used in the East, primarily to supply water for towns and for railroad locomotives. Horse-drawn mechanized farm machinery, such as the sulky plow, was also first used in

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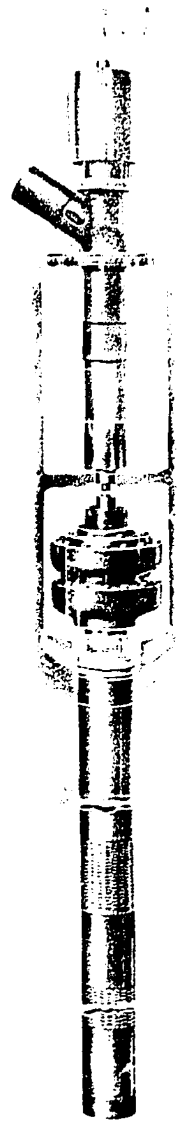
[35] Southern Pacific Irrigation Well Experts, p. 21. The 26-inch diameter tubular steel housing for the shaft was first referred to as a "steel pit." W. L. Rockwell, The Water Resources of Texas and Their Utilization, Texas Department of Agriculture Bulletin No. 43 (Austin, 1914), p. 26.

[36] Ibid., p. 21.

[37] J. E. Harmon to A. O. Fabrin, Columbus, Ohio, December 28, 1943. Files of Layne and Bowler Company, Memphis, Tennessee.



THE LAYNE "PIT-LESS" PUMP

From: Layne Water Facts. Courtesy of Layne & Bowler Company, Memphis, Tennessee.

the older prairie states.[38] Likewise, the irrigation pump suited for the Great Plains was first developed in a humid region.

The development of a suitable pump was not the only problem of technology to be solved. The problem of drilling a well of large enough diameter for the casing of such a pump loomed large. Such a drill had to be capable of sinking a hole twenty to thirty inches in diameter. The most common form of drill for the smaller-diameter windmill wells was the "spudder" rig which punched a relatively small hole by raising and dropping a heavy steel bit into the ground. The "spudder" was unsuitable for drilling large-diameter wells because the larger, heavier bits required larger, heavier, more expensive rigs which were much less mobile. In other words, "spudder" rigs were impractical for boring such wells. A different type of drill was needed.

The artesian well boom, which developed in the 1880's and 90's in the Dakotas, bred a generation of well-drillers. Peter Norbeck, who later became Governor and then Senator from South Dakota, made a fortune drilling extremely small-bore artesian wells ranging from one to three inches in diameter. Norbeck greatly improved the "jetting" method

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[38] See Webb, The Great Plains, pp. 295-318, 333-48, and Shannon, The Farmer's Last Frontier, Agriculture, 1860-1897, Vol. V of The Economic History of the United States, ed. by Henry David, et al. (New York: Holt, Rinehart and Winston, 1945), pp. 125-47.

in drilling wells, consequently lowering the cost to farmers.[39] Mahlon E. Layne also began his well-drilling career in the northern Great Plains, but he developed a different approach to putting down wells in the Dakota sands. He concentrated on drilling shallow non-artesian wells of large diameter--the kind of well later suited to his "pit-less" pump.

Layne's experience began in 1882 near Hurley, South Dakota when he began drilling small-diameter wells. But he was constantly hindered with the problem of fine sand which tended to clog up the wells, cutting off the water. In 1886 he decided to drill larger holes. Subsequently, he purchased an auger capable of drilling wells from eighteen to thirty-six inches in diameter, turned by a horse walking in a circle. He believed that a larger hole would be less likely to "sand up." Then in 1887, near Parker, South Dakota, Layne designed a unique "well screen" which he placed at the bottom of the casing. Earlier well screens had been designed to keep out fine sand allowing only water to pass into the well. But fine sand had the tendency to pack against the outside of the screen, completely choking off the water supply. Layne's screen contained larger perforations which allowed the

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[39]For an account of Norbeck's drilling career, see Gilbert C. Fite, Peter Norbeck: Prairie Statesman, The University of Missouri Studies, XXII (Columbia: University of Missouri Press, 1948), 14-27.

fine sand to pass through but held back coarse gravel. He contended that by pumping out the sand, the coarse gravel would become packed against the screen and serve to keep out other fine sand. Confident of his techniques, Layne advertised: "No water, no pay." Throughout the remainder of the 1880's and 1890's the well-driller bored wells for farmers, towns, and railroads in South Dakota, Nebraska, Minnesota, Wisconsin, and Iowa. He designed better drilling rigs powered by as many as six horses. In 1896 he converted to steam power. And that same year he built a rotary drill of his own design.[40]

The rotary rig was well suited for boring large-diameter wells. It had first come into use about 1890 in the oil fields of Louisiana.[41] Fitted with a rotating drill bit and powered by steam, it was capable of drilling small or large diameter holes depending upon the horsepower of the engine. Thus, even before Layne moved to the heart of the East Texas oil fields in 1902, where many "rotarys" were already in operation, he had acquired experience with this method.[42]

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[40]White, "Layne Founded His Business," 150-51. Layne Water Facts, pp. 151-52.

[41]Bennison, Ground Water: Its Development, Uses and Conservation, p. 133.

[42]When Layne and O. P. Woodburn arrived in East Texas, they purchased another rotary rig and rented a steam traction engine for power. O. P. Woodburn manuscript memoirs.

The final problem to be overcome before pump irrigation could gain a foothold on the Great Plains was that of finding a dependable and cheap power supply. Steam engines were used for the early centrifugal pumps.[43] In 1900, near Mesa, Arizona an eighty-horsepower steam engine was installed to power the centrifugal pump of S. J. Murphy. The Murphy plant required four men to maintain the operation--two engineers who serviced the engine and two firemen who cut wood for fuel. The daily cost for crew, oil, and maintenance parts was $9.25. Cost for the wood obtained from the property of Murphy's neighbor was an added expense. Taking all expenses into consideration, the Murphy plant cost $2.27 for each acre-foot of water produced.[44] Referring to a test run on the unit, an engineer of the United States Department of Agriculture announced: "It will be seen that the expense of raising water by steam power is very great indeed, and that as a general proposition such water is too costly for constant use in ordinary farming operations."[45]

By 1910 electricity was being used to drive some pumps. The Northern Colorado Power Company actively solicited irrigation farmers in its area to use electricity.

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[43]See p. 68.

[44]Mead, <u>Report of Irrigation Investigations for 1901</u>, p. 66.

[45]<u>Ibid</u>., p. 69.

The company recognized that irrigators pumped water primarily through the summer months when urban customers used a minimum amount of electricity. By increasing its service to irrigation farmers the company could increase its sales without increasing capitalization for equipment to generate more electricity.[46]

Electric motors connected to irrigation pumps by belt pulleys or by direct shaft connections were found from Texas to the Dakotas, and from Kansas to California. At least one Federal reclamation project used electric motors to power large centrifugal pumps located on barges which sucked water from a reservoir at Williston, North Dakota, and pushed it up onto a plateau to water some 12,000 acres. Power was supplied by a gas-generating plant using locally-mined coal for fuel.[47] One of the more interesting attempts at using electrical power was carried out near Garden City, Kansas on the Arkansas River.

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[46] E. C. Reybold, Jr., "Electric Irrigation Pumping in Colorado," Electrical World, LV (April 7, 1910), 863-66. E. C. Reybold, Jr., "Irrigation Pumping," Electrical World, LV (April 28, 1910), 1064-1066. E. C. Reybold,Jr., "Electric Irrigation Pumping in Kansas," Electrical World, LV (June 9, 1910), 1532-1533. C. H. Williams, "Electric Energy from Coal for Irrigation Farming in Colorado," Electrical World, LVIII (September 30, 1911), 805-11. Alton D. Adams, "Electric Pumping for Irrigation," Electrical World, LV (June 30, 1910), 1709-1711. Alton D. Adams, "Electric Pumping in California," Electrical World, LVI (July 28, 1910), 206-07. Electrical World, LVI (July 21, 1910), 150-52.

[47] Alton D. Adams, "Electric Pumping for Irrigation," 1709-1711.

There the United States Sugar and Land Company built a power plant in 1909 to generate electricity to power fourteen pumps. About fifteen miles of lines were strung and oil was used to power the plant engines.[48]

There were several desirable aspects of using electric motors. First, there were relatively few repairs on the motors. And second, they required a minimum of attention while in operation. But they also had serious drawbacks. An electric generating plant had to be located nearby. No problem existed near the mountains where new hydroelectric plants were located, or near cities which already had electricity. But in 1910, few rural areas on the Great Plains had access to electrical transmission lines. The most important difficulty, however, even where electricity was available, was cost.

Electric companies charged not only a rate per kilowatt hour, but there were other costs which the farmer had to meet. He had to pay for the electrical line to his pump. Sometimes the company required a simple fee. At times the cost was absorbed by requiring the farmer to pay increased rates for the first few seasons. Moreover, power companies usually charged a monthly rate for each horsepower of the motor. Finally, expensive rates per

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[48] George Wharton James, Reclaiming the Arid West (New York: Dodd, Mead and Company, 1917), pp. 263-70. E. C. Reybold, Jr., "Electric Irrigation Pumping in Kansas," 1532-1533.

kilowatt hour were charged. In 1908, a motor which powered a five-inch vertical centrifugal pump, and which produced an average of 448 gallons per minute from a lift of approximately seventy-three feet, cost about $3.94 per acre foot. This was figured at 2-1/2¢ per kilowatt hour.[49] Thus, it was more expensive to run pumps with electricity than with steam which required a four-man crew.

Like the pump, the type of power plant which pump irrigators on the southern Great Plains first depended upon was invented elsewhere. The first practical internal-combustion engine was constructed in 1860 by Jean Joseph Étienne Lenoir, a French engineer. Sixteen years later a German scientist name Nikolaus August Otto built the first successful four-cycle engine. Both machines used illuminating gas for fuel. By coincidence, that same year George Brayton, a Bostonian, exhibited a four-cycle engine fueled by gasoline at the Philadelphia Centennial Exposition.[50] The gasoline engine then became a toy for various inventors and engineers who improved it and applied it to all kinds of devices, including the earliest automobiles. But gasoline, which was more highly refined than kerosene, was not an inexpensive fuel at that time.

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[49] Ray Palmer Teele, "Review of Ten Years of Irrigation Investigation," <u>Annual Report of the Office of Experiment Stations</u> (Washington, 1908), p. 386.

[50] Eleanor Allen, "Internal-Combustion Engine," <u>The Encyclopedia Americana</u>, 1958 ed., XV, 225.

There was a need in industry as well as in irrigation for an engine which would burn the cheapest of fuels. That need was met in 1890 when Herbert Ackroyd-Stuart, an English engineer, built the first low compression oil-burning engine. Hornsby and Company of England became interested in the engine, worked with Ackroyd-Stuart in improving it, and placed it on the market in 1894. This type of engine became popular in the industrially-expanding United States. In 1895, a concern in the United States began to manufacture the engine which was now called the Hornsby-Ackroyd.[51] Within a few years other companies such as Primm, Charter, Bessemer, Van Sevrein, Fairbanks Morse, Herr, and others were manufacturing this type of engine and selling it to pioneer pump irrigators in the Gulf Coast rice belt, on the Great Plains, and throughout the West.[52]

There were several desirable qualities in this engine.[53] For example, it was extremely simple in design.

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[51]Diesel Engine Manufacturers Association, "Diesel Engine," The Encyclopedia Americana, 1958 ed., IX, 100.

[52]This type of engine was common in the rice belt soon after the turn of the century. As early as 1903, Mahlon E. Layne and O. P. Woodburn were using oil engines to power centrifugal pumps in their early rice wells. O. P. Woodburn manuscript memoirs.

[53]This type of engine should not be confused with the diesel engine which was developed during the 1890's. The diesel operated on a different principle at very high compression. For a detailed account of the differences between the two types of engines see Lacey H. Morrison, Oil Engines: Details and Operation (New York: McGraw-Hill, 1919), pp. 306-07.

It consisted of one large cylinder, although some later models had two or more cylinders. Horsepower ranged from five, to seventy or more in the larger engines. Single or double flywheels made of cast iron and ranging up to four feet or more in diameter augmented its power. The key to this engine was the method in which the fuel oil was ignited. There were no spark plugs or electrical system of any kind.

The Hornsby-Ackroyd engine had a "hot-bulb" in its head which ignited the oil. The "bulb," usually referred to as the "hot ball" or "hot spot" by Americans, protruded from the engine head. In order to start the engine, the "bulb" was heated with an alcohol or gasoline torch. Then the flywheel was rotated for two or three revolutions. In the meantime, oil was injected into the cylinder head against a piece of metal called a spoon or lip which absorbed the heat of the "bulb" by conduction. When the oil splashed against the hot metal, it vaporized into hydrocarbons which were then ignited by the heat of the "bulb." Small engines could be started by rotating the flywheel by hand, but larger models required the forcing of compressed air into the cylinder chamber which, in turn, pushed the piston forward. The engine re-heated the "hot-ball" with each ignition.[54]

[54] *Ibid.*, pp. 306-23.

By standards of the later twentieth century, the "hot ball" engine was crude. Cold weather made starting difficult. Its efficiency was low. And it was an expensive engine. In 1913 a seventy horsepower Bessemer engine retailed for $1,540; and costs for the engine foundation, freight, a belt to connect the engine to the pump, "drayage," and labor ran the total price up to $1,936.[55]

The cost of fuel for the engine, however, was very cheap. A report of the United States Department of Agriculture in 1916 recommended oil-burning engines for pump irrigation because the cost of the fuel ranged from three to seven cents per gallon or about one-fourth to one-third the cost of gasoline.[56] By 1919, it was reported: "In the oil districts of the Southwest the low-pressure engine is handling pumping plants and is burning the heavy crude oil to the entire satisfaction of all concerned."[57]

In the early experimental stage of pump irrigation on the Great Plains, various types of pumping plants appeared in different localities. In river valleys, where water was only ten to twenty feet from the surface,

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[55]Bill submitted by D. L. McDonald to Double U Company, Hereford, Texas, May 29, 1913, Double U Company Papers, file no. GC 1246, Southwest Collection, Texas Technological College.

[56]P. E. Fuller, "Pumping for Irrigation on the Farm," United States Department of Agriculture Yearbook, 1916 (Washington, 1917), p. 519.

[57]Morrison, Oil Engines, p. 447.

horizontal centrifugal pumps were used. For example, in the Arkansas River valley of western Kansas, such pumps, in existence before 1910, pulled water from several wells with a single pump. The pump, set in a pit just above water level, was connected to a battery of shallow wells. At the surface an oil or gasoline engine powered the pump by means of a long belt which stretched in a forty-five degree angle from the bottom of the pit to the power plant.[58] One Kansas farmer even used his automobile for power to irrigate. By raising the rear of his car and running a belt from the rear axle, he powered a small vertical centrifugal pump.[59] And in Scott County, Kansas, J. W. Lough built his own electric generating plant in 1917 in order to drive a motor which was directly connected to a "pit-less" pump.[60]

On the Texas High Plains, the irrigation plant evolved from a relatively simple to a more complex and more efficient unit. Aside from a few early test wells, the first irrigation plants, installed in 1910 and 1911, in the vicinities of Hereford and Plainview were vertical

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[58] J. B. Marcellus, "Selection and Installation of a Pumping Plant for Irrigation," Twenty-first Biennial Report of the Kansas State Board of Agriculture, XXVI (Topeka, 1919), 114-16.

[59] J. L. Pellaur, "Irrigating with an Automobile," Nineteenth Biennial Report of the Kansas State Board of Agriculture, XXIV (Topeka, 1915), 320-22.

[60] The Earth (Chicago), XIV (November, 1917), 12.

centrifugal pumps powered by gasoline and oil engines. D. L. McDonald, who played an important role in irrigation development of the region, installed the first successful unit near Hereford in February, 1910. Located in Frio Draw, a vertical centrifugal pump pulled water from a shallow pit. Within the year McDonald adopted three significant improvements for subsequent irrigation units which he installed--Layne "pit-less" pumps, a rotary drilling rig, and oil engines.[61]

At Plainview a similar technological pattern evolved. The first well, put down on the farm of banker John H. Slaton, was a pit-type with a vertical centrifugal driven by a naptha-burning engine. George E. Green and his partner, J. N. McNaughton, installed the unit.[62] In the next few years, George E. Green, a driller and self-taught engineer, put in many of the pumping plants in Hale County and in other areas of the High Plains. A native of Missouri, Green had migrated to Plainview in 1909 from South Dakota where he had been a well-driller. Before that he had founded the Ideal Pump and Manufacturing

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[61]See pp. 131-32.

[62]Riley E. Baker was unable in his research to discern the type of pump used in the Slaton well. Moreover, he is mistaken in calling that well the "first successful irrigation well in the Texas High Plains." See his "Water Development as an Important Factor in the Utilization of the High Plains of Texas," Southwestern Social Science Quarterly, XXXIV (September, 1953), 31-32.

Company at Green City, Missouri, which manufactured double-action hand and windmill pumps of Green's own patent.[63] Thus, the driller from Missouri brought a great deal of technological experience to Plainview. His first wells were vertical centrifugals, and most were powered by oil engines.[64]

Several "pit-less" pumps were in operation near Plainview by 1914. J. Walter Day, a local land agent, first put down a well in early 1912 and installed an ordinary centrifugal pump. In 1914, he replaced the centrifugal with a Layne pump. In a testimonial to the Layne and Bowler Company, he stated, "I am pumping twice as much water as I did with my old pump and do not have one particle of trouble with it. It is simple and efficient and gets the water."[65] The Texas Land and Development Company, which attempted to develop and to sell improved irrigation farms, used "pit-less" pumps manufactured by Layne and Bowler or by the American Well

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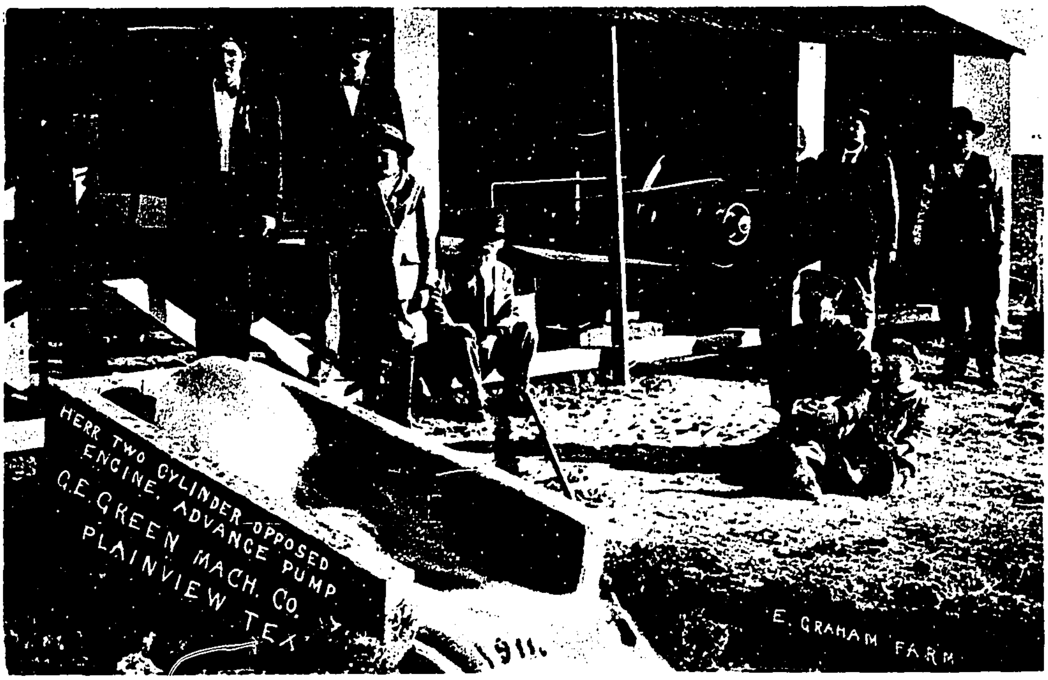
[63]Joseph F. Gordon, "George E. Green," in Builders of the Southwest, ed. by Seymour V. Conner (Lubbock: Texas Technological College, 1959), pp. 95-97.

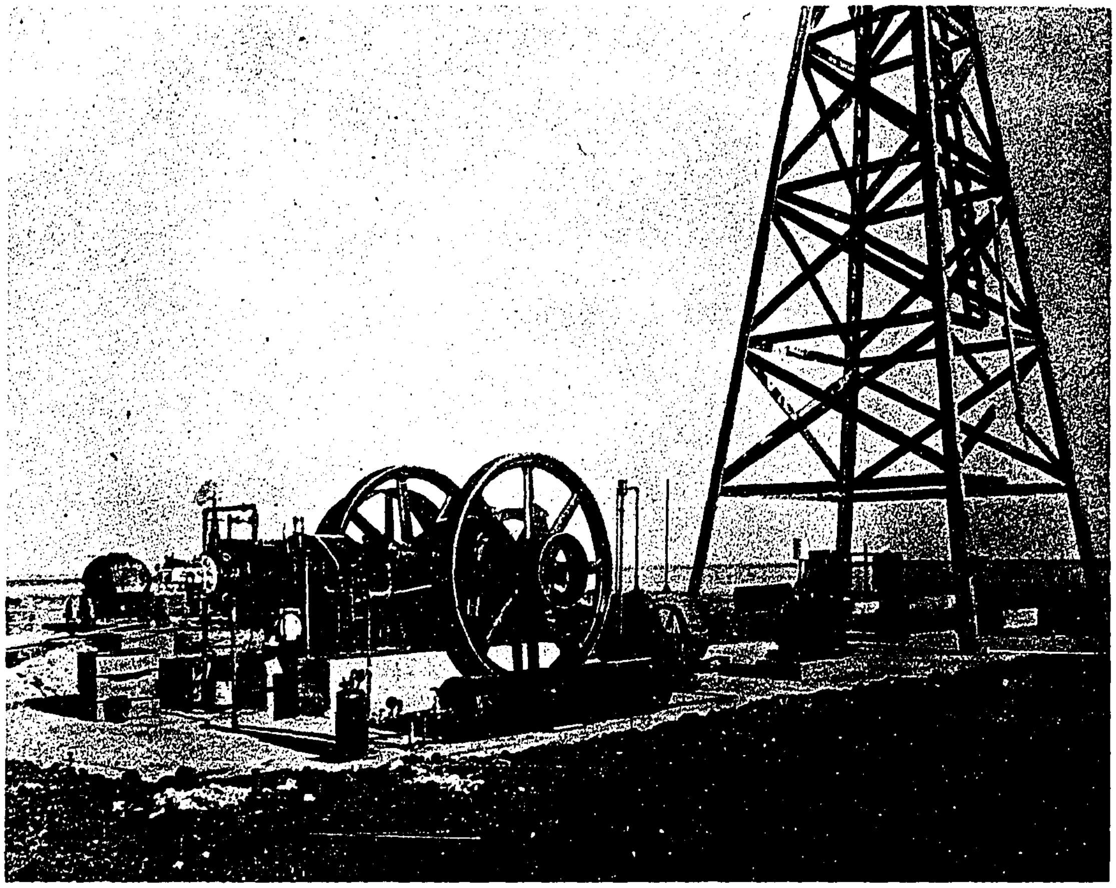
[64]Photograph of E. Graham well in files of Green Machinery Company, Plainview, Texas, is a good example of this type of pumping unit.

[65]Letter, J. W. Day to Layne and Bowler Company, May 14, 1914, Plainview, Texas, in Layne Water Facts, p. 46. Also see various other reprinted statements from users of Layne pumps in the Texas High Plains region in Layne Water Facts, pp. 29-47.




A VERTICAL CENTRIFUGAL PUMPING PLANT ON THE FARM OF E. E. GRAHAM, HALE COUNTY, TEXAS, _ca_. 1911

From: Courtesy of Green Machinery Company, Plainview, Texas. The plant was installed by George E. Green, standing second from right.



"PIT-LESS PUMP AND OIL-BURNING ENGINE INSTALLED
BY D. L. McDONALD ON HIS FARM NEAR
HEREFORD, TEXAS, IN 1915

From: Courtesy of John McDonald, Amarillo, Texas. The belt and engine-pump house have not yet been installed.


"PIT-LESS" PUMP IN OPERATION. A LUBBOCK IRRIGATION COMPANY WELL NEAR LUBBOCK, TEXAS, IN 1913

From: Courtesy of Southwest Collection, Texas Technological College.

Works Company of Aurora, Illinois, in all its installations even though its first wells were pits.[66]

Irrigation plants were found, by 1914, throughout the Texas High Plains between Amarillo and Lubbock. No official count of the number of wells was made between 1910 and 1920, but one observer estimated that in 1914 there were 139 wells in use.[67] By 1919 there were 187 wells in operation irrigating 13,510 acres. But this was undoubtedly a decrease from the total number of wells in operation during that decade. For example, the census of 1920 reported that Hale and Floyd Counties had a combined total of 116 pumping plants. Yet the Texas Land and Development Company alone put down 127 wells in those counties. Moreover, the census recorded no wells for Lamb, Lubbock or Swisher Counties, all of which had wells.[68] It must be noted, however, that the census

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[66]Notebook containing description of individual wells in Texas Land and Development Company Papers, Southwest Collection, Texas Technological College. Several of these early Texas Land and Development Company pumping units were installed and the wells were dug and drilled by George E. Green and J N. McNaughton. Memorandum agreement between Green-McNaughton Drilling and Machinery Company and Texas Land and Development Company, January 27, 1913, in files of Green Machinery Company, Plainview, Texas.

[67]Texas Board of Water Engineers, Progress Report No. 1 (Lubbock, Texas, 1938), p. 6, cited by Joseph F. Gordon, "The History and Development of Irrigated Cotton on the High Plains of Texas" (unpublished Ph.D. dissertation, Texas Technological College, 1961), pp. 352-53.

[68]Fourteenth Census of the United States, State Compendium, Texas (Washington, 1925), pp. 201-02. Billy

reported only those pumping plants which were in operation in 1919. Thus, the number of wells in operation had decreased by 1919. But the total number of irrigation pumping plants installed during the decade was probably between 200 and 250.[69]

Most of the wells could be identified from a distance by the wooden tower, resembling a squat, miniature oil field derrick some twenty to thirty feet high, which stood over the pump. It was built originally as an aid in drilling the well. Pulleys were placed at the top of the structure to suspend the drilling bit cables. The "well-man" usually required about ninety days to drill a hole 120 feet deep and thirty inches in diameter with a rotary rig. After completing the well, the driller used the derrick to lower casing into the well. The tubular casing, made in segments, had to be riveted together as each length was lowered into the well. A workman suspended inside the casing above ground level held the rivets while another worker bradded them from the outside. After the casing was installed the tower was used to lower the pump and its lengths of shaft and pipe into the well. The derrick then remained above the pump in order to "pull" the unit for repairs.

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Ray Brunson, "The Texas Land and Development Company" (unpublished Ph.D. dissertation, Texas Technological College, 1960), p. 124.

[69]See appendix.

Not only could one locate such a well easily by sight, but the distinctive sound of the huge oil engine --some models weighed several tons--also identified it. Both four-cycle and two-cycle engines were used, although two-cycle engines were more common. But both could be audibly identified by the loud, but slowly pulsating, pounding noise. In addition, some models were capable of blowing extraordinary blue smoke-rings out their exhausts and into the atmosphere. The engine was connected to the pump pulley by a long belt some ten to twelve inches in width twisted one-quarter turn. The pulley on the engine was connected to one of the large twin fly-wheels by means of a hand clutch. A house was usually built over the pump, belt, and engine to protect the machinery from the weather, and the derrick jutted into the sky above one end of the house.[70]

Elsewhere on the Great Plains, particularly in southwestern Kansas, the "pit-less" irrigation pumping

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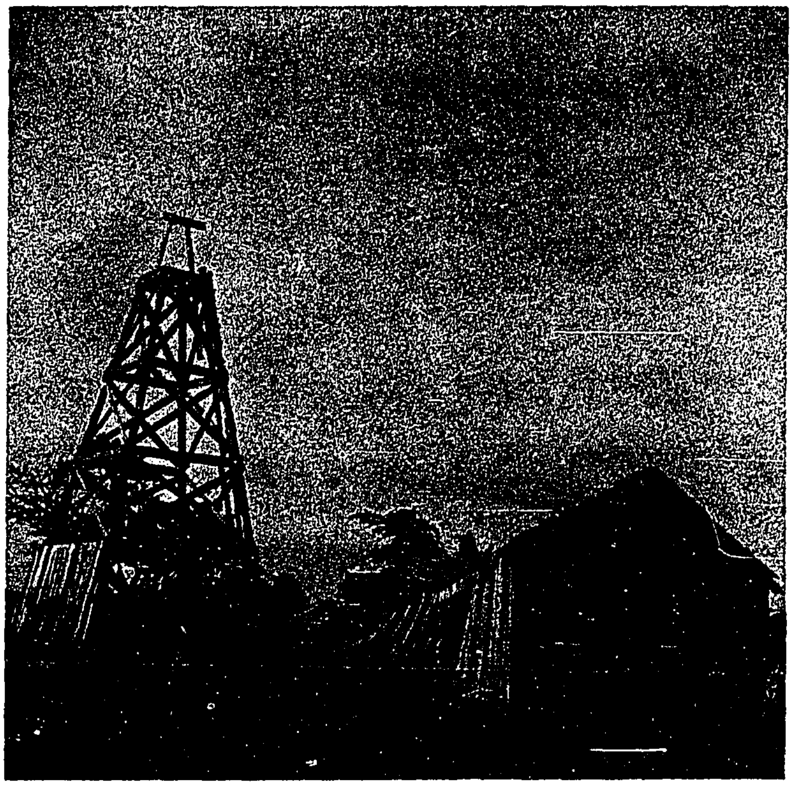
[70]Interview with Bill McDonald, son of D. L. McDonald, May 3, 1968, at Amarillo, Texas. Interview with John McDonald, son of D. L. McDonald, August 23, 1968, at Amarillo, Texas. Photographs of early pumps and engines installed by D. L. McDonald in files of McDonald Drilling Company and in private possession of John McDonald, Amarillo, Texas. Various photographs in Layne Water Facts. Personal observations of the author upon inspection of the Vaughn well near Tulia, Texas. Remains of this irrigation unit, installed in 1914, including a Layne pump and a Primm engine are still in existence. Interview of Ozella M. Green with Marshall Vaughn, son of one of the original owners of the well, at Tulia, Texas, November 25, 1968.



REMAINS OF THE VAUGHN WELL NEAR TULIA, TEXAS
INSTALLED IN 1914

From: Photograph by author. Notice derrick and collapsed engine-pump house.

plant was also emerging at about the same time. In 1911, J. W. Lough of Scott County, Kansas, installed a Layne pump and an oil-burning engine. The plant reportedly delivered an astounding 1,600 gallons per minute which irrigated some 200 acres.[71] J. C. Mohler, assistant secretary of the Kansas State Board of Agriculture, after touring several western Kansas counties in 1912 reported: "These large, deep wells, with the centrifugal pumps[72] and powerful cheap-oil engines, are the means by which the underground waters will be utilized to irrigate the lands of this great territory."[73]

Several technological innovations made it possible to tap the extensive sub-surface waters of the Texas High

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[71]E. H. Epperson, "Pump Irrigation in Scott County, Kansas," Eighteenth Biennial Report of the Kansas State Board of Agriculture, XXIII (Topeka, 1913), 79. And The Charter Type "R" Oil Engine Catalog No. 22 (Sterling, Illinois: Charter Gas Engine Company [ca. 1922]), p. 49, in files of Green Machinery Company, Plainview, Texas.

[72]At this time the "pit-less" pump was often still referred to as a centrifugal pump. It actually was a type of centrifugal--a greatly improved vertical centrifugal. Mohler probably referred to vertical and horizontal centrifugals, and to the "pit-less" pump as well. All three were in use in western Kansas at this time. See J. B. Marcellus, "Selection and Installation of a Pumping Plant for Irrigation," Twenty-first Biennial Report of the Kansas State Board of Agriculture, XXVI (Topeka, 1919), 111-24. And George S. Knapp, "A Review of Irrigation in Kansas," Twenty-third Biennial Report of the Kansas State Board of Agriculture, XXVII (Topeka, 1923), 217-25.

[73]J. C. Mohler, "Irrigation from Driven Wells," Country Gentleman (February, 1912), quoted in The Earth IX (April, 1912), 2.

Plains for irrigation. Engineers constructed a pump capable of delivering large volumes of water from deep wells, and invented an engine which could be operated on cheap fuels. Equipment for drilling large-bore wells also came into use on the plains. Zenas E. Black, a booster of Plainview, Texas, expressed the feeling of irrigation enthusiasts in the region when he wrote in 1914:

> The centrifugal [pit-less] pump has lifted the shallow water portions of the Texas plains from bondage to the erratic cloud. In this work it has been assisted by the crude oil and distillate burning engine. The perfection of the above agencies has been the greatest boon that inventors have given the world during the past ten years.[74]

Limitations to irrigation in the area still existed. A deeper well was not only more expensive to drill and to case, but it was also more expensive to operate. A larger engine and more powerful pump required greater consumption of fuel. Ground water had to be available in large enough quantities to be utilized for irrigation purposes. Perhaps most important, the increased profit from crops had to justify the great expense of a pump irrigation plant.

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[74] Zenas E. Black, "The Land of the Underground Rain," The Earth, XI (April, 1914), 13. Similar statements about important developments in pump and engine technology may be found in Farm and Ranch (Dallas), XXXI (June 1, 1912), 9; and in Amarillo Daily News, February 17, 1912, p. 6.

## CHAPTER V

## LAND SPECULATORS AND THE BEGINNINGS OF IRRIGATION ON THE TEXAS HIGH PLAINS, 1900-1910

During the first decade of the twentieth century, land colonizers, land agents, and land speculators from many areas of the United States, particularly from the Middle West, became interested in the Texas High Plains-Panhandle region. In 1900 large cattle ranches were still the predominant economic units in the area. Herds of the JA, the Matador, the XIT, and other ranches grazed the ranges.

But farmers had already emerged on the plains in small numbers. As mentioned earlier, in 1878 a congregation of Quaker farmers broke the sod of Crosby County and founded the colony of Estacado. Ten years later farming settlements were found west of the 101st meridian in Randall, Deaf Smith, Hale, Floyd, and other counties, and the increased movement of settlers into the High Plains was reported by local sources.[1] The newspaper at Tascosa

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[1] J. Evetts Haley, The XIT Ranch of Texas and the Early Days of the Llano Estacado (Norman: University of Oklahoma, 1953), pp. 210-13.

observed that, "a half dozen immigrant wagons, loaded with women, towheaded progeny and other plunder, passed through yesterday morning."[2]

Before 1900, however, there was no mass movement of farmers into the region. The census returns of 1900 reflected the sparse population. Hale County had only 1,680 people; Floyd County had 2,020; Deaf Smith County inhabitants numbered 1,477; and Lubbock County had a mere 293.[3] The settlement of the region had been retarded by control of the land by larger ranchers, failure of Texas land policy to favor the farmer until after 1883, the lack of surface water, recurrent drouths, the total absence of railroads in the Panhandle,[4] and perhaps most important, little demand by settlers for land in the western more semiarid part of the Great Plains.

Beginning in the late 1890's a number of factors served to draw more farmers into the region. First, a series of wet years set in which lasted almost through the first decade of the twentieth century. From 1895

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[2]Tascosa Pioneer, June 9, 1888, quoted in Haley, The XIT Ranch of Texas, p. 210.

[3]Twelfth Census of the United States, 1900, Population, Part I (Washington, 1901), pp. liv-lv.

[4]For an analysis of factors which retarded, then later aided the settlement of the "South Plains," the southern part of the Texas High Plains, see Jean Alexander Paul, "The Farmer's Frontier on the South Plains," (unpublished M.A. thesis, Texas Technological College, Lubbock, Texas, 1959), pp. 89-137.

through 1906, the rainfall at Amarillo was above the normal 21.92 inches every year except 1897 and 1904. Rainfall exceeded twenty inches every year except 1897. And in 1905 the precipitation climbed to more than ten inches above normal. At Plainview during the same period, rainfall was above the annual normal of 20.93 inches six of the years and below average the other six years. But in 1900, the rainfall was more than thirteen inches above normal, and in 1905 precipitation reached more than thirty-two inches. Rainfall in Crosby County was also above average for half of the period. And in 1905, the precipitation of 40.46 inches was almost twice the normal average.[5]

Second, isolation was broken as railroads pushed into the region bringing passengers and furnishing the means for transporting farm products to distant markets. In 1887 the Santa Fe Railroad reached Panhandle City, and by the next year the Fort Worth and Denver City Railroad stretched diagonally across the Panhandle from northwest to southeast. But it was not until 1907 that a railroad penetrated the southern Texas High Plains--the region

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[5]From 1894 to 1909, the rainfall in the region was generally sufficient. See table of drouths in John T. Carr, Jr., Texas Drouths: Causes, Classification and Prediction, Texas Water Development Board Report No. 30 (Austin, 1966), p. 47. Rainfall charts found in Charles L. Baker, Geology and Underground Waters of the Northern Llano Estacado, University of Texas Bulletin No. 57 (Austin, 1915), pp. 66, 69, 70.

referred to locally as the "South Plains." In that year, Santa Fe tracks reached Plainview. Two years later the same railroad reached Lubbock.[6]

Third, cheap prices for land and liberal credit terms attracted many land buyers. Soon after the turn of the century leases on Texas public lands, held by some large ranchers, expired. Under the provisions of the "Four Section" Act of 1895, a settler could file on as much as four sections of land (2,560 acres). The cost for such a block of land was $3,200--two dollars per acre for the first section and one dollar per acre for the remaining three sections. A down payment of only one-fortieth of the price was required and annual payments were extended over forty years at only 3 per cent interest.[7]

Much of the land was owned by ranchers, railroads and other private parties. Even this land was cheap in comparison with the price of land in the older, improved agricultural regions of the United States. For example, in 1904 it was reported that, "the remarkable thing about this part of Texas is the cheapness of land--from $4.00

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[6]Haley, The XIT Ranch of Texas, p. 204. David B. Gracy, II, Littlefield Lands: Colonization on the Texas Plains, 1912-1920 (Austin: University of Texas Press, 1968), pp. 8-9. Mary L. Cox, History of Hale County (Plainview, 1937), pp. 67-68.

[7]Paul, "The Farmer's Frontier on the South Plains," p. 136.

to $8.00 per acre in bodies from 160 acres up, with time from one to five years, and interest at 6 per cent."[8]

Finally, not only was land relatively cheap, but because of certain national trends in agriculture during the first decade of the twentieth century, the demand for land increased. As the nation emerged from the depression of the 1890's, prices of crops and land tended to move upward, making both farming and land speculation more attractive. Between 1900 and 1910 the index price of farm products increased steadily from 69.0 to 105.0.[9] The value of land also tended to rise. In some areas, prices of improved land rose as much as 5 to 10 per cent annually. For example, in South Dakota land values more than tripled between 1900 and 1910. And the valuation of land rose about twofold in Iowa during the same period.[10] By 1908, land in the latter state was being sold at prices ranging from $80 to $125 or more per acre.[11]

Rising land values throughout the United States encouraged land speculators, both large and small, to purchase Panhandle-High Plains land. Many farmers were

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[8] The Earth (Chicago), I (September, 1904), 7.

[9] Murray R. Benedict, Farm Policies of the United States, 1790-1950: A Study of their Origins and Development (New York: Octagon Books, Inc., 1966), pp. 114-15.

[10] Ibid., pp. 112-13. John D. Hicks, "The Western Middle West, 1900-1914," Agricultural History, XX (April, 1946), 73.

[11] Ibid., 73.

"resident speculators" who bought their farms with the intention of earning a living from their lands until offered a good profit for their improved holdings. Others were "resident speculators" who bought land, then rented the land to tenants. Among this group were professional men such as lawyers, doctors, businessmen and real estate agents who subsequently settled in towns near their holdings. Still others were "absentee speculators" who may have purchased only a section or thousands of acres, but who continued to live in another region of the United States.[12]

The demand brought into existence a number of colonization agencies which purchased large blocks of unimproved land, sub-divided it into smaller units, brought "prospectors" to the land by excursion train and automobile, and sold the lands for a good profit. For example, William P. Soash of Waterloo, Iowa, formed a company and bought a large tract of XIT land in the northwest corner of the Texas High Plains. Trains loaded with "prospectors" poured into the area, and within a relatively short time, Soash sold his lands and turned to other colonization projects on the plains.[13] In 1904, the

[12]The terms "resident speculator" and "absentee speculator" are used by Paul W. Gates in his classic study, "The Role of the Land Speculator in Western Development," The Pennsylvania Magazine of History and Biography, LXVI (July, 1942), 315.

[13]For an account of land colonization activities see David B. Gracy, II, "A Preliminary Survey of Land

Farm Land Development Company, owned by individuals living in Chicago, Lincoln, Nebraska, and Salt Lake City, bought large tracts of land in Parmer and Dallam counties at prices ranging from $2.50 to $6.00 per acre for colonization purposes. W. W. Ryan of Kansas City bought approximately 176,800 acres from the XIT at $5 to $6 per acre in 1906. George G. Wright, who had been associated with Ryan in Kansas City, bought land from the XIT and other sources in the region that same year for about $5 per acre. Agents who sold Wright's land for $25 per acre received commissions of $5 to $6 per acre. Wright realized approximately a 100 per cent return on his investment. It was estimated that he netted more than one million dollars from his speculation.[14]

In addition to the more obvious speculative colonization agencies, other enterprises also played an important role in attracting speculators to the region. Railroads set up colonization departments to sell not only their own lands, but to attract settlers and land buyers into the area along their lines.[15] Some ranch owners colonized their own lands. For example, the wealthy Texas

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Colonization in the Panhandle-Plains of Texas, 1878-1934," (unpublished manuscript in Southwest Collection, Texas Technological College, Lubbock, Texas).

[14]Haley, The XIT Ranch of Texas, pp. 218-21.

[15]Ira G. Clark, Then Came the Railroads: The Century from Steam to Diesel in the Southwest (Norman: University of Oklahoma, 1958), pp. 263-65.

businessman and cattleman, George W. Littlefield, bought the Yellow House division of the XIT on the "South Plains" in 1901. In 1912, after the Santa Fe railroad had completed a line through his ranch, he formed the Littlefield Lands Company for colonization purposes.[16]

A number of smaller speculators who bought land on the Texas High Plains were from the Middle West and undoubtedly had witnessed or profited from the rise in land values. John D. Hicks has stated that in the period 1900-1914, "the average Middle Western landowner . . . made his money, not so much from good farming, as from the unearned increment that came with the ownership of farm lands."[17]

By 1906 so many land buyers rushing into the Texas High Plains were from the Middle West that a correspondent for the New York Evening Post reported: "Farmers, chiefly from the North and Middle West, dissatisfied with the rigor of the winter climate at home, or attracted by other reasons, are beginning to come here. The possibilities of the land coupled with the moderate cost at which they can obtain a whole section of land, 640 acres, apparently attract them."[18]

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[16]Gracy, Littlefield Lands, pp. 43-66. Haley, The XIT Ranch of Texas, p. 218.

[17]Hicks, "The Western Middle West, 1900-1914," 73.

[18]Quoted in The Earth, III (April, 1906), 12.

Stories of profits made from buying and selling land, and of rising land values were circulated by land agents, local boosters and other interested parties. A Panhandle clergyman observed in 1906: "Lands that I saw selling two years ago at eight dollars an acre are now selling from twelve to twenty."[19] In one case an unnamed man supposedly bought two sections of land for twenty-five cents per acre in 1901. Within a few months he sold the sections for a total of $2300--almost eight times the original price of the land. A farmer from Illinois purchased some land for $5.50 per acre and made a profit of $12.50 per acre the first year growing "Kaffir corn." But the speculative urge caused him to sell his land at a good profit and to purchase "more raw land."[20] One observer reported meeting a man on a railroad excursion car who was in the process of buying over 17,000 acres, and concluded: "I was impressed with the fact that conservative business men in looking over the proposition were ready to invest largely in the country on looking it over."[21]

A newspaper editor from Belle Plaine, Iowa, went to the Panhandle "with no intention of buying land" on one of the special excursion trains for "prospectors" for the purpose of writing an article about the region. He

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[19]Reverend Walter H. North, "The Texas Panhandle," in The Earth, III (November, 1906), 10.

[20]Ibid. [21]Ibid.

became so impressed with the region that he borrowed money while on the trip and bought some land for himself.[22] The editor also reported that one man from Lenox, Iowa, bought a four-section ranch for $64,000--a little more than $20 per acre--with the expectation of selling it for $84,000.[23] A letter which appeared in a Bloomington, Illinois, newspaper in 1906 perhaps summed up the hopes of most speculators who were buying land in the Panhandle: "The land is being taken at rapidly increasing prices. At present the prices range from $10 to $24 per acre. The difference in price being determined largely by the distance from the town and the number of acres in the section under cultivation. . . . Generally, the writer believes the price of land will increase 100 per cent within the next six to ten years."[24]

Such accounts of rising land prices and profits made by speculators were in most cases exaggerated. But there was just enough truth in the rumors circulating wildly on the prairies of the Middle West to continue feeding "prospectors" into the area. In the period 1900-1910, the population of Hale County increased from 1,600 to 7,506; Deaf Smith County grew from 1,477 to 3,942; and

[22] The Earth, IV (June, 1907), 12.

[23] Ibid.

[24] Letter from F. O Handson in Daily Pantagraph (Bloomington, Illinois), n.d., quoted in The Earth, III (August, 1906), 4.

Lubbock County increased from 293 to 1,474.[25] Several years of sufficient rainfall aided the speculative fever. In addition the rise of the "dry-land" system of soil cultivation was a boon to speculators and colonizers. The United States Department of Agriculture reported in 1907 that because there had been a steady increase of rainfall on the Great Plains since 1894, land companies had tended to exploit the idea of dry-land farming.[26] This method of farming, known by some as the "Campbell" system, after its foremost advocate and propagator, Hardy W. Campbell, had become gospel to the new settlers of the Panhandle. By 1909 there were three "Campbell dry [demonstration] farm[s]" in the Panhandle located near Amarillo, Bovina, and Plainview, convenient for "prospectors" to view from train windows.[27]

Before 1910 boosters and speculators were particularly averse to any suggestion that irrigation was needed. They pointed out that, "Irrigation as it is done in New Mexico, Colorado, and elsewhere is unknown in the Panhandle.

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[25] Thirteenth Census of the United States, 1910, Population, I (Washington, 1913), 119-20.

[26] E. C. Chilcott, "Dry-Land Farming in the Great Plains Area," in United States Department of Agriculture Yearbook, 1907 (Washington, 1908), p. 464.

[27] The Earth, V (May, 1908), 3; VI (February, 1909), 4. For a description of the dry-land system and an account of the movement from its rise in one area of the Great Plains, see Mary W. M. Hargreaves, Dry Farming in the Northern Great Plains, 1900-1925 (Cambridge: Harvard University, 1957).

There are no irrigation plants and no irrigation ditches. The fruit trees and berry bushes are watered from large tanks near the windmills. As for the crops, there seems to be enough annual rainfall for their nourishment. . . ."[28] One enthusiastic booster clearly jumped the most remote bounds of reason when be boasted: "The bugaboo of too little moisture for the production of crops has almost completely disappeared before the demonstrated fact that the annual rainfall throughout this territory is equal to that in the vicinity of Chicago. . . . Climatically, the Panhandle very nearly approaches perfection."[29] Don H. Biggers, a newspaperman from Lubbock and one of the most persistent boosters of the Texas Plains stated flatly that, "it rains more now."[30]

Biggers himself admitted during the dry year of 1910, when the total rainfall at Plainview was little more than 11 inches, that the vast sub-surface water resources of the region could be utilized for irrigation.[31] But he did not want to leave the impression that it would ever be

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[28]The Earth, III (April, 1906), 12.

[29]S. G. Tetwiler, "The Productive Panhandle of Texas," in The Earth, IV (July, 1907), 5.

[30]Don H. Biggers, "Banner Counties of the Plains," in The Earth, VII (January, 1910), 12.

[31]Rainfall chart in [W. G. Carter], "Plainview Economic Survey" (mimeographed; Southwestern Bell Telephone Company, Plainview, Texas, March 16, 1925), in Southwest Collection, Texas Technological College, Lubbock, Texas.

needed. The booster insisted that "irrigation never will be extensive here, for the reason that it is not at all necessary. . . . There never has been a total [crop] failure, even with the most indifferent and primitive farming methods."[32] On another occasion he reiterated that the region "has sufficient water supply to irrigate every acre of land, should that be necessary, but it will not [be]. . . ."[33]

Biggers, whom the editor of The Earth paradoxically called "a prophet of the South Plains,"[34] was correct in one respect. Because of the wet years from 1895 through 1907, crop failures even with "indifferent and primitive farming methods" were uncommon. Farmers in the area had become accustomed to sufficient moisture. How well High Plains farmers practiced the principles of "dry farming" is not known. But sufficient moisture probably made few converts to the newer farming methods.

Campbell himself reported in September, 1906 that on one of his Panhandle farms he found enough moisture four feet deep to grow crops. Then in September he reported that the soil five feet deep was moist enough to mold into "mud balls."[35]

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[32]Don H. Biggers, "Two Fine South Plains Counties," in The Earth, VII (November, 1910), 7.

[33]Biggers, "Banner Counties of the Plains," 13.

[34]Ibid., 7.

[35]The Earth, III (November, 1906), 10.

Optimism soon turned to pessimism as a drouth emerged on the Texas High Plains as early as 1907 in some areas, and stretched out over the entire region over the next several years. At Amarillo the annual rainfall fell almost to four inches below normal in 1907. In Crosby County, on the "South Plains," the rainfall was more than three inches below the normal average by 1908. Less than sixteen inches of precipitation fell on Deaf Smith County in 1909. And by 1910 the entire region was gripped in a drouth which covered most of the Southern Great Plains. That year Deaf Smith County reported only a little over eleven inches. Amarillo had about the same. Precipitation in Hale County totaled about twelve inches. Swisher and Crosby Counties were more fortunate with a total rainfall of approximately fifteen inches in both counties.[36]

The response of farmers, boosters, colonizers and speculators to the drouth varied. In at least one instance, citizens attempted to attract that nineteenth century anachronism of the Great Plains--the rainmaker. In the summer of 1909, citizens of Dawson County advertised for "a Rainmaker of Experience." Moreover, they promised a "Good commission . . . to right party."[37] Many people left the

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[36]Baker, Geology and Underground Water of the Northern Llano Estacado, pp. 66-72.

[37]Dawson County (Texas) News, June 11, 1909, quoted in Leona Marguerite Gelin, "Organization and Development of Dawson County to 1917" (unplublished M.A. thesis, Texas Technological College, 1937), p. 105.

region, turning their mortgaged lands back to land companies as the pressure of the drouth forced land prices down. By 1910 absentee owners who could afford to keep their farms had difficulty attracting tenants[38] as the flow of "prospectors" came to a halt. The owner of an abstract and title office in Floyd County made the following observations to three different absentee landowners:

> We have had another very dry season, and consequently crops are very short. Lands have declined considerably in price, and quite a number of our people are anxious to sell and move away, but there are no buyers coming in.
>
> I am inclined to think that $15.00 per acre would be the top price at which your land could be sold now, and I am not certain that it could be sold even for said figure. . . .
>
> Land is so dull now, and almost no prospectors coming in, that it seems it is hardly worth while to try to sell land at this time.[39]

The Santa Fe Railroad responded in a more positive way to the drouth which transcended State boundaries. In 1909 the company appointed Professor J. D. Tinsley, an expert on soils at New Mexico A. and M. College, to the new post of agricultural agent. Tinsley was assigned specifically to eastern New Mexico. The next year, as the drouth

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[38]A. B. Duncan to D. M. Burke, July 13, 1910, Floydada, Texas, in Arthur B. Duncan Papers, Southwest Collection, Texas Technological College.

[39]A. B. Duncan to W. E. Jones, August 13, 1910, Floydada, Texas; A. B. Duncan to Mr. and Mrs. F. P. Baumgardner, September 28, 1910, Floydada, Texas; A. B. Duncan to W. A. Tibbets, August 13, 1910, Floydada, Texas, in Arthur B. Duncan Papers.

worsened, the company appointed Professor Harry M. Bainer of Iowa State Agricultural College to be agricultural agent to the Texas High Plains-Panhandle region.[40] The editor of the railroad company's agricultural journal, The Earth, announced: "It is a new departure in railroading but in keeping with the spirit of progress maintained by the Santa Fe."[41]

Tinsley and Bainer instituted a program aimed at providing the most recent techniques and information on dry-farming to farmers. First, a system of demonstration plots scattered throughout the area was inaugurated in 1911. Individual farmers cooperating with the agents planted special drouth-resistant crops with seed provided by the railroad, and used special methods of cultivation. By the end of the first year 148 demonstration plots had been initiated.[42] Second, that same year the company inaugurated a program of sending demonstration trains throughout the region. The purpose, as indicated by the name of the 1913 train referred to as "The Cow, Sow, and

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[40] The Earth, VII (July, 1910), 11; (February, 1910), 8. Clark, Then Came the Railroads, p. 265.

[41] The Earth, VII (February, 1910), 8. Some agricultural programs had been carried on by various railroads in conjunction with colonization activities before 1910. In 1905 the Missouri Pacific Railroad created the position of agricultural agent as a separate office from that of colonization agent. Clark, Then Came the Railroads, pp. 263-65.

[42] Ibid., p. 270.

Hen," was to encourage farmers to diversify their operations.[43]

Still another, and the most significant response to the drouth was a revival of the irrigation movement which had been prevalent on the Great Plains during the late 1880's and early 1890's. But the revival differed from the original movement in at least two important ways. First, the new movement was spearheaded primarily by speculators and urban boosters rather than by crusading editors, representatives of farmers, and scientists. Second, the revival pragmatically emphasized the tools of the newly developed pump technology and the use of pumping plants by individuals rather than the development of irrigation through governmental assistance.

The idea of irrigation in 1910 was not new to the High Plains-Panhandle region. In the broken country below the Cap Rock it was possible to utilize the limited waters of streams and springs. As early as the 1870's small irrigated garden patches could be seen along the banks of the Canadian River.[44] As early as 1888, R. A. Cameron, emigration agent for the Fort Worth and Denver City Railroad, investigated the possibility of setting up a demonstration farm to utilize the waters of the Canadian but nothing

[43] Ibid., p. 269.

[44] José Ynocencio Romero, "Spanish Sheepmen on the Canadian at Old Tascosa," as told to Ernest R. Archambeau, Panhandle-Plains Historical Review, XIX (1946), 49.

came of the proposal.[45] In 1902 it was reported that one F. H. Rathjen of Mobeetie in Wheeler County, was irrigating 60 acres of corn and alfalfa from a one-quarter mile ditch running from Williams Creek. The Reynolds Land and Cattle Company in Hartley County watered a 40-acre field of alfalfa, fruit trees, and vegetables from a spring.[46]

On the High Plains, as in other areas of the Great Plains, windmills were used to irrigate small plots of orchards and gardens before 1900 in spite of at least one anti-irrigation newspaper editor in Amarillo who referred to such experiments as "the fakir of irrigation wells."[47] In Hale County there were at least three windmill systems in operation in 1901 irrigating from 5 to 10 acres each. And one citizen of the county boasted that there were at least fifty such systems which could be used by as many different irrigators "if the season renders irrigation necessary."[48]

The advent of pumping plants designed specifically for delivering huge volumes of water for irrigation increased the possibilities for irrigating large areas of

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[45]Clark, Then Came the Railroads, pp. 263-64.

[46]Thomas U. Taylor, Irrigation Systems of Texas, United States Geological Survey Water-Supply and Irrigation Paper No. 71 (Washington, 1902), p. 79.

[47]The Amarillo News, February 9, 1895, p. 4.

[48]Taylor, Irrigation Systems of Texas, p. 78.

the High Plains.[49] In 1904 the editor of The Earth stated, "It is the consensus of opinion . . . that with the development of irrigation by gasoline engines, the inexhaustible underflow, or water-sheet, is available to make the virgin plains the wheat and fruit belt of the United States."[50] Two years later the same editor reported that pumps could now successfully water the farmlands of the Llano Estacado.[51] In early 1905, S. A. Fuller, an irrigation farmer from Longmont, Colorado, who was visiting his brother at Hereford in Deaf Smith County, stated that steam and gasoline-powered pumps, which were coming into general use in the west, would be feasible in the Hereford area.[52]

The summer before Fuller's visit, a test irrigation well had been drilled on the ranch of G. R. Jowell east of Hereford. The well was one hundred feet deep with the water level only forty feet below the surface. But it had not yet been pumped. Within a few weeks after Fuller's announcement, Jowell borrowed a small Wood's Propeller-type pump from an irrigation engineer of Roswell, New Mexico Territory, and installed it in the well. A twenty-five horsepower steam engine was connected to the

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[49] See chapter IV.

[50] The Earth, I (February, 1904), 6.

[51] Ibid., III (August, 1906), 6.

[52] Hereford (Texas) Brand, January 13, 1905, p. 6.

pump by a belt and pully. Then on February 23, 1905, "at about 2 p.m., a large crowd of citizens having assembled, the pumping was begun. A stream of water five by seven inches came rolling forth and continued for about twenty-five minutes, without any perceptible decrease in the water supply. . . ." The local newspaper editor prematurely boasted that the well which had furnished only from 188 to 200 gallons per minute "will doubtless mark the beginning of actual irrigation from wells in West Texas."[53]

In the next few years, other experimental test wells were probably put down in many areas of the Texas High Plains. For example, in Dallam County, a well seventy feet deep and five feet square was reportedly dug in 1907. A centrifugal pump powered by a steam engine pulled water from the pit, but like the Jowell well, the unit was never used for irrigation purposes.[54]

Contrary to local expectations, the Jowell well did not inaugurate an irrigation boom. Rainfall in Deaf Smith County averaged twenty inches or more from 1905 through 1907. Elsewhere on the High Plains, 1905 was an

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[53]<u>Ibid</u>., February 24, 1905, p. 1. <u>The Earth</u>, II (April, 1905), 6.

[54]Notes made by Laura V. Hamner, Federal Writer's Project, June 9, 1936, upon interviewing several Dallam County citizens, including J. W. Pigman who had a photograph of the pumping plant. In William P. Soash Papers, Literary Efforts, Southwest Collection, Texas Technological College.

exceptionally wet year. Crosby County received more than forty inches, and Amarillo's rainfall was more than ten inches above normal.[55] The demand of High Plainsmen for irrigation tended to rise in inverse ratio to the decline of rainfall.

By 1909, not only the drouth, but also irrigation developments in adjacent New Mexico Territory caused some interested parties to consider seriously the possibilities of irrigating the Texas High Plains. In New Mexico the irrigation frontier originated in the more arid western region, then like the mining frontier of the West, it moved toward the East.

The interest of New Mexicans in irrigation dated back to early works built by the Indians, Spanish, and Mexicans long before the United States annexed the region. The tradition was continued during the irrigation movement of the late nineteenth century when much of the territorial press actively campaigned for private, corporate, and government-sponsored irrigation works.[56] The territorial government established a department of irrigation in 1905.[57]

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[55]Baker, Geology and Underground Waters of the Northern Llano Estacado, pp. 66-69.

[56]Porter Andrew Stratton, "The Territorial Press of New Mexico, 1834-1912" (unpublished Ph.D. dissertation, Texas Technological College, 1967), pp. 404-07.

[57]H. B. Henning, "Development of Irrigation in New Mexico," in The Earth, VII (July, 1910), 13.

After passage of the National Reclamation Act in 1902, the Federal Bureau of Reclamation began construction of dams on the Rio Grande and the Pecos River. The Pecos River project was completed in 1907. The citizens of Carlsbad were so enthusiastic over its completion that they celebrated July 4th of that year with a "water carnival" rather than with fireworks. Water from the new reservoir flowed abundantly through large ditches, into some laterals leading to fields, through canals constructed in downtown Carlsbad and back into the Pecos below the city. Moreover, a strong artesian basin in the Roswell area already in use for irrigation added to the water resources of the Territory.[58]

On the Llano Estacado in Eastern New Mexico, irrigation resources were also investigated. At Portales, in the region known locally as "Inland Valley," water could be found at depths from two to fifty feet according to a local booster.[59] Actually the depth averaged about thirty feet,[60] but it was shallow enough to attract interest as a

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[58] F. L. Vandegrift, "A Southwest Water Celebration," in The Earth, IV (August, 1907), 2.

[59] W. L. Neel to editor of The Earth, n.d., Bethel, Roosevelt County, New Mexico, quoted in The Earth, IV (August, 1907), 11.

[60] George V. Johnson, editor of the Portales Times, reported in 1911 that the depth to water in the Portales area was thirty to thirty-five feet. Johnson, "Irrigation in Portales," The Earth, VIII (May, 1911), 21.

possible source for pump irrigation. In 1903 a group of businessmen led by Washington Ellsworth Lindsey, who later became Governor of New Mexico, put up money for a local well-driller named W. A. Jessup to drill an artesian well. Jessup drilled a hole 1,000 feet deep but failed to strike artesian water.[61] Later in 1905, a few months after Jessup completed the well, a Portales business firm put a six-inch test pump, perhaps similar to the pump which had been used to test the water at Hereford, Texas, the same year, into a shallow well which the Santa Fe Railroad had drilled. The pump delivered a 600 gallon-per-minute stream of water,[62] but like the neighboring Texas High Plains, until the drouth struck Eastern New Mexico, neither need nor widespread interest in irrigation existed.

Then in 1908 a decrease in rainfall yielded a short crop in the region. By the summer of 1909 searing Southwest

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[61]James Elmer Rowan, "Agricultural Land Utilization in the Llano Estacado of Eastern New Mexico and Western Texas" (unpublished Ph.D. dissertation, University of Nebraska, 1960), p. 124. Ira C. Ihde, "Washington Ellsworth Lindsey," New Mexico Historical Review, XXVI (October, 1951), 182.

[62]Rowan, "Agricultural Land Utilization in the Llano Estacado," pp. 124-25. Joseph F. Gordon, "The History and Development of Irrigated Cotton on the High Plains of Texas" (unpublished Ph.D. dissertation, Texas Technological College, 1961), p. 82, states that the pump was a "piston pump," but in this writer's opinion, a six-inch piston pump is incapable of delivering six hundred gallons per minute. The pump must have been some type of early centrifugal pump, possibly a Wood's propeller pump, or a vertical centrifugal pump.

winds signaled the onslaught of drouth. In the fall of that year, Lindsey again took the lead and drilled a fourteen-inch test hole to a depth of 100 feet on his land. The depth to water was undoubtedly much less. By using a centrifugal pump powered by a gasoline engine, the well reportedly delivered 1,000 gallons per minute. More wells were put down that fall and pit-type centrifugal pumps were installed by other citizens of the area. In the meantime, Portales leaders consulted P. E. Fuller, an irrigation engineer with the United States Department of Agriculture. Fuller encouraged the development of pump irrigation in the area by stating that wells such as that drilled by Lindsey were capable of irrigating 160 acres each.[63] By the end of 1909 a few wells were being pumped and plans were being laid for an extensive irrigation project in the Portales Valley.

At some time during the latter part of 1909, D. L. McDonald, an automobile dealer and land agent from Hereford

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[63]George V. Johnson, "Irrigation in Portales," 21. A different account is found in Rowan, "Agricultural Land Utilization in the Llano Estacado," p. 125. Rowan, whose sources consisted solely of interviews with early settlers of the area, states that a "Kansas firm" was responsible for exploring the possibilities of pump irrigation in the area. When the firm was satisfied with its test wells, its managers decided to establish a company for the purpose of generating and selling electricity to farmers for powering irrigation pumps. But Johnson's contemporary account shows that the initial steps were taken by Lindsey and other Portales citizens who formed an organization, and made a contract with a firm to build an electric generating plant for that purpose. Also see The Earth, VII (January, 1910), 11.

took a Santa Fe train to Portales. The object of the trip was to pay the taxes on some land which McDonald had accepted as payment for a Winton automobile. But at Portales, McDonald viewed one of the new irrigation wells. He was amazed to see so much water spewing forth from a single pipe in the ground. During the trip back to Hereford, he began thinking of the four hundred windmills tapping the shallow sub-surface water on the Hereford town-section. The existence of the water had been known in the area at least since the Jowell well had been tested in 1905, and Jowell, a friend of McDonald, still lived at Hereford.[64]

McDonald, who would be referred to within the next few years as the "father of irrigation on the Staked Plains," was representative of the aggressive entrepreneur-speculators who played such a prominent role in the development of irrigation on the Texas High Plains. Born in Concord, Pennsylvania, on November 26, 1872, he grew up in

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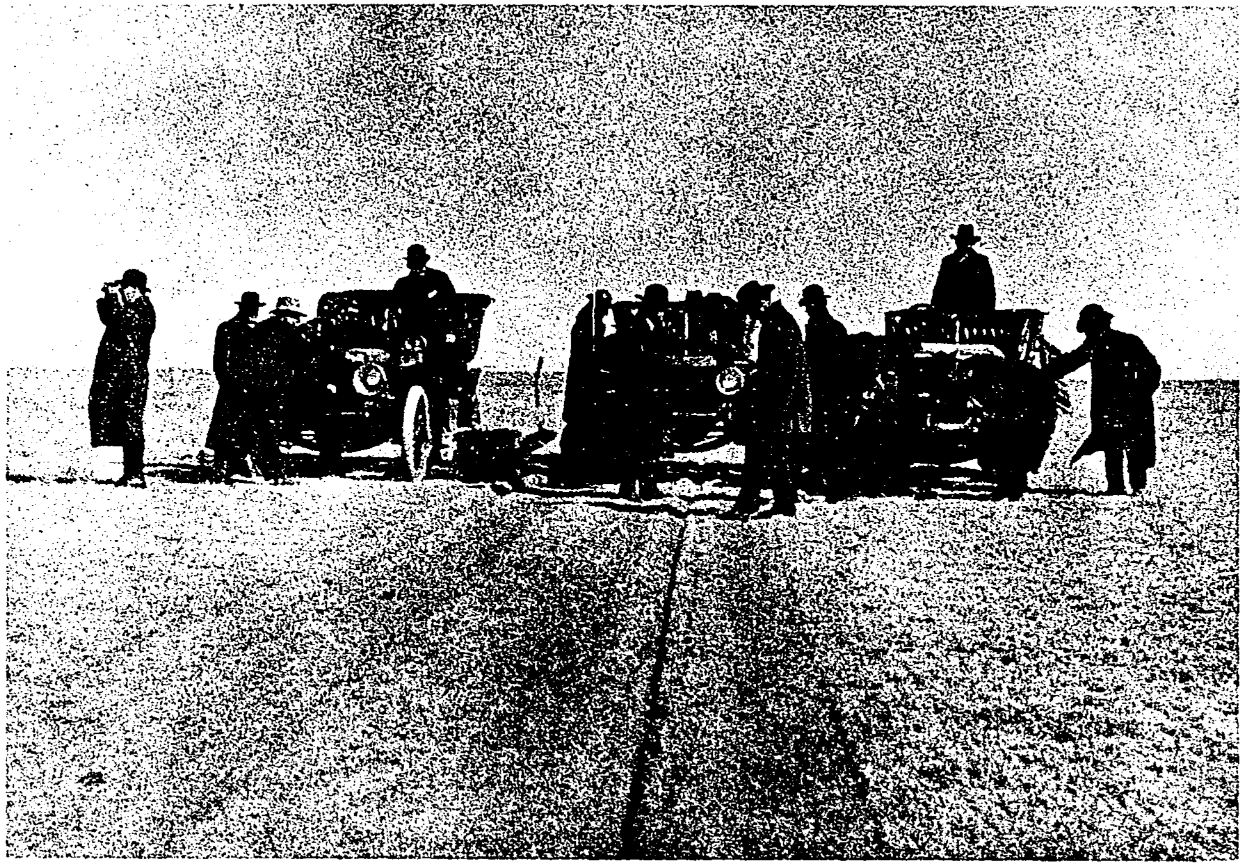
[64]Interview of author with Bill McDonald, a son of D. L. McDonald, May 3, 1968, Amarillo, Texas, and with John McDonald, oldest son of D. L. McDonald, August 23, 1968, Amarillo, Texas. Conversation of writer with John McDonald, August 23, 1968. Wilma Hixson, "The Influence of Water upon the Settlement of the Llano Estacado," (unpublished M.A. Thesis, West Texas State College, 1940), p. 68. "Lesson of Windmills on a Townsite," Fort Worth Star-Telegram, January 13, 1913, reprinted in The Earth, X (June, 1913), 19. Hixson's account of the reason for McDonald's trip to Portales differs from that of John and Bill McDonald. She states that McDonald went to Portales for the specific purpose of seeing the wells, but both of McDonald's sons state that their father made the trip for the purpose of paying taxes on a quarter-section of land.

Ohio. After becoming a registered pharmacist, he established a drug store at Van Wert, Ohio. But he left that profession upon the advice of his physician who told him that he needed to spend more time out-of-doors. Then, soon after the turn of the century, he began selling Winton automobiles. As a fairly successful car dealer he became acquainted with some wealthy owners of a lucrative stone-quarry company located in Ohio. During the High Plains-Panhandle land boom of the early twentieth century, these wealthy businessmen offered McDonald one-third interest in a chunk of High Plains land if he would handle the sales. McDonald accepted the offer, probably with a view toward improving his health in the Southwestern climate. In 1906 he arrived in the small town of Hereford aboard a train accompanied by several of his Winton automobiles.

For the next few years, the former druggist combined automobile and real estate sales. His two businesses went together well. He would catch a train back to the Midwest about once a month and stir up interest in Texas lands among citizens of Ohio and other neighboring states. After gathering some "prospectors," he would escort the group by railroad Pullman coach to Hereford. Then the potential land buyers would enjoy free automobile rides in the Wintons as they inspected the properties.

The lush, green grass growing from the rich, dark brown soil reminded McDonald of Ohio without the natural



"PROSPECTORS" BROUGHT TO THE TEXAS HIGH PLAINS
BY D. L. McDONALD, *ca*. 1906 or 1907
NEAR HEREFORD, TEXAS

From: Courtesy of John McDonald, Amarillo, Texas.

impediments of trees and rocks. No doubt the area had the same appeal for other midwesterners who purchased the land on credit terms offered by McDonald. Most of the land was sold, but the boom ended in 1909 with the recurring visit of that old enemy of the Great Plains--drouth. Unable to make payments or to find tenants, most of those who had bought land were forced to allow McDonald reluctantly to foreclose on the properties. The population of Hereford dropped from several thousand to a little over a thousand by 1910, and as in other areas of the Texas High Plains, land values declined.[65]

One citizen of Hereford observed: "It is the closest [sic] times here I have ever witnessed any time. People keep leaving here and the very ones we would like to see stay, the farmers. The name they will give the country will stay with it for a long time as they are from every part of the U.S."[66]

During this economic crisis McDonald returned from Portales determined to introduce irrigation as a means for raising land values, attracting settlers, and aiding the economic development of the High Plains. Irrigation as a device for increasing land values had been contemplated by speculators on the High Plains before McDonald. In

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[65] Interviews of author with Bill and John McDonald.

[66] C. W. Hunt to A. B. Duncan, December 14, 1910, Hereford, Texas, in Arthur B. Duncan Papers.

1886, a New York agent for the newly-formed White Deer Lands Company inspected the company's lands located in the north central area of the Texas Panhandle. On his return journey he stopped at Mobeetie in Wheeler County. There some local boosters--"men of intelligence"--told the agent that the White Deer Creek, a tributary of the Canadian which ran a small stream of water through the lands, was capable of irrigating 20,000 acres. That estimate was greatly exaggerated, but the agent accepted the estimate at face value and concluded his report by stating: "If so, the land could be worth as much as Kansas land."[67] After the Jowell well was tested the editor of the Hereford newspaper boasted that land which could be watered by irrigation pump would be worth $50 per acre.[68] At Portales in 1903, Washington Ellsworth Lindsey left little doubt about his motives in promoting a project to locate artesian water when he asserted: "Should a sufficient flow be obtained at a depth of even 1,000 feet . . . land values within the area of the artesian flow would immediately rise to the value of that in the artesian belt of the adjoining County of Chaves."[69]

[67]Russell Benedict to Frederic P. Foster, trustee of White Deer Lands Company, June 22, 1886, quoted in Lester F. Sheffy, The Franklyn Land and Cattle Company: A Panhandle Enterprise, 1882-1957 (Austin: University of Texas Press, 1963), p. 216.

[68]Hereford (Texas) Brand, February 24, 1905, p. 1.

[69]W. E. Lindsey, Director Portales Trade Association, to editor of The Earth, n.d., in The Earth, I (November, 1904), 5.

In the late fall of 1909, the same idea was in the mind of D. L. McDonald as he began digging a pit in the bottom of Frio Draw south of Hereford. He struck water at twenty-five feet and installed a vertical centrifugal pump in the well. In February, 1910, a long, wide belt from a steam traction engine was attached to the pump pulley, McDonald engaged the engine clutch and a large stream of water spewed out of the discharge pipe into a weir. In the spring of 1910, the Ohio land agent planted thirty to forty acres nearby in a variety of crops including potatoes, onions, corn, kaffir corn, and celery. The combination of virgin soil and abundant water produced an impressive crop in the very dry summer of that year.[70]

McDonald, meanwhile, began digging a second well on a higher elevation north of Hereford in order to dispel local doubts about obtaining sufficient water above Frio Draw. On March 15, 1910, a Layne & Bowler "pit-less" pump was shipped to McDonald from Houston.[71] This improved pump powered by a Fairbanks-Morse gasoline engine was

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[70]Interview of author with John McDonald. Wilma Hixson, "The Influence of Water upon the Settlement of the Llano Estacado," pp. 68-69. Bessie Patterson, <u>A History of Deaf Smith County</u> (Hereford, Texas: Pioneer Publishers, 1964), p. 13. Hixson and Patterson state that the first McDonald well was put down in 1910. But according to John McDonald, the digging of the well actually began in late 1909.

[71]Interview of author with John McDonald. Layne and Bowler Company purchase order, shop no. 720, files of Layne and Bowler Company, Memphis, Tennessee.

placed at a depth of approximately 38 feet.[72] By the middle of December, McDonald had three irrigation pumping plants in operation.[73]

The McDonald wells, the first large-volume irrigation wells on the Texas High Plains, impressed local land speculators and promoters. One Hereford real estate agent wrote: "I have seen it [a pump] with my own eyes after it had been running for hours. Filled an eight inch pipe and came out of it at almost lightning speed. . . . It is a wonderful sight to see. . . ."[74] The same correspondent noted that the $6,400 cost of the irrigation plant, including the price for drilling and casing the well, was expensive. "Still," he concluded, "the land would be worth many times more than that after it was put to irrigation."[75]

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[72]*Ibid.* Interview of author with John McDonald.

[73]*Ibid.*

[74]C. W. Hunt to A. B. Duncan, December 14, 1910, Hereford, Texas, in Arthur B. Duncan Papers.

[75]*Ibid.* The venture was the beginning of another business for McDonald--well-drilling. In 1910 he purchased his first rotary well-drilling rig from the Layne and Bowler Company of Houston. The company sent not only the rig, but also a well-driller to show McDonald the fine points of the craft. That same year McDonald discontinued the use of gasoline engines for his pumps, and began to use the cheaper-operating oil engines. He acquired the franchise for Layne and Bowler Pumps and Bessemer oil engines, and installed them in most of the wells he drilled in the next few years on the Texas High Plains. McDonald installed each pumping plant for approximately $6,000, which included the costs of drilling and casing

In the period 1900-1909, land speculators and colonizers were drawn to the Texas High Plains because as land values were rising significantly in more settled areas of the United States, the cheap lands of the High Plains-Panhandle region offered prospects for speculative profits. Moreover, rainfall was usually sufficient during this period for farming. But the drouth which appeared in the latter part of the decade dashed the hopes of land investors. Settlers began an exodus. As in the earlier drouth of the Great Plains, some turned their thoughts to possibilities for irrigation. Some test wells had been installed in the earlier part of the decade, but interest in irrigation was not prevalent until drouth showed its necessity.

Encouraged by the recent development of pump irrigation in neighboring New Mexico Territory, McDonald, a land agent, put down the first successful irrigation wells on the Texas High Plains with a view toward increasing the depressed land values and attracting settlers. Within a few weeks after McDonald had tested his first well in the Frio Draw, the Texas Department of Agriculture published the results of an investigation into the economic resources

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the well, pump, engine, and derrick. For an account of McDonald's early drilling activities see Donald E. Green, "D. L. McDonald and the Beginnings of Irrigation on the Texas High Plains," Irrigation Age, III (December, 1968), 16-G3 through 16-G10.

of the High Plains-Panhandle region which had been conducted the previous year. The author, Frederick W. Mally, prophecied: "It is not an idle dream to predict that some day, not so far distant, there will be stretches of miles of the fertile level black loam areas northwesterly from Plainview to Hereford, which will be one grand succession of alfalfa meadows under irrigation."[76] Mally's dream was similar to the vision of D. L. McDonald and many other land speculators who became active in the next few years.

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[76]Frederick W. Mally, The Panhandle and the Llano Estacado of Texas, Texas Department of Agriculture Bulletin No. 12 (Austin, 1910), p. 172.

# CHAPTER VI

## THE LAND SPECULATOR AS A PROMOTER AND DEVELOPER OF IRRIGATION ON THE TEXAS HIGH PLAINS, 1910-1920

Carl F. Kraenzel, in his sociological study of the Great Plains, has observed that, "Main Street has sometimes been active in promoting agricultural ventures. One of these ventures is irrigation."[1] On the eve of the completion of D. L. McDonald's first well near Hereford, the Texas Department of Agriculture conducted a study of the High Plains-Panhandle region. The author encouraged "landowners" of the "shallow water" area to install centrifugal irrigation pumps and plant their farms to alfalfa because "first class alfalfa lands have such high valuations placed upon them." In conclusion, he stated: "this is a proposition which should be a very attractive one for the Commercial Clubs and Business Leagues of those districts to develop and exploit."[2] "Main Street" became interested in the "proposition" in 1910.

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[1] Carl F. Kraenzel, The Great Plains in Transition (Norman: University of Oklahoma, 1955), p. 278.

[2] Frederick W. Mally, The Panhandle and Llano Estacado of Texas, Texas Department of Agriculture Bulletin No. 12 (Austin, 1910), pp. 172-73.

The irrigation movement on the Texas High Plains from 1910 to about 1917 was essentially a product of urban promoters, rather than a demand from farmers. The motives among urban leaders in towns such as Hereford, Plainview, Hurley, Lubbock, and Amarillo varied. Some wished to stem the exodus which the drouth had produced and to attract another wave of settlers. Others were essentially boosters who took pride in the growth and economic development of their community. The most significant group, however, became interested in irrigation not only for what it would mean to the community as a whole, but primarily because irrigation tended to increase local land values, and to make land more attractive to buyers. This would increase profits to land speculators and draw the population needed for prosperous local business.

Not all urban leaders of the Texas High Plains promoted irrigation. In places where the depth to water was considerably greater than in the "shallow water belt," and in areas along the eastern edge of the region, which averaged slightly more rainfall than the area farther west, local leaders showed little interest. For example, at Floydada, along the eastern edge of the High Plains where the water lay at about 120 feet in depth, J. C. Gaither, secretary of the local Commercial Club, stated: "Owing to the abundant crops maturing with our annual rainfall, the farmers of Floyd [county] have not been interested in any great extent in the question of irrigation." He added, however, that "the water is available here for the use of those who may prefer that method."[3] And at Amarillo, the board of directors of the Chamber of Commerce discussed the possibilities for irrigation in that area but no further action was taken.[4]

In the spring of 1911, a Dawson County farmer, whose interest had been kindled by irrigation developments at Plainview and Lubbock, advocated putting down a subscription well. "Let us get together," he wrote, "put in from $1 to $10 each and give it a thorough test."[5] But urban leadership in the county showed little enthusiasm for the project. Not until late summer of 1912 had enough money been raised to complete the subscription well in the bottom of a "draw." The pit was fifty feet deep, almost twice the depth of wells at Hereford and Plainview. A centrifugal pump was borrowed and installed in the chasm, but before the well could be tested, a downpour descended upon the

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[3]J. C. Gaither, "Floyd's Fertile Soil," <u>The Earth</u> (Chicago), VIII (May, 1911), 18. Arthur B. Duncan, an abstract agent at Floydada, reported to a correspondent that water lay at "about 120 feet here at Floydada." A. B. Duncan to Leroy C. Brown, June 18, 1914, Floydada, Texas, letterpress book in Arthur B. Duncan Papers, Southwest Collection, Texas Technological College.

[4]Amarillo <u>Daily News</u>, November 22, 1911, p. 2.

[5]S. W. Blackburn to the <u>Lamesa</u> [Dawson County] <u>News</u>, n.d., reprinted in <u>The Earth</u>, VIII (May, 1911), 16. Leona Marguerite Gelin, "Organization and Development of Dawson County to 1917" (unpublished M.A. thesis, Texas Technological College, 1937), p. 105.

draw, caved in the pit, and buried the pump.[6] The rain furnished not only some relief for the parched land; it also dampened any enthusiasm for putting down deep irrigation wells. Subsequently the irrigation movement subsided in Dawson County.

The plans of some speculative concerns never materialized. For example, at Tulia in Swisher County, local promoters J. E. Swepston, who had been observing irrigation developments in New Mexico, and Colonel J. Morgan Trummel, a recent settler from Kentucky, managed to attract "an association of Indiana and Kentucky capitalists." The group established an office in Tulia in 1912 and announced plans to develop several thousand acres in the Vigo Park community by installing an irrigation pumping plant on each 160-acre tract.[7] In the northwestern area of the Texas High Plains, out of the "shallow water" district, a former governor of Washington, M. E. Hay, and his brother, announced plans in 1913 to develop part of their 50,000-acre holdings near Texline.[8] But both groups failed to carry out their plans.

In the "shallow water belt," stretching roughly from Hereford south to Lubbock and from Plainview west to Muleshoe, enthusiasm for pump irrigation ran high during

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[6] _Ibid._, pp. 105-06.

[7] Amarillo _Daily News_, November 16, 1912, p. 2.

[8] _Ibid._, April 13, p. 7.

the next few years. The relationship between land speculators, urban promoters, and irrigation was apparent in the beginning of the irrigation movement at Hereford. The first wells were put down by D. L. McDonald, a land agent, with the backing of the Hereford Commercial Club which put up $3,000 to cover the costs of the first two irrigation units.[9] Boosters advertised the irrigation possibilities of the region. In a newspaper article which appeared in the Amarillo Daily News in 1912, a Hereford correspondent boasted that underneath Deaf Smith County there existed enough "water to float the navies of the world." Opportunities for investors and settlers were unlimited, he said. In conclusion the article stated that, "To the poor man and capitalist there is equal opportunity."[10]

By July, 1912, McDonald had formed the McDonald Farm Company which owned 5,000 acres and four irrigation wells.[11] The real estate company of Baskin and Hester had at least one McDonald well on its land.[12] And the Walker and Perkins land company began buying land that same year

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[9] Interview by author with John McDonald, oldest son of D. L. McDonald, August 23, 1968, Amarillo, Texas. Wilma Hixson, "The Influence of Water upon the Settlement of the Llano Estacado," pp. 68-69. Bessie Patterson, A History of Deaf Smith County (Hereford, Texas: Pioneer Publishers, 1964), p. 13.

[10] Amarillo Daily News, February 25, 1912, section II, p. 1.

[11] Ibid., July 28, 1912, p. 2.

[12] Interview by author with John McDonald.

around Hereford. Within a year the latter company owned 14,000 acres, sixteen irrigation wells, and was attempting to sell its land as irrigated farms ranging in size from 40 to 320 acres each.[13]

Charles E. Harding of Chicago, Illinois, who already owned thirty-five square miles of land near Hereford, bought a section in 1913 which already had an irrigation well, for a little more than $47 per acre, with the intention of further developing irrigation on that section.[14]

McDonald formed a company with S. B. Edwards, a banker, and developed a unique plan of selling shares in a 160-acre irrigation farm planted in alfalfa. Each share would represent one acre and would be sold for $250. The shareholder had to pay $10 down and $10 per month. In return he would receive a guaranteed 7 per cent on his investment per year. In addition, after costs and dividends were deducted, the investor would receive his share of the proceeds from one-half the profits. The Edwards-McDonald Investment Company was to retain control of the farm for the first three years beginning in January, 1913.[15]

The Portales wells not only had an influence on the beginnings of irrigation in the Hereford region, but on

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[13]Amarillo <u>Daily News</u>, July 9, 1912, p. 4; July 28, 1912, p. 2.

[14]<u>Ibid</u>., November 9, 1913, p. 1.

[15]<u>Ibid</u>., July 28, 1912, p. 2. Brochure printed by the Edwards-McDonald Company entitled "Facts, nothing else" (Hereford, 1913), in Texas State Archives, Austin, Texas.

other areas of the High Plains as well. Don H. Biggers, J. C. Burns and possibly other members of the Lubbock Commercial Club went to Portales during a "water carnival" held there in 1910. Enthusiastic at the prospects, Biggers suggested that a central electric power plant like that at Portales be built at Lubbock to supply electricity for irrigation pumps. But the estimated cost of $75,000 discouraged implementing the idea.[16] A member of the Commercial Club, however, put down the first successful irrigation well in Lubbock County. Burton O. McWhorter, a cattleman, real estate agent, automobile dealer, and entrepreneur, completed a pit-type well in early March, 1911.[17] By May there were at least two more wells in the vicinity, a small 200 gallon per minute well owned by W. H. Bacon, and a much larger unit put down by Don H. Biggers, a member of the Commercial Club who had attended the "water carnival."[18]

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[16] Joseph F. Gordon, "The History and Development of Irrigated Cotton on the High Plains of Texas" (unpublished Ph.D. dissertation, Texas Technological College, 1961), p. 86.

[17] Ibid., pp. 86-87. Roy Sylvan Dunn, "B. O. McWhorter," in Builders of the Southwest, ed. by Seymour V. Connor (Lubbock, Texas: Texas Technological College, 1959), pp. 156-57. Dunn states that the well was put down in about 1910. Work on the well may have begun that year, but it was not completed until 1911. Gordon shows that the local newspaper, the Lubbock Avalanche, reported that the well was Lubbock's first successful irrigation well on March 2, 1911. See Dunn's later article, "Agriculture Builds a City," in A History of Lubbock, ed. by Lawrency L. Graves (Lubbock, Texas: Texas Technological College, 1962), p. 282.

[18] The Earth, VIII (May, 1911), 17.

McWhorter sold his irrigation unit and the 160-acre tract surrounding it in early 1913 to a P. Van Rosenburgh of Austin, who had also bought 2,550 additional acres for irrigation development. Van Rosenburgh planned to put down three or four more wells during 1913.[19] John P. Wortham and Colonel "Sheb" Williams formed the Lubbock Irrigation Company and acquired a 12,000-acre tract east of Lubbock. In 1913 the Layne and Bowler Company drilled a large, highly-publicized well on the tract.[20]

Speculators and urban boosters of Muleshoe and Hurley in Bailey County also promoted irrigation. The Coldren Land Company in the Black Water Valley near Muleshoe, owned by three brothers--Clymer, Paul, and Stevens Coldren--from Kansas City, purchased about 50,000 acres in 1911 or 1912. By 1914, the Company was selling its 160-acre tracts complete with an irrigation unit on each tract for $80 per acre. For $100 per acre, the Coldren concern would supply a house, outbuildings and other improvements in addition to the pumping plant.[21]

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[19] Amarillo Daily News, February 5, 1913, p. 6.

[20] Ibid. John L. Wortham to Layne and Bowler Company, October 3, 1913, Lubbock, Texas, reprinted in Layne and Bowler Company, Layne Water Facts (Houston, Texas, and Memphis, Tennessee, 1914), p. 31.

[21] The first irrigation well in the Muleshoe area was probably put down by Willard Burns in late 1910. Gordon, "History and Development of Irrigated Cotton on the High Plains," p. 88. Thelma W. Stevens, "History of Bailey County" (unpublished M.A. thesis, Texas Technological College), pp. 44-49, 75. Don H. Biggers, "In the Black Water Valley," The Earth, XII (January, 1915), 11.

Ten irrigation wells were in operation around Hurley in 1912, most of which had probably been installed by the Coldren Company. There is no evidence that any of the wells were put down through subscription by local urban interests, but in March, 1912, the Hurley Commercial Club held a two-day irrigation demonstration. The event was widely advertised. On the first day, automobiles from Hurley met visitors arriving by train at Friona, and drove them to the event. Harry M. Bainer and L. L. Johnson, agricultural demonstration agents for the Santa Fe railroad, spoke. A tour of the irrigation wells climaxed the festivities. There could be no doubt of the objective of the Hurley Commercial Club. L. R. Cox, the secretary, boasted that the slogan of the Club was "not to boost, or to boom, but to develop."[22]

In early 1913 the Fairview Land and Cattle Company near Hurley announced that the Hickox-Whyman Engineering Company would begin drilling twenty-five wells on the company's lands. Irrigation pumping units were to be installed and forty-acre tracts with pumping plants "will be offered to settlers at appealing figures."[23]

An excellent example of the relationship between irrigation promotion and land colonization or speculation

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[22]Amarillo Daily News, February 25, 1912, section II, p. 8.

[23]Ibid., January 26, 1913, p. 1.

is found in the Littlefield Lands Company of Lamb and Hockley Counties.[24] Major George W. Littlefield, the well-known Texas cattleman and businessman, had bought a 312,000-acre bloc of land known as the Yellow House Division of the XIT Ranch from the Capitol Freehold Land and Investment Company in 1901 for $2 per acre.[25] In 1912 Littlelield contracted with the Santa Fe Railroad to build a road from Lubbock northwest to Texico on the New Mexico border where the line would connect with the main Santa Fe line. To entice the railroad into crossing the Yellow House Ranch, Littlefield gave the Santa Fe Company a right-of-way strip of 196 acres and a bonus of $100,000. Then the Major organized the Littlefield Lands Company and hired his nephew-by-marriage, Arthur P. Duggan, as the sales manager.[26]

Duggan informed a correspondent in November, 1912, that the company intended "development along pumping well irrigation lines." To make the land more attractive to the prospective buyer, he emphasized that "you will have the advantage of increased values from that [irrigation] source."[27] The next month Duggan began to press Littlefield

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[24]An excellent study of the activities of this company is David B. Gracy, II, Littlefield Lands: Colonization on the Texas Plains, 1912-1920 (Austin: University of Texas, 1968).

[25]*Ibid.*, p. 7. [26]*Ibid.*, pp. 9-11.

[27]Arthur P. Duggan to Ralph E. Huston, November 25, 1912, Lubbock, Texas, in Ralph E. Huston Papers, Southwest Collection, Texas Technological College.

into putting down a demonstration well on the lands in order to increase the value of the property and to attract more buyers. Duggan emphasized: "My experience so far strongly proves the necessity for one of the irrigation wells on this land. . . . Shallow water is the thing that will make this land sell, and bring a much better price. It will mean many additional dollars for each acre to develop it here."[28]

More specifically, Duggan believed that a successful well would increase the value of the land on an average of at least $5 per acre.[29] Moreover, the sales manager insisted that a demonstration of the availability of irrigation water was necessary to attract settlers. Duggan wrote: "Shallow water is the one thing that is attracting the people to the South Plains now."[30] Littlefield agreed with Duggan, stating that such a well located near the railroad so that it could be seen from passenger car windows "would be a winning card."[31] In February, 1913,

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[28]Arthur P. Duggan to George W. Littlefield, December 12, 1912, Lubbock, Texas, in Littlefield Lands Company Papers, in private possession of David B. Gracy, II, Lubbock, Texas.

[29]Ibid., January 17, 1913, Lubbock, Texas, in ibid. Gracy, Littlefield Lands, p. 25.

[30]Arthur P. Duggan to George W. Littlefield, April 24, 1913, Littlefield, Texas, in Littlefield Lands Company Papers. Gracy, Littlefield Lands, p. 27.

[31]George W. Littlefield to Arthur P. Duggan, January 21, 1913, Austin, Texas, in Littlefield Lands Company Papers.

Major Littlefield consented to put down a demonstration well.[32]

Littlefield recognized, however, that there were certain risks to the speculator or colonizer in putting down a test well. What if the well failed to yield enough water for irrigation purposes? The Major suggested that "we could put down the test well, if a failure keep it to ourselves. If a success then develope [sic] [the well] to enable us to sell all the land in that water belt for $20.00 to $25.00 per acre."[33] As a well was being drilled north of the new town of Littlefield, the elderly cattleman warned Duggan that it would be unwise to allow the public to see the well "unless you Know [sic] it to be a Success [sic]."[34]

The first two wells which Duggan drilled were not the hoped-for successes. Both were put down just outside the geographic confines of the "shallow water belt." In April the first test well was completed; it was a small producer of probably less than 200 gallons per minute. Determined to make the best of it, Duggan built a reservoir and started a fifteen to twenty-acre demonstration farm.[35]

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[32] Ibid., February 8, 1913, Austin, Texas, in ibid.

[33] George W. Littlefield to Arthur P. Duggan, February 14, 1913, Austin, Texas, in ibid.

[34] Ibid., March 14, 1913, Austin, Texas, in ibid.

[35] Gracy, Littlefield Lands, p. 27.

To make the situation more critical for the colonizers, drouth struck the region by the end of July, 1913. Land sales ceased. Having heard of the well at Lubbock which the Layne & Bowler Pump Company had just completed for The Lubbock Irrigation Company, Duggan suggested that the Layne & Bowler Company be given the contract to drill some wells with its rotary rig.[36] The pump company subsequently put down the second well, but it, too, was a small producer of about 200 gallons per minute.[37]

After the second failure, Duggan decided to drill southeast of town in an area already known to have "shallow water."[38] By early January, 1914, a good well producing some 1,200 gallons per minute had been brought in.[39] There had been some indication by the middle of December that the well would furnish plenty of water. Before completion Littlefield advised Duggan that "you should at once raise the price of all the land near that well [.] When we can sell those Choice [*sic*] tracts up at $50.00 to $75.00 per Acre [*sic*] It will take care of the lands where good wells Can[']t [*sic*] be got." He added

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[36]Arthur P. Duggan to George W. Littlefield, July 22, 1913, Littlefield, Texas, in Littlefield Lands Company Papers.

[37]Gracy, *Littlefield Lands*, pp. 32-33.

[38]*Ibid.*, p. 33. See also Arthur P. Duggan to George W. Littlefield, October 2, 1913, Littlefield, Texas, in Littlefield Lands Company Papers.

[39]Gracy, *Littlefield Lands*, p. 35.

enthusiastically: "And there is no estimating hardly what lands are worth where plenty of cheap water can be had on them."[40]

With one good well churning an abundance of water to the surface, Duggan began to consider the possibility of selling farms to prospectors with irrigation units installed. "In my judgment," he stated, "it will be easier to sell the tracts where the water is developed, even at a much higher price than the others."[41] But this idea did not appeal to Major Littlefield. Duggan was allowed, however, to sink four more demonstration wells in 1914.[42] Littlefield wanted "wells running" and "crops growing" by the time a new crop of prospectors arrived in the spring. And he stressed to Duggan: "That land under the big well should be put in and crops planted early so it will make a good show."[43]

The most active promotion, however, and the best example of the relationship between urban speculation and

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[40]George W. Littlefield to Arthur P. Duggan, December 18, 1913, Austin, Texas, in Littlefield Lands Company Papers.

[41]Arthur P. Duggan to George W. Littlefield, January 12, 1914, Littlefield, Texas in _ibid_.

[42]These wells were put down by George E. Green of Plainview who had installed the pumping plant in the John Henry Slaton well in the Plainview area. Two of the wells were not drilled until the summer and fall of 1914. Gracy, _Littlefield Lands_, pp. 38, 40.

[43]George W. Littlefield to Arthur P. Duggan, March 14, 1914, Austin, Texas, in Littlefield Lands Company Papers. Gracy, _Littlefield Lands_, p. 38.

the irrigation movement occurred in the Plainview area. Some time during 1910 a committee from the Plainview Commercial Club visited the wells at Portales, possibly during the "water carnival" of August 28.[44] Impressed with the New Mexico project, the group returned and formulated a plan to encourage irrigation in Hale County. The president of the Commercial Club, J. O. Wyckoff, led a movement to put down a pit-type "subscription" well similar to those which D. L. McDonald had first dug near Hereford. The group then entered into an agreement with John Henry Slaton, a Plainview banker, to finance a well and installation of a pumping unit on his farm west of town. But there was a difference between this agreement and the McDonald subscription wells. Slaton agreed to pay for the well if it produced a good stream of water. The money would then be used to put down a second well under a similar agreement.

The Slaton well, like the first wells at Hereford and Lubbock, was a pit-type well. J. N. McNaughton, a local well-man, dug a rectangular pit six by eight feet in diameter and 26 feet deep. Then McNaughton and George E. Green, an inventive mechanic, drilled a smaller hole into the water-bearing formation to a depth of about 110 more feet. By January, 1911, the well was completed. Green

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[44] Ira C. Ihde, "Washington Ellsworth Lindsey," New Mexico Historical Review, XXVI (October, 1951), 183. Postcard, Ben Smith to A. B. Duncan, August 8 [1910], Portales, New Mexico Territory, in Arthur B. Duncan Papers.

installed a vertical centrifugal pump, similar to the early McDonald unit, and powered it with a thirty-two horsepower engine which burned naptha for fuel.[45]

Within two months, two more wells were in operation and several more were being drilled. In the meantime, the Plainview Commercial Club hired a "live secretary"--a full-time executive secretary. It also began a concerted effort through its local members to "bring about a better friendship between the farmer and the business man. . . ."[46] J. E. Lancaster, the president of the Third National Bank, pleaded: "The time has come for united effort of the farmers, merchants, bankers, and all other business men,

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[45]Mary L. Cox, History of Hale County Texas (Plainview, Texas, 1937), pp. 48-49. Interview of Joseph F. Gordon with George E. Green, March 13, 1958, Plainview, Texas, in Southwest Collection, Texas Technological College. Gordon, "The History and Development of Irrigated Cotton on the High Plains of Texas," pp. 85-86. Billy Ray Brunson, "The Texas Land and Development Company" (unpublished Ph.D. dissertation, Texas Technological College, 1960), pp. 18-19. Zenas E. Black, "The Magic of the Pump," Farm and Ranch (Dallas), XXXI (September 28, 1912), 2. Zenas E. Black, "The Pump in the South Plains," The Earth, IX (March, 1912), 13-14. Zenas E. Black, "The Land of Underground Rain," The Earth, IX (December, 1912), 13-14.

Black reported in "The Pump in the South Plains" that the well was completed in February, 1911 but W. A. Parker, "New Era for Plainview," The Earth, VIII (May, 1911), 19, stated that the well was tested in January. Parker, who was the editor of the Plainview News, was probably correct. The well could have been completed in January and tested that same month, but not put into actual operation until February.

[46]The Earth, VIII (March, 1911), 10. W. A. Parker, "New Era for Plainview," 19.

to develop this county into one of the finest irrigated districts of the world."[47]

Within two years after the first well was sunk in the Plainview area, Zenas E. Black, Secretary of the Plainview Commercial Club, who referred to the irrigation pump as the "rod of Moses," estimated that some $5,000,000 in land had been purchased by buyers coming from other regions of the country. Moreover, he noted that one large irrigation development company which planned to develop improved farm lands including putting down wells, would sell its lands at $100 to $250 per acre. "This," he noted paradoxically, "in a country where 10 years ago a man refused to trade a wagon and team for 640 acres of land."[48] But there is also no doubt that the news of irrigation wells tended to boost the price of land and to attract buyers and investors. The editor of The Earth noted that by the middle of 1912, "improved alfalfa farms in shallow water areas" were selling at prices ranging from $25 to $200 per acre.[49]

A number of professional and businessmen, many of whom were undoubtedly members of the Commercial Club, dug or drilled wells in Hale County. Some were absentee owners, but most lived in the area. Robert Alley, President of the

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[47] Quoted in The Earth, VIII (March, 1911), 10.

[48] Zenas E. Black, "The Magic of the Pump," 2-3.

[49] The Earth, IX (July, 1912), 2.

First National Bank of Hale Center, installed a pumping plant to water 160 of his 2,000 acres.[50] E. E. Graham, a lawyer of Plainview, dug one of the early wells in 1911.[51] Doctor R. R. White, of the famous Scott & White clinic located at Temple, Texas, put down a well on his land. The White well reportedly was the largest on the Plains by 1913, pumping an incredible 3,000 gallons per minute. This well required a large number eight Layne pump and a 110 horsepower engine.[52] Dr. J. C. Anderson of Plainview, put a Layne pump in his well and powered it with an electric motor connected directly to the vertical shaft.[53] J. Walter Day, a dealer in lands and securities at Plainview who installed a well in the spring of 1912 near Hale Center, reasoned that "irrigated land, even in isolated irrigated regions, is selling for from $400 to $1,000 per acre. Why will not this land in a few years sell for the same prices, since it is much better in many ways."[54]

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[50] Amarillo Daily News, June 21, 1912, p. 6.

[51] The Earth, IX (April, 1912), 4. Photograph of the pumping unit in the files of Green Machinery Company, Plainview, Texas.

[52] Amarillo Daily News, August 17, 1913, p. 1. Photograph in Layne Water Facts, p. 44.

[53] Ibid., p. 32.

[54] J. Walter Day, "Shallow Water and Pump on the Plains," The Earth, XI (July, 1914), 11. Amarillo Daily News, June 21, 1912, p. 6. J. Walter Day to Layne and Bowler Company, May 14, 1914, Plainview, Texas, reprinted in Layne Water Facts, p. 46.

By November, 1912, twenty pumping plants were operating in the Plainview area. Existence of the irrigation units was widely publicized. Local leaders sponsored "water carnival" Fourth of July holidays in 1911 and 1912. One enthusiastic booster noted that during the holiday of 1912, "a large number of wells were in action and behaved splendidly."[55]

Officials of the Santa Fe Railroad also took an interest in the Plainview developments. In early 1912, C. L. Seagraves, the general colonization agent for the Santa Fe, and Harry M. Bainer, its agricultural agent for the Panhandle-High Plains, toured the Plainview area. During the visit Seagraves gathered statistics, photographs, and data about the wells with a view toward publicizing the irrigated areas of the High Plains on a national scale.[56] The next year, an irrigation specialist from the Santa Fe arrived in Plainview to measure the flow of the oldest irrigation well in that area. He reported that the well still flowed its original 1,500 gallons per minute.[57] This move was intended to publicize the belief that the water could not be exhausted.

The publicity given to the abundance of irrigation water by the Santa Fe, local urban leadership and various

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[55] Amarillo Daily News, July 9, 1912, p. 6.

[56] Ibid., January 30, 1912, p. 2.

[57] Ibid., March 21, 1913, p. 6.

speculators reached many areas of the nation in the same way that stories of cheap land had attracted national interest during earlier years. A man who lived in Council Bluffs, Iowa, and who had not seen the pumps, learned of the wells on the Texas High Plains from "the Santa Fee [*sic*] literature." He was interested in drilling a well on some land which he owned in Floyd County, and inquired about the prospects for water on his property in view of the fact that, "the wells around Plainview have water coming, in some case[s], to within 6 or 8 feet of the top of the ground."[58] Another man from Claypool, Indiana, who owned 480 acres of land in Floyd County, inquired of the local abstract agent, "What prospects are there for pumping for irrigation in the vicinity of Floydada[?]."[59] Within the next few years, land in the vicinity of Plainview became increasingly attractive. By the end of 1912, some forty real estate agencies were operating in Hale County, and several of them regularly brought in excursion trains loaded with "prospectors."[60]

One real estate agent who became very important in promoting sales in the Plainview area was Milton Day

[58]Leroy C. Brown to A. B. Duncan, June 15, 1914, Council Bluffs, Iowa, in Arthur B. Duncan Papers.

[59]E. H. Kinsey to A. B. Duncan, July 22, 1913, Claypool, Indiana, in Arthur B. Duncan Papers. Duncan gave no encouragement for drilling wells in eastern Floyd County because of the great depth to water.

[60]Brunson, "The Texas Land and Development Company," p. 83.

Henderson. By 1912 Henderson was using stationery which had a map of the "Shallow Water Belt" on its reverse side.[61] He conceived the idea of marketing completely developed and improved irrigation farms, complete with pumping plants. He believed, as did other land agents, that an irrigation pumping plant operating in the area made land more attractive. Moreover, he thought that with proper capital backing, complete irrigation farms would be even more attractive. But the real estate agent did not have the capital to develop his plan.[62]

Henderson forged the link between his plan and reality when in 1912 he contacted a prominent Eastern engineer and promoter named Frederick Stark Pearson. Pearson appeared in the Plainview area that year while making a railroad reconnaissance for the Frisco Railroad. The railroad scheme failed to materialize, but Henderson apparently approached Pearson about his plans. The prominent engineer, whose accomplishments included that of chief engineer of the Metropolitan Street Railways in New York City, consulting engineer for early hydroelectric projects in Europe, North and South America, and head of his own Pearson Engineering Corporation, became attracted to

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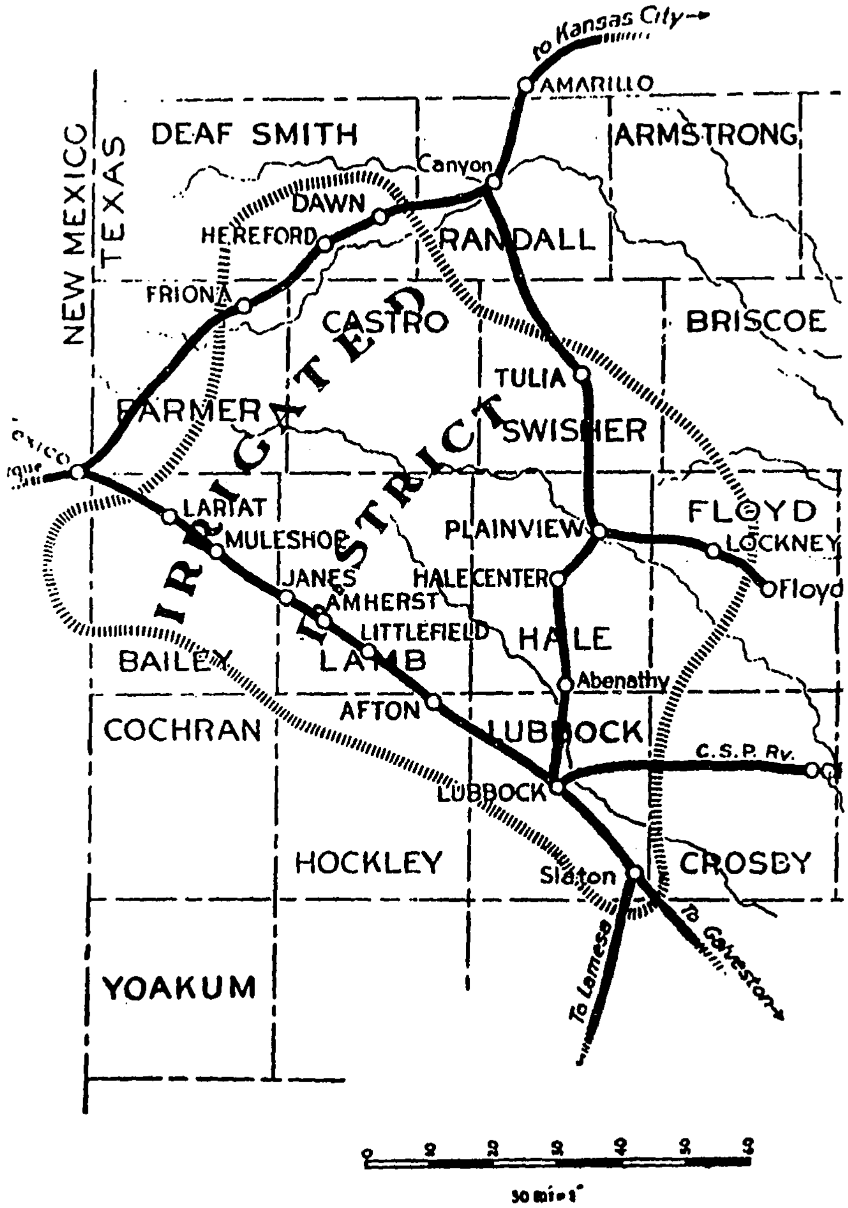
[61]M. D. Henderson to A. B. Duncan, May 6, 1912, Plainview, Texas, in Arthur B. Duncan Papers.

[62]Brunson, "The Texas Land and Development Company," p. 20.




Map of Shallow Water Counties of Texas

THE "SHALLOW WATER BELT" OF THE TEXAS HIGH PLAINS

From: The Earth, XII (August, 1915). Courtesy of the Santa Fe Railroad Company.

the Henderson plan primarily because he was impressed by the Plainview irrigation pumps.[63]

The Pearson Engineering Corporation, known locally as the "Pearson Syndicate," began pouring money into the project in May, 1912. Henderson bought tracts of land from farmers and ranchers in Hale, Floyd, and Swisher Counties. On October 21, 1912, the "Pearson Syndicate" completed the organization of the largest irrigation development enterprise on the Texas High Plains--The Texas Land and Development Company. The TL&D, as it was known locally, was the agency which, through the next few years, underwent several reorganizations. At the outset, however, Henderson was elected president. The company was owned by a Canadian holding company which Pearson organized, and which included as trustees, John Henry Slaton, who had put down the first Plainview well, and H. D. Randolph, a prominent Plainview attorney.[64]

The TL&D's capital investment amounted to over $1,500,000. Before the conclusion of 1912 the company had purchased some 61,360 acres at an average price of $25 per acre, which was above the current going price. Most of the capital came from British associates of Pearson. The historian of the TL&D has conjectured that the much

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[63] Ibid., pp. 21-28.

[64] Ibid., pp. 21-28, 30-43. "Where Business Combines Philanthropy," The Earth, XI (January, 1914), 10.

publicized objectives of Pearson may have been a factor in the rise of land prices.[65] But the publicity about the existence of shallow water in the region may already have forced prices up. Land prices tended to rise as the existence of irrigation water became more widely known throughout the High Plains.

Originally, the "Pearson Syndicate" planned to develop and to sell all its lands within five years. The firm first offered improved farms for sale in minimum units of forty acres. The purchaser could buy multiples of these at a corresponding decrease in cost, which ranged from $250 per acre for a 40-acre farm to about $100 for 160 acres or more. The price depended on the improvements which the buyer desired. On a typical unit, the TL&D built a house, barn, and outbuildings, put up a windmill for a domestic water supply, and put down an irrigation well complete with pump and engine. In addition, the company dug the primary canals leading away from the well to the field, put 50 per cent of the land in cultivation, seeded twenty of those acres to alfalfa, planted two acres in fruit trees, and fenced the entire farm. The plan, however, was flexible enough to allow for individual desires. If a prospective buyer wanted to exclude such items as outbuildings or barn, the company correspondingly decreased the total price for

[65] Brunson, "The Texas Land and Development Company," pp. 30-31, 49, 60.

the farm. Some farmers wanted fewer acres in orchards or more land in alfalfa. For example, one buyer was given a $100 credit on his total cost in lieu of the two acres of orchard. In another case, the company gave the buyer "$75 worth of hog fencing instead of the orchard."[66]

The TL&D guaranteed an irrigation well capable of watering the entire tract of land on each farm, and sold its lands for one-fourth down and the balance within five years at 6 per cent.[67] But by 1916 the company was selling land for as little as 10 per cent down with twelve years to pay the remainder at 6 per cent interest. For example, E. J. Smith of Morrisville, Missouri, bought a 160-acre tract in 1916. He paid $2,300 down and was to pay the remainder in twelve annual installments of approximately $1,340 each, which included 6 per cent interest. Smith paid $115 per acre for the tract which included 80 acres under cultivation. Another buyer who bought land the same year paid approximately $124 per acre for 74-1/2 acres with similar terms.[68]

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[66] *Ibid.*, pp. 78, 97. Advertisement by Texas Land and Development Company in *The Earth*, XI (March, 1914), 15. Contract for sale of land to E. J. Smith by Texas Land and Development Company, July 19, 1916, file no. 2-3; contract for sale of land to Frank A. Kindwall by Texas Land and Development Company, May 1, 1916, file no. 3-24, in Texas Land and Development Company Papers, Southwest Collection, Texas Technological College. Hereafter cited as TL&D Papers.

[67] Brunson, "The Texas Land and Development Company," pp. 78, 123. "Where Business Combines Philanthropy," 10.

[68] Contract for sale of land to E. J. Smith by Texas Land and Development Company, July 19, 1916, file no. 2-3;

The TL&D advertised its lands in the most glowing terms. The "inexhaustible" shallow water supply lay only 30 to 60 feet from the surface. The flat surface of the plains was inexpensive to prepare and to level for irrigation. A single well could water from 160 to 320 acres of crops. The cost for raising the water was estimated at only one dollar per acre-foot. And in order to appeal to the speculative urge, the company implied that because of irrigation, land values would rise throughout the Plainview area.[69]

Originally, the "Pearson Syndicate" planned to install four hundred pumping plants, or approximately one well for every 160 acres.[70] The first wells for the company were pit-wells installed by the Green-McNaughton Drilling and Machinery Company of Plainview which had dug the well for John Henry Slaton in Hale County. Milton Day Henderson signed an agreement with George E. Green on January 27, 1913, to dig a minimum of ten pit-type wells. These wells were to be five feet in diameter and dug to a depth of six feet below the first water level. Then a hole 15 inches in diameter was to be drilled from that level to

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contract for sale of land to Frank A. Kindwall by Texas Land and Development Company, May 1, 1916, file no. 3-24, in TL&D Papers.

[69]Brunson, "The Texas Land and Development Company," pp. 74-75.

[70]*Ibid*., p. 123.

175 feet below the surface.[71] By August, Green completed the first ten wells and began under contract to dig and drill the next twenty wells. The TL&D also made a contract with the Layne & Bowler Company for a number of wells to be completed with a rotary drill, and purchased at least one rotary rig for its own use. By November, 1913, the company had installed at least seventeen pumping plants, possibly more.[72]

The techniques which the TL&D used to attract buyers were similar to those used by other speculators and colonizers of the High Plains. The company sent its agents to various cities in the country, primarily to the midwestern region. In 1913, a permanent office was opened as far east as Chicago. The agents advertised the lands in local

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[71]Memorandum agreement signed by M. D. Henderson for the Texas Land and Development Company, and George E. Green, January 27, 1913, in files of Green Machinery Company, Plainview, Texas.

[72]Amarillo Daily News, August 1, 1913, p. 4. R. S. Charles came to Plainview in 1912 as chief engineer for the Texas Land and Development Company irrigation project. From August 14, 1913 to November 1, 1915, he served as General Manager of the company. He later became an official of the Layne and Bowler Pump Company. R. S. Charles to D. E. Nelson, November 14, 1949, New York City, in files of Layne and Bowler Pump Company, Memphis, Tennessee. Brunson, "The Texas Land and Development Company," p. 303.

Between March and August, eighty-two irrigation wells were drilled in the Plainview area. Of this number, Layne and Bowler drilled forty-eight, Green Machinery Company put down twenty-two, and the Texas Land and Development Company drilled twelve with the company's own rigs. Most of the total number were drilled for the Texas Land and Development Company. Amarillo Daily News, August 17, 1913, p. 1.

newspapers, and provided railroad excursions for "prospectors" free of charge or at a very nominal rate. In order to emphasize the availability of underground water, the TL&D drilled a well within a few yards of the Santa Fe passenger station at Plainview. The Layne & Bowler irrigation plant operated continuously, pumping water into a multi-tier concrete weir, which produced a waterfall effect, and into a playa lake or "buffalo wallow" only a few yards away, named "Lake Plainview" by the company. On Sundays, row boats and small sail craft could be seen on the pond. Prospectors stepping off excursion trains were impressed. Some expressed disbelief that such a large stream of water could continuously be pumped from the ground and voiced the belief, before scrutinizing the unit more closely, that the water was being pumped out of the lake.[73]

From 1914 through 1916, the TL&D conducted regular monthly excursions to its lands from various points throughout the Midwest.[74] The TL&D excursions probably brought in "prospectors" for other land agents as well. For example, Dr. R. R. White, who had the largest well in the area, placed large billboards near the highways and the railroad

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[73]Brunson, "The Texas Land and Development Company," pp. 81-83, 105-13. Photograph of the well and lake in Layne Water Facts, pp. 35-36.

[74]Brunson, "The Texas Land and Development Company," p. 89.

leading into town, which stated: "See Dr. White's irrigated farms before you buy, nearer town for less money; no cash payment required, twenty years time."[75] Some local citizens, including John H. Slaton, protested that White obviously was attempting to siphon off "prospectors" which the TL&D had brought into Plainview at the company's expense. Some local leaders were fearful that White, and possibly other local speculators, might antagonize the TL&D, which would then withdraw from the Plainview area.[76] White replied that the company operated as a business concern, not as a philanthropic organization. To quiet fears that the competition might cause the TL&D to withdraw from the area, White stated in an advertisement appearing in a local newspaper: "Speculators and development companies buy land to sell--they can't eat it, and they do not want to keep much of it, so do not be annoyed by any hot air talk that any of us [land speculators] are going to withdraw from the Plainview country."[77]

Up to July, 1916, the company had sold approximately 12,000 acres to 92 individuals. Pending the complete payment for the farms, the company would gross approximately $1,090,000 from the sales. By May, 1915, the TL&D had

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[75] Plainview _Evening Herald_, June 15, 1915. Quoted in _ibid_., p. 91.

[76] _Ibid_., p. 92.

[77] Plainview _Evening Herald_, June 29, 1915, and July 2, 1915. Quoted in _ibid_., p. 93.

drilled or dug 127 irrigation wells at a total cost of $257,410. After that date, the company drilled no more wells.[78]

Not all early irrigation wells were the products of urban land speculators. A few of the large ranchers and some farmers drilled wells in order to raise forage for their livestock, or to produce certain specialized crops. As early as 1910 the Alamocitas Division of the Matador Ranch in Oldham County installed an elaborate plant and aqueduct system at a cost of over $10,000 to pump water from the Canadian River for forage crops.[79] Officials of the ranch arrived at Hereford in July, 1913, "to investigate the irrigation proposition."[80] In September, 1914, D. L. McDonald completed the second of two irrigation wells with which the ranch officials planned to irrigate alfalfa.[81] That same year the XIT Ranch had an irrigation farm in operation near Friona.[82]

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[78] Ibid., pp. 90, 124.

[79] Averlyne M. Hatcher, "The Water Problem of the Matador Ranch," West Texas Year Book, XX (October, 1944), 65-66.

[80] Ranch Manager's Diary, Alamocitas Division of the Matador Ranch, July 21, 1913, Matador Land and Cattle Company Papers, Southwest Collection, Texas Technological College.

[81] September 8, 1914, in ibid. Amarillo Daily News, April 5, 1914, p. 6.

[82] Frances Phillips, "The Development of Agriculture in the Panhandle-Plains Region of Texas to 1920," (unpublished M.A. thesis, West Texas State College, 1946), pp. 93-94.

The Fairview Land and Cattle Company near Hurley used one of its wells to raise forty acres of truck garden. The forty-acre plot was divided into two-acre fields and rented to individuals who raised beans and tomatoes. The company built a cannery to provide a market for the truck, and for a few years cans of "Hurley Best" vegetables were freighted out of Bailey County.[83]

In Randall County, Mrs. J. A. Mooney put down a small irrigation plant in 1912 to water a field of alfalfa.[84] And in Swisher County, two brothers--J. D. and J. W. Vaughn--installed a Layne pump on their farm in 1914 for the purpose of raising kaffir corn and other forage crops for their livestock.[85]

Other farmers who could afford the cost of irrigation plants drilled wells, but urban speculators provided the primary impetus for the irrigation movement, and installed most of the pumping units. One indication of the success of speculation was the rise in the price of land. During the drouth of 1910, it was reported that unimproved land in Floyd County was selling at $14 or $15 per acre when buyers could be found.[86] Later that same year as

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[83]Stevens, "History of Bailey County," pp. 75-76.

[84]Amarillo Daily News, February 18, 1912, p. 1.

[85]Telephone interview by Ozella M. Green with Marshall Vaughn, son of one of the Vaughn brothers, November 25, 1968, at Tulia, Texas.

[86]A. B. Duncan to Mr. and Mrs. F. P. Baumgardner, September 28, [1910], in Arthur B. Duncan Papers.

news of the McDonald wells in Deaf Smith County spread throughout the High Plains, Harry M. Bainer, agricultural agent for the Santa Fe, reported that although "unimproved dry-land farms" were priced at $10 to $20 per acre, unimproved lands in the "proven irrigation districts" were selling at prices ranging from $25 to $50 per acre.[87] In 1915, unimproved land in Hale and Deaf Smith Counties was selling for $35 to $50 per acre.[88]

There were indications by 1916 that the irrigation movement was coming to a halt. In that year the Texas Land and Development Company made its credit terms more attractive by lowering the down payment and spreading the balance out over twelve years instead of the originally announced five years.[89] The TL&D brought its last excursion trains to Plainview and discontinued its sales program that year.[90] Moreover, in 1916, the Layne & Bowler Company, which had provided most of the irrigation pumps to the Texas High Plains, shipped its last load of pumps to the region until the 1930's.[91]

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[87]H. M. Bainer, "Tried and Not Found Wanting," The Earth, XI (April, 1914), 14.

[88]Editorial Correspondence, "Shallow Water Counties of Texas," The Earth, XII (August, 1915), 7, 9.

[89]See p. 159.

[90]Brunson, "The Texas Land and Development Company," pp. 89, 95.

[91]Determined by the author upon an examination of shipping receipts for pumps in the files of the Layne & Bowler Company, Memphis, Tennessee.

The irrigation movement on the Texas High Plains, which began during the drouth of 1910, failed to develop under the promotion efforts of urban speculators. By 1920, there were only 187 irrigation wells in operation in the four counties of Bailey, Deaf Smith, Floyd, and Hale, and probably over one-half of these were TL&D wells. These irrigation units were used during the season of 1919 to irrigate 13,510 acres, an average of only about seventy-two acres per well. By 1930 the number of wells had declined to 170, and the irrigated acreage at 7,384 was little more than one-half of that in 1919.[92] The deep well irrigation movement was premature because it lacked a solid base of farmer support. Nevertheless, many of the early pumping units continued to operate during the 1920's and early 1930's.

Paul W. Gates has stated, "For better or worse the speculator, whether absentee or resident, squatter or banker, local politician or eastern senator, was present on every frontier. He affected every phase of western development and left in all places his indelible mark."[93]

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[92] Fourteenth Census of the United States, 1920, State Compendium, Texas (Washington, 1925), pp. 201-02. Fifteenth Census of the United States, 1930, Irrigation of Agricultural Lands (Washington, 1932), pp. 219-23.

[93] Paul W. Gates, "The Role of the Land Speculator in Western Development," The Pennsylvania Magazine of History and Biography, LXVI (July, 1942), 333.

His "indelible mark" on the Texas High Plains consisted of a Layne pump and Bessemer oil-burning engine--evidence of the possibilities for future irrigation.

## CHAPTER VII

## EARLY FAILURE OF PUMP IRRIGATION, 1910-1920

The early attempt to develop pump irrigation on the High Plains was primarily the work of land speculators who used irrigation as a means for raising land prices and making land more attractive to "prospectors." Included among those early irrigators were not only land speculators, but also a few ranchers, some local farmers, and especially out-of-state farmers who purchased "shallow water" lands equipped with pumping plants from speculators. The experiment in the irrigation of semiarid lands was, on the whole, not successful. For example, about 80 per cent of the irrigated farms purchased from the Texas Land and Development Company, the largest developer of pump irrigation in the region, were turned back to the company by the original buyers.[1]

Pump irrigation had emerged during a period of relatively high prices for both farm products and farm lands in the United States, and in direct response to a

[1]Billy Ray Brunson, "The Texas Land and Development Company," (unpublished Ph.D. dissertation, Texas Technological College, 1960), p. 188.

regional drouth. But both national and regional conditions changed. The forces which halted the irrigation frontier on the Texas High Plains sprang from complex factors, most of which appeared during the period 1910-1920.

One important circumstance was the involvement of the United States in World War I. The conflict in Europe had a direct effect upon market prices for American crops. The prices for farm products, especially those of wheat and livestock, rose sharply. Wheat which had brought an average price to farmers in 1915-16 of $0.98 per bushel sold for $2.48 by June, 1917. At the same time, prices for livestock and meat products rose 52 per cent beyond the 1913-14 level.[2]

The increased demand for wheat and livestock encouraged extensive dry-land agriculture on the High Plains rather than intensive irrigation farming. Farmers sowed more freshly-broken sod land to wheat, and began stocking their ranges with additional livestock, especially with hogs which matured faster than cattle. Pigs were fattened on kaffir corn, milo and other grain sorghums. Irrigation farmers even pastured their hogs on alfalfa meadows.[3] Local boosters announced that Hale County was the "most

[2]James H. Shideler, Farm Crisis: 1919-1923 (Berkeley and Los Angeles: University of California Press, 1957), p. 11.

[3]Myrtle Middleton Powell, "Plainview Pork and Prosperity," The Earth, XV (February, 1918), 17.

piggish part of the United States." In 1917 the Santa Fe Railroad began running a special weekly "hog train" which departed from Plainview on Saturday morning and arrived at the Fort Worth stockyards Sunday night.[4] By the summer of 1918 the price of wheat at Plainview, Texas, was $2.10 per bushel.

Higher prices for these farm products might have stimulated irrigation development had it not been for two important factors. First, the period 1911-1920 was, for most years, an era of adequate rainfall. The drouth which had begun in parts of the High Plains as early as 1908 was broken in 1911. That year Plainview received over thirty inches of rainfall, with one-third of that amount falling during the usually dry month of July. In 1912 the rainfall at Plainview fell to a little under nineteen inches, but most of it occurred during the critical spring and summer months. Widespread drouth emerged only in 1917. That year Lubbock received less than nine inches, Tulia received a little more than twelve inches, and about ten inches occurred at Plainview.[5] But even then, complete

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[4]<u>Ibid</u>.

[5]Rainfall charts in [W. G. Carter], "Study Covering Advisability of Owning Central Office Quarters in Lubbock, Texas, 1924," (mimeographed; Southwestern Bell Telephone Company, 1924), pages not numbered. [W. G. Carter], "Plainview Economic Survey, Plainview, Texas, March 16, 1925," (mimeographed; Southwestern Bell Telephone Company, 1925), pages not numbered. Southwest Collection, Texas Technological College.

crop failures were not widespread. A Plainview correspondent wrote in early 1918: "The past year was one of the dryest [sic] years this country [has] experienced, the rainfall having been but about ten inches. In spite of this fact, however, a good wheat crop was produced and considerable feed was grown without irrigation."[6]

The region, as a whole, had enough rainfall to produce grain sorghums for livestock feed, pasture for grazing, and wheat for the nation's flour mills without irrigation. There is even some evidence that the increased prices for wheat and livestock may have created a greater demand for dry-land farms. For example, during 1917 the Texas Land and Development Company reportedly sold only four irrigated farms. During the same period the company "sold over $75,000.00 worth of unimproved land for all cash."[7]

Second, the war stimulated costs as well as prices and produced shortages of some raw materials, particularly metals. This circumstance both increased the costs of pumps, engines, and casing, and created shortages of those vital components of pump irrigation. The Layne & Bowler Company announced to its dealers in the spring of 1916:

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[6]C. E. Craig, general manager of the Texas Land and Development Company to F. A. Kindwall, January 21, 1918, Plainview, Texas, file no. 3-24, Texas Land and Development Company Papers, Southwest Collection, Texas Technological College. Hereafter cited as TL&D Papers.

[7]*Ibid.*

> Word comes from our managers at the Memphis shops that on account of the great advance of our raw material used in the construction of our patent products we have been forced to make a decided advance on pumps, screen, and pit, etc. Not only are we paying three or four times more for the material, but it is also very difficult to obtain material under four to six months.[8]

The next year the general manager of the Texas Land and Development Company, largest of the speculative irrigation development concerns, wrote: "Because of the unusual conditions caused by the war, we have had very serious difficulty during the past few months in getting delivery of all kinds of materials and machinery needed in our work."[9] Thus, the war created shortages of pumping plant machinery, raised the costs for such equipment and placed a premium on dry-land agriculture of the High Plains. In addition, the advent of a period of increased rainfall encouraged farmers to become more interested in wheat and cattle than in irrigation plants.

Factors other than the war played important roles in the failure of irrigation to expand. Farmers faced

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[8] Our Field News (Memphis, Tennessee), I (March 15, 1916), 12, in files of Layne & Bowler Company, Memphis, Tennessee.

[9] C. E. Craig to C. E. Lundgren, September 5, 1917, Plainview, Texas, file no. 3-15, in TL&D Papers. The historian of the TL&D points out that the war affected that company in the following ways: (1) increased costs of irrigation equipment, (2) higher interest rates, (3) death of the founder, Frederick S. Pearson, who went down on the Lusitania, (4) curtailment of the flow of English capital into the company. Brunson, "The Texas Land and Development Company," pp. 133-34.

difficulties in their new experience as pump irrigators. In the first place most were probably inexperienced with irrigation, and some may even have been inexperienced at farming. Early in 1918 the general manager of the TL&D complained that, "a great many of the people who purchased irrigated farms in this country were people inexperienced in irrigation . . . ."[10] The same official blamed the company's zealous land agents for the problem. In a letter to an agent in Minnesota, the general manager declared: "On practically every one of the sales in which you have an interest, the purchasers were people from cities or towns who had no experience in farming, to say nothing of irrigation."[11]

From information obtained about twenty-three persons who purchased irrigated land from the TL&D before 1920, none came from western irrigated regions. Twenty-two were from Minnesota, Missouri, Pennsylvania, Tennessee, and eastern Nebraska. Only one person arrived from Texas, but he was from the more humid central part of the state. Many of these were absentee owners, but little information is available about the irrigation experience of their tenants.[12]

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[10] C. E. Craig to F. A. Kindwall, January 21, 1918, Plainview, Texas, file no. 3-24, in TL&D Papers.

[11] C. E. Craig to John Boden, December 7, 1918, file no. 3-1, in TL&D Papers.

[12] Information obtained from analysis of biographical sketches of TL&D land buyers in Brunson, "The Texas Land and Development Company," pp. 311-74.

There are indications that some, perhaps most, inexperienced irrigation farmers used their pumps only as a last resort. That is, crops were allowed to wither for lack of moisture before farmers started their pumps. Moreover, irrigators were sometimes uncertain about the amount of water to apply. In one case the general manager of the TL&D notified a farmer that, "the alfalfa which the company planted last fall had not been irrigated this spring and clearly shows the need of water immediately."[13] In another instance, an official of the company asked a farmer why he had not started to irrigate parched wheat during the dry spring of 1917. The farmer reportedly replied: "It may rain."[14] Two brothers in Swisher County who had put down a well on their land found that their crops suffered from lack of moisture because they began watering too late, and with too little water.[15]

There is no evidence that the TL&D, or any of the other land companies which attempted to attract land buyers through the promises of irrigation, screened "prospectors" for experienced irrigators. For example, the land agent criticized by the general manager of the TL&D for sending

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[13]Winfield Holbrook to E. A. Rydell, April 23, 1919, Plainview, Texas, file no. 3-18, in TL&D Papers.

[14]D. L. Alexander to C. E. Craig, May 25, 1917, Plainview, Texas, file no. 3-5, in TL&D Papers.

[15]Telephone interview of Ozella M. Green with Marshall Vaughn, son of one of the brothers, November 25, 1968, Tulia, Texas.

the company inexperienced "prospectors," replied in his own defense: "But as my contract with the company say [sic] nothing about what kind of people it should be I do not feel any further responsibility after the company has accepted there [sic] money."[16] TL&D farmers voiced other complaints about their irrigated farms. Some believed that their wells failed to produce enough water for their acreage. Others complained of land not being level enough to flood, of inadequate ditching, and of failure to achieve a good stand of alfalfa. Another common complaint was that irrigated fields and ditches became choked with Johnson grass, "blue weeds," and other noxious plants which were difficult to control.[17]

By 1918, some farmers were expressing their disenchantment. One farmer, a graduate of Wisconsin Agricultural College who was experienced in farming before purchasing a TL&D irrigated farm, complained after one year

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[16] John Boden to C. E. Craig, December 19, 1918, Duluth, Minnesota, file no. 3-1, in TL&D Papers.

[17] Brunson, "The Texas Land and Development Company," p. 188. C. E. Craig to A. T. Tornholm, February 16, 1917, Plainview, Texas, file no. 2-23; Victor J. Wallin to C. E. Craig, July 5, 1917, Minneapolis, Minnesota, file no. 3-18; Victor J. Wallin to C. E. Craig, July 17, 1917, Minneapolis, Minnesota, file no. 3-18; legal summons of Carl B. Anderson v. Texas Land and Development Company and Third National Bank of Plainview (1918), in file no. 3-5; D. L Alexander to C. E. Craig, May 25, 1917, Plainview, Texas, file no. 3-5; C. F. Myers, General Manager of TL&D, to Cal Byars, November 9, 1916, Plainview, Texas, file no. 3-5; legal summons of E. J. Johnson v. Texas Land and Development Company (1918), in file no. 3-27, in TL&D Papers.

on his new farm that the farm had been misrepresented.[18] A land agent who almost moved to an irrigation farm himself which he had purchased from the TL&D stated in late 1918: " . . . as things developed to a dissatisfaction on the irrigated farms it frightend [*sic*] me and I am now glad that I did not move on to the farm as I understand that the farmers that have tryed [*sic*] can not make a living on these places sold by the T L & Dev co."[19]

Pump irrigators also encountered mechanical difficulties with engines and pumps. Most farmers had no prior experience with operating or repairing internal combustion engines, although many had probably worked with steam engines. They were still using horse-drawn farm equipment, and driving to town in buggies or wagons rather than automobiles. In 1918, the general manager of the TL&D complained that only a few of those who had bought land from the company, "knew anything at all about the care and operation of large engines."[20]

The diary of Roland Loyd, a tenant farmer who rented an irrigation farm near Hereford, sheds light on the

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[18]John Boden to C. E. Craig, October 21, 1918, Duluth, Minnesota; Elmer G. Johnson to C. E. Craig, February 23, 1917, Minneapolis, Minnesota, file 3-1, in TL&D Papers.

[19]John Boden to C. E. Craig, November 29, 1918, Duluth, Minnesota, file no. 1-3, in TL&D Papers.

[20]C. E. Craig to F. A. Kindwall, January 21, 1918, Plainview, Texas, file no. 3-24, in TL&D Papers.

mechanical problems faced by irrigators. Loyd sometimes found his engine difficult to start. For example, he recorded: "Worked about half of afternoon trying to start pumping outfit [.] gave [sic] it up as bad job and cut weeds rest of afternoon."[21] On another occasion he wrote: "Worked 'til 3 30 P.M. trying to start big engine. then [sic] gave it up and went to town."[22] Irrigators were fortunate if a good mechanic lived in the area. Such was the situation at Hereford where one "Bessemer" Smith, who earned the nickname because of his ability to repair Bessemer engines, earned his living as an engine mechanic. Smith repaired Loyd's engine frequently during the latter's first year as a pump irrigator. By the next year, however, Loyd had learned enough about the engine to do much of his own mechanical work.[23]

A more frequent mechanical problem concerned the long, wide belt which connected the engine to the pump. Because summer temperatures on the High Plains varied frequently, the big belt constantly expanded or contracted. A loose belt slipped on the pulleys causing not only

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[21]Diary of Roland Loyd, June 20, 1914, in private possession of Mrs. Roland Loyd, Vega, Texas.

[22]*Ibid.*, August 10, 1915.

[23]*Ibid.*, June 22, August 1, August 15, 1914; June 23, July 14, July 17, 1915. By 1916, Loyd was taking his engine apart in order to clean out carbon deposits and make other repairs. Entries for March 30, May 29, June 28, July 18, 1916.

excessive wear on the belt but a marked decline in pump efficiency. A tight belt caused excessive pressure and wear upon pump shaft bearings, which in turn created a "hot box" within the upper pump shaft housing. Consequently, irrigators had to cut segments out of the belt to shorten it when the weather turned warm, and to lace pieces back into the belt to lengthen it when the temperature dropped. During the summer of 1914, Roland Loyd "cut big belt" on June 29 when the temperature climbed to 103 degrees, "put piece in big drive belt" on July 21, shortened the belt again on July 30, and "cut big belt" once again on August 1.[24]

Because of the frequency of mechanical difficulties, a farmer did not usually leave his pumping plant unattended while operating the machine. Consequently, irrigators did not run their pumps at night, and wells watered only about half the land they were capable of irrigating had they been operated twenty-four hours per day. J. D. and J. W. Vaughn of Tulia irrigated only about fifty acres from their well. Roland Loyd failed

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[24]*Ibid.*, June 29, July 21, July 30, August 1, 1914. By 1914 the Layne & Bowler Company had patented a "Sliding Pit Head" by which the belt could be tightened or loosened by adjusting set screws on the well casing, but this researcher found only three of these being used on the Texas High Plains. D. L McDonald ordered three "Sliding Pit Head" pumps in 1915. Shop order receipts in files of Layne & Bowler Company, Memphis, Tennessee. *Layne Water Facts* (Houston, Texas, and Memphis, Tennessee, 1914), p. 207. In possession of Carl Gelin, Lubbock, Texas.

to record the number of acres he irrigated, but the average from wells on the Texas High Plains during the season of 1919 was seventy-two.[25] Loyd ran his pump for periods as long as ten and twelve hours at a time, but never for more than a thirteen-hour period. It was a proud Loyd who once confided to his diary: "Irrigating alfalfa all day--Run 13 hrs without a bobble."[26]

Farmers grew several kinds of crops under irrigation, but no cash crops suitable to irrigation farming emerged in the region. In addition to small quantities of truck and fruit grown under irrigation, farmers experimented with cotton, wheat and other small grains, and even sugar beets. But little market for truck existed in the area, and high winds and hail prevented much success in growing commercial fruit orchards.[27] In the area south of Hale County, some cotton was grown under irrigation for demonstration purposes. The Littlefield Lands Company planted five acres of cotton which was irrigated in

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[25]Telephone interview by Ozella M. Green with Marshall Vaughn. Fourteenth Census of the United States, State Compendium, Texas, pp. 201-02.

[26]Diary of Roland Loyd, June 26, 1916. In contrast, pump irrigation farmers of the region in the 1960's run their engines twenty-four hours per day for weeks at a time, stopping them only long enough occasionally to change the engine oil or to make minor adjustments.

[27]Charles L. Baker, Geology and Underground Waters of the Northern Llano Estacado, University of Texas Bulletin No. 57 (Austin, 1915), p. 95.

1914.[28] In 1911, D. L. McDonald planted 55 acres in sugar beets at Hereford. The beets were harvested and sent to the United States Sugar and Land Company at Garden City, Kansas, to be refined.[29] Some wheat was irrigated on Texas Land and Development Company lands in Hale County.[30]

The crop which most interested irrigation farmers, however, was alfalfa. It was not new to the Panhandle-High Plains region. Even before the advent of pump irrigation some alfalfa was being raised for livestock feed in the valleys of various streams where shallow subsurface water could be tapped by the long roots of the plant. One stock farmer in Randall County began growing alfalfa in 1896. By 1910, the legume was found in Hale, Hansford, Dallam, Potter, Deaf Smith, Randall, Floyd, and possibly other counties. A farmer in Hansford County was even raising alfalfa seed and marketing it in Kansas as well as Texas before 1910.[31] On the eve of developing the

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[28]David B. Gracy, II, Littlefield Lands: Colonization on the Texas Plains, 1912-1920 (Austin: University of Texas Press, 1968), pp.37-38. Arthur P. Duggan to G. W. Littlefield, March 23, 1914, Littlefield, Texas; A. P. Duggan to G. W. Littlefield, May 8, 1914, Littlefield, Texas, Littlefield Lands Company Papers, in private possession of David B. Gracy, II, Lubbock, Texas.

[29]The Amarillo Daily News, January 2, 1912, p. 3.

[30]C. E. Craig to F. A. Kindwall, December 29, 1917, Plainview, Texas; O. L. Allen to C. E. Craig, January 8, 1918, Plainview, Texas; C. E. Craig to F. A. Kindwall, June 19, 1917, Plainview, Texas, file no. 3-24, in TL&D Papers.

[31]Frederick W. Mally, The Panhandle and Llano Estacado of Texas, Texas Department of Agriculture Bulletin No. 12 (Austin, 1910), pp. 11-20.

first irrigation wells, Frederick W. Mally of the Texas Department of Agriculture, wrote: "First class alfalfa lands have such high valuations placed upon them that I am surprised that the land owners, especially of Hale and adjoining counties, have not put in pumping plants of sufficient capacity to place thousands of acres of their level prairie lands under irrigation, and plant them to alfalfa."[32] J. H. Slaton, who had put down the first irrigation well in Hale County, planted alfalfa on his land in 1911. During that season he reportedly harvested some five tons to the acre and sold his hay for an average price of $15 per ton.[33]

The prospect for growing alfalfa was especially attractive to "prospectors." TL&D agents informed prospects that the price for the farm included a good stand of alfalfa. Some agents went so far as to claim that profits from the alfalfa crop alone would pay the principal and interest on the farm mortgage.[34]

In spite of the boasts of land agents, good local markets for hay usually existed only during exceptionally dry years when grain sorghums, the predominant forage crops

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[32] Ibid., p. 172.

[33] The Amarillo Daily News, January 2, 1912, p. 3.

[34] Octave Poissant to TL&D, February 24, 1819, Minneapolis, Minnesota; Victor Wallin to Winfield Holbrook, April 2, 1919, Minneapolis, Minnesota; file no. 102, in TL&D Papers..

of the region, failed. For most of the period from 1910 to 1920, rainfall was sufficient for the production of grain sorghums. Consequently, by 1915 the local market for hay was so weak that irrigation farmers who had first planted alfalfa as a cash crop were pasturing hogs and cattle on hay meadows.[35]

Another drawback to the culture of alfalfa on the High Plains was the unstable weather. Summer rains tended to damage a freshly-cut crop,[36] and a good stand on freshly broken sod-land was sometimes difficult to achieve. The Texas Land and Development Company encountered much difficulty in getting a good stand. Native grass had a tendency to spring up and choke out the alfalfa.[37] The general manager of the company admitted that the problem existed. In 1919 he observed:

> The trouble with these fields seems to be that the prairie grass gets started before the alfalfa takes a vigorous growth. We have been sufferers from this same cause on farms operated by the company, and each

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[35]Baker, Geology and Underground Waters of the Northern Llano Estacado, p. 96.

[36]Ibid.

[37]Elmer G. Johnson to C. F. Myers, October 3, 1916, Minneapolis, Minnesota, file no. 3-18; Elmer G. Johnson to Texas Land and Development Company, January 5, 1917, Minneapolis, file no. 3-18; Octave Poissant to Texas Land and Development Company, February 24, 1919, Minneapolis, file no. 102; Winfield Holbrook to Octave Poissant, March 1, 1919, Plainview, Texas, file no. 102; Victor Wallin to Winfield Holbrook, April 2, 1919, Minneapolis, file no. 102; E. Dowden to A. T. Tornholm, September 23, 1914, Plainview, file no. 3-23, in TL&D Papers.

> year we have been obliged to plow out alfalfa that has gone back to sod. The cause of this is not known. . . .[38]

One disappointed absentee owner wrote: "It was on the strength of the irrigation and the alfalfa that I bought the land and that the whole proposition has fallen down."[39]

The most reliable irrigated crops appeared to be forage crops combined with stock-farming. Those farmers who seemed to enjoy the most success with irrigation were those who fed their crops to their livestock. D. L. McDonald referred to this practice as "Irrigation Live Stock Farming," and on one occasion stated: "I have never marketed a bushel of grain other than wheat, except on the hoof and I never expect to Try [*sic*] it, if you [*sic*] want to succeed as a Panhandle farmer."[40] He continued to irrigate his 640-acre farm through the war and the 1920's, using three irrigation wells, primarily for grain sorghums, alfalfa, and oats which he fed to his cattle and hogs.[41] The Vaughn brothers near Tulia irrigated wheat and kaffir corn from their well during their first season as irrigation

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[38]Winfield Holbrook to F. A. Kindwall, March 4, 1919, Plainview, Texas, file no. 3-24, in TL&D Papers.

[39]Octave Poissant to TL&D, March 15, 1919, Minneapolis, Minnesota, file no. 102, in TL&D Papers.

[40]D. L. McDonald, *Where Crops Never Fail* (Hereford, Texas, [*ca*. 1917 or 1918]), pages not numbered, in files of McDonald Drilling Company, Amarillo, Texas. The Amarillo *Globe*, May 11, 1925, p. 8.

[41]*Ibid*.

farmers, but afterwards they confined themselves to irrigating only kaffir corn and other grain sorghums.[42] Roland Loyd of Hereford raised a variety of crops under irrigation including garden vegetables and fruit, but, like his neighbor D. L. McDonald, he concentrated on raising forage crops such as milo maize, kaffir corn, alfalfa, oats, and barley.[43] And J. R. Robinson, who installed an irrigation plant on his 120-acre stock farm in Deaf Smith County in 1912, was reportedly free of debt in 1917.[44]

Another factor which retarded the early development of irrigation was the cost for installation of the pumping plant. Pit-type units such as the first plant installed by McDonald at Hereford, and early plants installed by George E. Green at Plainview were the cheapest, but they were less trouble-free and practical only where the depth to water was about thirty feet or less. The plant installed by Green for John H. Slaton consisted of a vertical centrifugal pump powered by a thirty-two horsepower engine. Total cost for digging the well and completely installing pump and engine was $2,350.[45]

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[42]Interview of Ozella M. Green with Marshall Vaughn.

[43]Diary of Roland Loyd, various entries for 1914, 1915 and 1916.

[44]McDonald, Where Crops Never Fail.

[45]The cost for the installation was given as $1,500 in Zenas E. Black, "The Pump in the South Plains," The

As the Layne & Bowler "pit-less" pump came into general use, which was more trouble-free and more efficient than the pit-type, the cost, depending upon the depth of the well and the size of the engine, also increased. Cost for drilling and casing the well varied. Layne & Bowler Company drillers were the most expensive and charged $5.25 per foot for drilling and casing a well. A local driller at Plainview charged $4.00 per foot for a twenty-six inch well capable of handling a Layne & Bowler Pump.[46] Thus, cost for a well 120 feet deep was approximately $480 to $630.[47] The price of a Layne & Bowler pump was approximately $500.[48] Incidental items including

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Earth, IX (March, 1912), 13. But in Baker, Geology and Underground Waters of the Northern Llano Estacado, 91, the cost for the Slaton well is given as $2,350. Black possibly gave only the cost of the engine and pump, but the figure given by Baker includes the cost for the well.

[46]Arthur P. Duggan to G. W. Littlefield, July 22, 1913, Littlefield, Texas, in Littlefield Lands Company Papers. D. L. Alexander to C. E. Craig, March 9, 1917, Plainview, Texas, file no. 3-24, in TL&D Papers.

[47]The cost might be more, however, if the irrigator insisted, as many did, on drilling a smaller hole at the bottom of the well deeper into the water-bearing formation. For example, on one TL&D well, the driller bored a 26-inch well one hundred feet deep, then drilled a 16-inch hole another 142 feet, adding $347 to the cost for the well.

The pump was usually set twenty to thirty feet below the water level in order to accommodate the resulting "draw-down," the drop in water level which occurred by operating the pump. D. L. Alexander to C. E. Craig, March 9, 1917, Plainview, Texas, file no. 3-24, in TL&D Papers.

[48]J. E. Harmon to A. O. Fabrin, December 28, 1943, Columbus, Ohio, in files of Layne & Bowler Company, Memphis, Tennessee. J. W. Lough of Scott County, Kansas,

lumber and construction of the derrick and pump-engine house, a concrete foundation for the engine, drayage, freight, an oil-storage tank, an air compressor, air tanks, and other small items might cost an additional $1,000 or more.[49]

The most expensive item for the plant was the engine which ranged from twenty-five to about sixty horsepower. The less expensive and less powerful engines such as the Charter, Van Sevrein, or Herr, ranged from $1,000 to about $1,600, but more powerful machines such as the Prim and the Bessemer cost from $1,800 to $2,500 or more. Although the Bessemer was more expensive, it was designed to run on cheaper oil than the smaller engines.[50] Thus,

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reported in 1911 that his Layne & Bowler pump had cost $550. F. D. Coburn, "Irrigation by Pumping in Western Kansas," Eighteenth Biennial Report of the Kansas State Board of Agriculture, XXIII (Topeka, 1913), 68-69.

[49]This is a conservative estimate. The total cost for such accessories as installed on a Texas Land and Development Company demonstration farm in 1920 was about $1,300. But this price obviously reflected the inflated war-time cost for machinery. Winfield Holbrook to Henry S. Fleming, October 19, 1920, Plainview, Texas, file no. 41-42-43, in TL&D Papers.

[50]The price for a sixty or seventy horsepower Bessemer engine delivered to the Littlefield Lands Company in 1914 was $2,650. Cost of the engine may have varied with the dealer. For example, in contrast to the figure above, D. L. McDonald sold a seventy horsepower Bessemer to the Double U Company at Post City, Texas, for $1,720. Arthur P. Duggan to G. W. Littlefield, January 8, 1914, Littlefield, Texas, in Littlefield Lands Company Papers. Bill from D. L. McDonald and Company to Double U Company, May 29, 1913, Hereford, Texas, file no. GC 1246, in Double U Company Papers, Southwest Collection, Texas Technological

wells could be installed for approximately $4,000. But some professional drillers such as D. L. McDonald, and the Layne & Bowler Company, drilled wells and installed irrigation plants on a turnkey basis guaranteeing sufficient water. Such turnkey jobs usually amounted to about $6,000.[51]

The cost for irrigating with pumping plants varied with the costs for fuel, horsepower of the engine, repairs, depreciation, and interest on the investment. Low grade oil used in Bessemer engines cost only about four and one-half cents per gallon.[52] Some contemporary state agricultural specialists estimated at the time that the cost per acre-foot of water delivered by the pumps, including depreciation, interest on the investment, costs for fuel and lubricating oils, repairs, and labor varied from $5.00 to $6.25 per acre foot. Alfalfa required about two and one-

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College. J. B. Marcellus, "Selection and Installation of a Pumping Plant for Irrigation," Twenty-first Biennial Report of the Kansas State Board of Agriculture, XXVI (Topeka, 1919), 120.

Cost for an oil engine was about $30 per horsepower. Thus, cost for a sixty horsepower engine suitable for a deeper well should have been about $1,800 plus the freight charges. Coburn, "Irrigation by Pumping in Western Kansas," 68.

[51]The Layne & Bowler Company charged the Vaughn brothers of Tulia $6,000 for a turnkey job in 1914. McDonald's contract with the Double U Company of Post City was for $6,500. Telephone interview of Ozella M. Green with Marshall Vaughn. Bill submitted by D. L. McDonald Company to Double U Company, May 29, 1913, Hereford, Texas, file no. GC 1246, in Double U Company Papers.

[52]Diary of Roland Loyd, Memoranda, 1914.

half acre-feet of water.[53] The cost for irrigating alfalfa, therefore, ranged from approximately $12.50 to $15.60 per acre. On an alfalfa farm of eighty acres, the cost of irrigation figured at $12.50 per acre-foot would be $1,000. If the field yielded three tons per acre, and brought $15 per ton, the gross returns would be $3,600. After deducting $1,000 for the cost of irrigation and $600 for harvesting, the remainder would be $2,000. But the farmer would have to deduct taxes and interest on his land in addition to depreciation on his farm equipment, and the cost of seed and labor in planting the crop. Moreover, it must be kept in mind that the weather on the High Plains tended to modify the theoretical farm picture. Alfalfa might be very profitable during the driest years when rains did not damage the crop and when shortages of cattle feed boosted the price for forage crops. Unlike the irrigation farmer of the dry, arid West, however, who could control the amount of water for his crops, the semiarid farmer had no such mastery over his supply of moisture. He might receive a four-inch downpour which would damage his alfalfa, only to be followed by two months of drouth. Finally, the price of alfalfa fluctuated greatly in the region. Thus, irrigated alfalfa was a risky cash crop on the Texas High Plains.

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[53]Baker, Geology and Underground Waters of the Northern Llano Estacado, p. 92. W. L. Rockwell, The Water Resources of Texas and their Utilization, Texas Department of Agriculture Bulletin No. 43 (Austin, 1914), p. 34.

Still another cause for the failure of irrigation to develop in the region was the lack of adequate credit facilities for farmers to install their own irrigation systems. Although some land companies, such as the Texas Land and Development Company and the Coldren Land Company, sold developed irrigated farms on credit, the "prospector" had to pay $100 an acre or more for a 160-acre unit. Before 1916, the buyer had to pay for the land in five years. In that year, however, the TL&D liberalized its credit terms by allowing payments to be made over a twelve-year period, and by not requiring the first payment until the end of the second year of occupancy. In a typical contract for a 160-acre farm selling for $18,400, $115 per acre, a buyer made a down payment of $2,300. His annual payments on the principal were $1,349 for the first installment and $1,341 for the remaining eleven payments. In addition, the 6 per cent interest rate charged by the company boosted annual payments several hundred dollars more. The first installment payment, which would include two years' interest would be over $3,200. Subsequent payments would of course be lower, but would remain about $2,000 or more for the first few years.[54] Thus, the farmer was handicapped by high principal and interest payments on his irrigated farm. This meant that because of the circumstances of the

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[54] Contract between E. J. Smith and TL&D, July 19, 1916, file no. 2-3, TL&D Papers.

decade, as well as the post-war agricultural depression, irrigators found it difficult to meet their payments on such high-priced land. Consequently, about 80 per cent of those who bought TL&D farms were unable to pay for them.[55]

If, on the other hand, credit for putting down irrigation wells had been available to farmers who bought unimproved lands, the total cost for the irrigation farm would have been significantly lower. If a farmer had bought 160 acres for $25 per acre, the price paid by the TL&D for its lands, the cost for the unimproved farm would have been $4,000. Then, if he could have borrowed money to install an irrigation plant at $4,500, to erect a house and outbuildings for another $1,000, and to build fences and break his land for another $1,000, his total bost for land, irrigation plant and improvements would have amounted to $10,500, or about $65 per acre, almost one-half less than an irrigated farm marketed by the TL&D.

For the average farmer of the Texas High Plains, already in debt for his land, his improvements, or both, credit facilities for installing an irrigation plant simply were not available. The chattel mortgage records in Deaf Smith, Hale, Floyd, Bailey, and Swisher Counties fail to reveal any long-term credit for pumping units during this

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[55]Brunson, "The Texas Land and Development Company," p. 188.

period. A few farmers who put down wells on their lands could afford to pay cash for their plants. The Vaughn brothers near Tulia, who were reported by 1909 to be worth more than $60,000, installed a plant on their farm in 1914.[56] But most farmers were probably like Charles E. Cooper of Lafayette, Indiana, who used all his capital to purchase a plot from the Littlefield Lands Company, and borrowed money on his land to make $1,000 worth of improvements. Cooper then attempted, apparently without success, to borrow money from George W. Littlefield in order to put down an irrigation well.[57]

Another important factor which helps to explain the failure of irrigation is found in the origin of the movement on the Texas High Plains. The irrigation movement in the West during the late 1880's and early 1890's, had been led by social reformers, such as William H. Smythe, who were primarily interested in furnishing a means to enable groups of settlers to farm and live in arid regions.[58] In contrast, the move toward irrigation on the Texas High Plains was led by speculators who were primarily interested in enhancing the value of their land.

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[56] Farm and Ranch (Dallas), XXVIII (July 10, 1909), 2. Telephone interview by Ozella M. Green with Marshall Vaughn.

[57] Arthur P. Duggan to G. W. Littlefield, December 9, 1914, Littlefield, Texas, Littlefield Lands Company Papers.

[58] See Chapter II.

Although there is no evidence of intent to defraud "prospectors," there are indications that most land companies were more interested in demonstrating the availability of water for irrigation purposes than in proving that farmers could make a profit through pump irrigation farming.[59]

The irrigation frontier failed to expand during the decade of its beginnings on the Texas High Plains. World War I increased prices for pump machinery, wheat and meat products. Moreover, the inexperience of farmers in irrigation techniques and in using internal combustion engines hindered the early acceptance of pump irrigation. The end of the drouth which had initially stimulated the movement was probably important in diverting local interest away from irrigation. In addition, the failure to adapt cash crops which were both suitable to the uncertain High Plains climate and which could assure farmers of stable high profits to offset fixed costs for irrigation, played an important role. Finally, the initial cost to install a pumping plant was beyond the resources of most farmers, and even more important, no adequate credit facilities to finance such improvements were available.

All of these factors serve to emphasize that economic conditions were unfavorable to pump irrigation at the time. It is significant that farmers of the region did not furnish

[59]See Chapter VI.

the leadership for the movement, nor were they important in promoting irrigation. Instead, it was the speculator who furnished the short-lived momentum for the movement, and who attempted to superimpose a type of economy on the region not yet prepared for it. Like a surgically-transplanted biological organ which had been too hastily engrafted, the Texas High Plains "rejected" irrigation.

CHAPTER VIII

# THE REVIVAL OF IRRIGATION, 1930-1940

National and local interest in irrigation declined in the 1920's as prices for farm products plunged downward. Between June and December of 1920, the average price for wheat dropped from $2.58 to $1.43 per bushel. Between July and December, the price for cotton fell from thirty-seven cents to fourteen cents per pound. In terms of purchasing power the American farmer by the spring of 1921 could purchase only 63 per cent of the industrial goods which he had been capable of buying in prewar America with the same crop production. Farm prices declined to their prewar levels while prices for other goods, although falling somewhat in the postwar recession, remained above prewar levels. The valuation of farms also declined. In 1921 the value of farm land stood at 57 per cent above the pre-World War I level, but by 1928, values had dropped to only 17 per cent above the prewar price.[1]

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[1]Gilbert C. Fite, "The Farmers' Dilemma, 1919-1929," Change and Continuity in Twentieth Century America, the 1920's, ed. by John Braeman (Columbus: Ohio State University, 1968), p. 69. Murray R. Benedict, Farm Policies of the United States, 1790-1950: A Study of their Origins

Overproduction of farm products stimulated criticism of and opposition to additional production through expanding irrigated acreage in the West. Farming spokesman in the Middle West expressed opposition to the expansion of irrigation projects by the Reclamation Service, and the initiation of new projects by the Congress. By 1927 the Department of Agriculture under the Kansan, William M. Jardine, directly opposed new irrigation projects. Moreover, in western Canada, too, an irrigation movement which had originated before the First World War came to a halt by the middle 1920's because of the agricultural depression. A further factor in the decline of interest in irrigation was that many settlers on reclamation projects were unable to meet payments on land or water rights.[2]

The depression also discouraged further pump irrigation projects on the Texas High Plains. One absentee

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and Development (New York: Octagon Books, 1966), p. 172. George Soule, Prosperity Decade, From War to Depression: 1917-1929, Vol. VIII of the Economic History of the United States, ed. by Henry David, et al. (New York: Holt, Rinehart and Winston, 1947), pp. 229-30.

[2]Paul C. Conkin, "The Vision of Elwood Mead," Agricultural History, XXXIV (April, 1960), 93-94. Donald C. Swain, Federal Conservation Policy, 1921-1933 (Berkeley: University of California, 1963), pp. 83-86. Laurence B. Lee, "Dominion Ditches and British Columbia Canals: A History of the Western Canada Irrigation Association," Journal of the West, VII (January, 1968), 37-38.
Other segments of the population, including some economists, were also opposed to further expansion of Federal irrigation projects by 1929. Roy E. Huffman, Irrigation Development and Public Water Policy (New York: Ronald Press, 1953), pp. 292-94.

landlord who had purchased a Texas Land and Development Company irrigated farm received a net income of $196.53 from his seventy-four acre tract, after taxes and expenses, for the crop year of 1924.[3] The subsequent lack of interest caused D. L. McDonald, who had drilled many of the early wells in the region, to stop drilling irrigation wells in 1923 and to begin installing pumping units for municipalities, railroads and oil companies.[4] The general manager of the Texas Land and Development Company wrote in late 1925:

> Since about 1920 farming has not been profitable here. It seems that when we have made a crop that prices have been low. This condition prevailed in the falls of 1920, 1921, and this year. We have one of the best feed crops we have ever grown here and the price of threshed maize and kaffir is only 40¢ to 50¢ per bushel.
>
> Our cotton is also of poor grade this year and the price low. Since 1920 we have only sold two irrigated farms and none this year.[5]

By 1929 conditions had not improved. That year the same correspondent stated: "It is the general opinion of real estate men that the price of land is now the lowest it has

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[3]Statement of account of F. A. and A. L. Kindwall from December 1, 1923 to April 1, 1925, file no. 3-24, Texas Land and Development Company Papers, Southwest Collection, Texas Technological College. Hereafter cited as TL&D Papers.

[4]Interview by author with John McDonald, oldest son of D. L. McDonald, August 23, 1968, at Amarillo, Texas. The McDonald Drilling Company, owned by John and Bill McDonald, still exists, and has offices in Amarillo.

[5]Winfield Holbrook to F. A. Kindwall, December 3, 1925, Plainview, Texas, file no. 3-24, TL&D Papers.

been since 1920. It is only occasionally that we are able to make a sale and then at very low prices."[6]

In spite of the agricultural depression, sufficient rainfall through most of the decade encouraged immigration into the region.[7] Increased immigration was reflected in the platting of more large ranches into farms. The remainder of the Yellow House Ranch of the now-deceased George W. Littlefield was put on the market at $25 per acre with liberal credit terms of fifteen years and interest at 6 per cent. Land companies advertised the advantages of growing cotton in an area free from boll weevils and Johnson grass among central and east Texas farmers who had an abundance of both pests. Moreover, land agents were "prepared at all times to take you out to inspect this land in good closed cars."[8] In Lamb County, W. E. Halsell placed his "Sod House pasture of 70,000 acres on the market."

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[6]Winfield Holbrook to F. A. Kindwall, December 10, 1929, Plainview, Texas, in file no. 3-24, TL&D Papers.

[7]Ernest C. Ratliff, "A Survey, Analytical and Historical, of Irrigation in Hale County, Texas," (unpublished M.A. thesis, Texas Technological College, 1938), p. 51. The Lubbock area was an exception to this generalization. The years of 1921 and 1924 were also years of low precipitation during this period. [W. G. Carter], "Study Covering Advisability of Owning Central Office Quarters in Lubbock County, 1924" (mimeographed; Southwestern Bell Telephone Company, 1924), in Southwest Collection, Texas Technological College.

[8]Advertisement posters of Yellow House Land Company (ca. 1923); advertisement in Denton (Texas) Herald, June 22, 1923, p. 8, in Yellow House Land Company Papers, Southwest Collection, Texas Technological College.

Within nine months, over 50,000 acres were reportedly sold to farmers and the town of Amherst was founded.[9]

Population increased greatly throughout the region during the decade of the 1920's. In 1920, Deaf Smith County reported 3,747 persons. Hale County had 10,104; Floyd County boasted 9,758; Lubbock County had 11,096; and Swisher County reported 4,388. But by 1930 Lubbock County boasted a population of 39,104; Deaf Smith had 5,979; Floyd numbered 12,409; Hale had 20,189; and Swisher County reported 7,343.[10]

Occasionally local groups aroused interest in the possibilities of irrigation. The Texas Board of Water Engineers, in 1924, surveyed the Canadian River for possible dam sites for the purpose of flood control as well as irrigation. Civic leaders of Amarillo were enthusiastic at the prospect. An Amarillo newspaper heralded the survey by stating: "When the Panhandle blossoms as the rose may not be far off."[11] At the conclusion of a preliminary survey, a member of the Board said that such sites for irrigation dams did exist in the valley of the Canadian near Amarillo.[12]

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[9] A. M. Hove, "The Transformation of Texas' South Plains," The Earth (Topeka), XX (July, 1924), 18, 20.

[10] Fourteenth Census of the United States, State Compendium, Texas (Washington, 1925), pp. 13-16. Fifteenth Census of the United States, 1930: Population, I (Washington, 1931), pp. 1058-1062.

[11] Amarillo Daily News, January 17, 1924, p. 1.

[12] Ibid., January 19, 1924, p. 1.

But no dam would be built on the Canadian in Texas until after the middle of the century, and even then the resulting reservoir would be used for municipal water supplies and for recreation rather than for irrigation. During the dry year of 1927, a group of business men and farmers from Hereford, went to Portales, New Mexico, to examine the system of small irrigated truck farms which had come to dominate the Portales valley. The group returned and attempted to promote truck farming in Deaf Smith County by publicizing the Portales farms.[13] And in 1930 the Plainview Board of City Development began to advertise the existence of the old Texas Land and Development Company irrigation wells for the purpose of boosting irrigation development. Winfield Holbrook, general manager of the Texas Land and Development Company, was one of the leaders. A committee report stressed that 5,600 acres in Hale, Floyd, and Swisher counties were currently being irrigated, and that a complete irrigation plant could be installed for $5,500.[14]

Interest in irrigation on the Texas High Plains was not rekindled, however, until the region found itself choking in the swirling "black dusters" of the Depression decade. The New Deal's Agricultural Adjustment Act of 1933

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[13] Amarillo Sunday News-Globe, June 5, 1927, section III, p. 1.

[14] Maury Hopkins, "Making the Plainview Section a Land of Flowing Water," The Progressive Farmer and Southern Ruralist, Texas edition, XLIX (June, 1935), 5.

helped to alleviate the economic difficulties of High Plains farmers who cashed their government checks, and used the money to meet long overdue mortgage payments or to make down payments on new farm machinery. Many farmers chose to spend their new money on farm mechanization rather than upon small luxuries for their families. One observer who toured the "South Plains" in the spring of 1934 noted "the astounding number of new tractors and other equipment that are seen on South Plains farms." The contrast between new green John Deere's and red Farmall's on the one hand, and drab, run-down farm houses was especially noticeable. In Cochran County, which had just been platted into farms in the 1920's, the reporter was amazed to see "the incongruousness of apparently new tractors and up-to-date farm equipment on farms where the farm people themselves are living in mere holes [dugouts and half-dugouts] in the ground."[15] By 1935 it was reported that "South Plains" farmers had bought almost a million dollars worth of tractors during the first six months of the year.[16]

Farm mechanization and government subsidy checks were not enough to combat the "black dusters" enveloping the Texas High Plains. In 1931 the region plunged into

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[15]Eugene Butler, "A South Plains Potpourri," The Progressive Farmer and Southern Ruralist, Texas edition, XLIX (June, 1935), 5.

[16]The Earth, XXXII (July, 1935), 6.

one of the most severe and prolonged drouths men had yet experienced on the Plains. With the exception of 1932 and 1937, the next nine years were plagued with below-average rainfall.[17] In the fall of 1933 the first of the dark brown dust storms blotted out the sun, blew fine silt through cracks around the windows and doors of buildings, and swept the parched soil of the Great Plains as far east as Albany, New York. For the next three years, the soil of the High Plains in some areas drifted into miniature sand dunes, collecting along fence rows like brown snow during a blizzard.[18]

In desperation many High Plains farmers began to search for ways to employ what had been for many in the past that fanciful panacea for Great Plains drouths--irrigation. In 1934 some new irrigation plants began to appear around Lockney in eastern Floyd County, near Plainview, and in a few other areas. During the next six years the number of new irrigation wells and the increase in irrigated acreage grew at a phenomenal rate in contrast

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[17]Ratliff, "A Survey, Analytical and Historical, of Irrigation in Hale County, Texas," p. 51. Texas Board of Water Engineers, Ground Water in High Plains of Texas, Progress Report No. 5 (Austin, 1945), p. 3.

[18]Frederick Lewis Allen, Since Yesterday: The Nineteen-Thirties in America (New York: Harper and Brothers, 1940), pp. 196-200. Arthur M. Schlesinger, Jr., The Coming of the New Deal, Vol. II of The Age of Roosevelt (Boston: Houghton Mifflin, 1959), pp. 68-70. For a treatment of the drouth see Fred Floyd, "A History of the Dust Bowl," (unpublished Ph.D. dissertation, University of Oklahoma, 1950).

to the abortive movement between 1910 and 1920. The census of 1930 reported only 170 wells in use, a marked decrease from the possible 250 wells drilled in the decade before 1920. The number of irrigation plants began to expand in 1934. At the end of that year there were 296 irrigation plants watering some 35,000 acres. By 1936 the number of wells had more than doubled, and the irrigated acreage stood at 80,000. The year of most rapid growth during the Depression decade was 1937. The number of wells that year was estimated at 1,150, almost double the number of the previous year. The acreage increased to 160,000. Finally, by 1940 the region had become one of the most important irrigated areas in the West with some 250,000 acres under irrigation from 2,180 wells.[19] As one observer in 1936 assessed the reason for renewed interest in pump irrigation in the region: "sandstorms which have lately scourged a large part of the United States have made imperative some form of crop insurance."[20] Irrigation appeared to be that "crop insurance."

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[19] Fifteenth Census of the United States: 1930, Irrigation of Agricultural Lands (Washington, 1932), pp. 219-23. Sixteenth Census of the United States: 1940, Irrigation of Agricultural Lands (Washington, 1942), pp. 544-55. Regional Water Conservation Division of the Soil Conservation Service, Ground Water and Irrigation in the High Plains of Texas (Fort Worth, Texas: Soil Conservation Service of the United States Department of Agriculture, July, 1947), p. 9.

[20] C. V. Eubanks, "Modern Rainmakers," The Farmer-Stockman (Oklahoma City), XLIX (May 15, 1936), 277.

Why were farmers able to make a success of irrigation in the 1930's in view of the failure of the experiment twenty years earlier? Several important factors and new developments not present in the earlier movement aided the inception and growth of pump irrigation during this era.

First, important improvements in technology made irrigation plants less expensive, more trouble-free, and more efficient. During the 1920's the pump itself had been greatly improved by several manufacturers who decreased the diameter of its bowls[21] from the old 26-inch Layne & Bowler "pit-less" centrifugal pump to twelve inches or even smaller.[22] The reduction was made possible by increasing the revolutions of the pump from about 865 to high speeds ranging from 1200 to 3600 rpm, as well as by

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[21]The bowl is the round component which encases the impeller near the bottom of the well. Each bowl and its impeller is usually referred to as a "stage." Most deep-well pumps have two, three or more "stages" depending upon the depth of the well and the desired water pressure at the discharge pipe.

[22]As early as 1914 the Layne & Bowler Company was marketing "The Layne Patent Deep Well Turbine Pump" which had bowls fourteen to sixteen inches in diameter. It was designed for use in wells three hundred feet or deeper, but this high-speed unit could only have been driven by a direct-connected electric motor. This researcher found no evidence of this type of pump being used on the High Plains in the 1910's. Layne Water Facts (Memphis, Tennessee and Houston, Texas: Layne and Bowler Company, 1914), pp. 201-02.

A description and diagram of the "deep-well turbine centrifugal pump" used for irrigation is found in Paul A. Ewing, Pumping from Wells for Irrigation, United States Department of Agriculture Farmers Bulletin No. 1404 (Washington, 1924), pp. 12, 16-17.

modifications of the pump impeller, lubrication and bearing systems. The same large volume of water could thus be pumped by a smaller pump revolving at a much higher speed.[23] In addition, the pump was less expensive to install because it required a smaller diameter well and casing than the old pump. By 1930 the new high-speed pump, commonly referred to as the "deep-well turbine pump," and manufactured by such companies as Layne & Bowler, Byron Jackson, Pomona, Peerless, Kimball-Krough, and others, was already in use not only for irrigation purposes in the West and in the Gulf Coast rice belt, but also to provide municipal water supplies.[24]

Extensive use of the high-speed pump was made possible, in turn, by the development of powerful high-speed industrial and automobile gasoline engines which developed considerably more rpm than the old 250 rpm oil engines which had been used in the pre-World War I era. For

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[23]Information found in resume of speech given by A. O. Fabrin, executive of the Layne & Bowler Company, at the "First Annual Get-Together Meeting, Layne Subsidiaries and Affiliated Companies, Lake Charles, Louisiana, December 28, 29, and 30, 1935," reprinted insert booklet in <u>Layne Deep Waters</u> (Memphis, Tennessee), III (November, 1968), no page numbers.

[24]This pump, however, is not a true turbine. It still operates on the principle of a centrifugal rather than a turbine pump. Conversations of author with Carl Gelin, a pump engineer and manager of Layne Pumps, Inc., Lubbock, Texas.

Photographs and descriptions of pump in Orson W. Israelson, <u>Irrigation Principles and Practices</u> (New York: John Wiley and Sons, 1932), pp. 77-81.

example, Ben Quebe, a farmer of Floyd County, installed one of the new-type pumps in 1930 and powered it successfully with a four-cylinder gasoline engine.[25] George E. Green who owned the Green Machinery Company of Plainview and who had installed the first irrigation plant in Hale County in 1911, began putting relatively cheap automobile engines on the new pumps.[26] By 1935 rebuilt engines made by Buick, Pierce Arrow, Studebaker, Ford, and Chevrolet were being used in Hale County. In 1938 a farmer could purchase a Ford "V-8" engine for $310 or a Chevrolet engine for $235, prices considerably below those paid for the early oil-burning engines.[27]

Equally important, engineers developed a more efficient device for connecting the engine to the pump. The early pump was connected to the engine by means of a long, wide belt which ran from the engine pulley to the pump pulley. As mentioned earlier, it was difficult to maintain the desired tension on the belt because of changing temperatures. Early irrigators were constantly lengthening or shortening the belt. In 1915 Charles L. Baker, who

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[25]The Lockney (Texas) Beacon, special irrigation issue, section III, April 30, 1937, p. 3.

[26]The Floyd County (Texas) Hesperian, May 28, 1940, p. 7. Plainview Daily Herald, special edition, Fiftieth Anniversary of Green Machinery Company, November 26, 1961, section C, p. 5.

[27]Ratliff, "A Survey, Analytical and Historical, of Irrigation in Hale County, Texas," pp. 21, 37-38.

conducted one of the earlier irrigation investigations of the region, wrote: "One of the great losses of efficiency in centrifugal pumps is in the slipping of the belt connecting the pump with the engine. Some system of direct connection should be devised in order to get more efficiency. [italics mine]"[28] In response to the need, as early as 1915 or 1916, George E. Green, who had installed the first irrigation plant in Hale County, designed a right-angle drive "geared pump-head" to take the place of the belt. Resembling half of an automobile differential, the "gear-head" as it was later referred to, was attached to the pump shaft at the surface. A horizontal gear on the pump shaft meshed with a vertical gear on the engine shaft, and the oil-lubricated gear works were enclosed in a housing. Such a device would have been unsuitable for the slower rpm engine, but Green used a new type of gasoline engine developed by the Twin City Company which developed about 800 rpm, more than three times the rpm of the oil-burning engine. By using a larger diameter gear on the engine shaft than on the pump shaft, the rpm rate could be increased for the pump. Thus, with an 800 rpm engine using certain ratio gears, the pump could develop 1200 to 1600 rpm.[29] In 1917 Green agreed to install "the 45 h.p. Twin

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[28]Charles L. Baker, Geology and Underground Waters of the Northern Llano Estacado, University of Texas Bulletin No. 57 (Austin, 1915), p. 95.

[29]A photograph of the first gear-head installed by Green has the date "1915" written on it, but evidently the

City engine and geared pump-head" on a farm recently sold by the Texas Land and Development Company.[30]

George E. Green apparently continued to manufacture a few gear-heads, although for some reason he never obtained a patent, but the device did not come into general use until the early 1930's.[31] Then with the development of high-speed pumps, probably powered at first by electric

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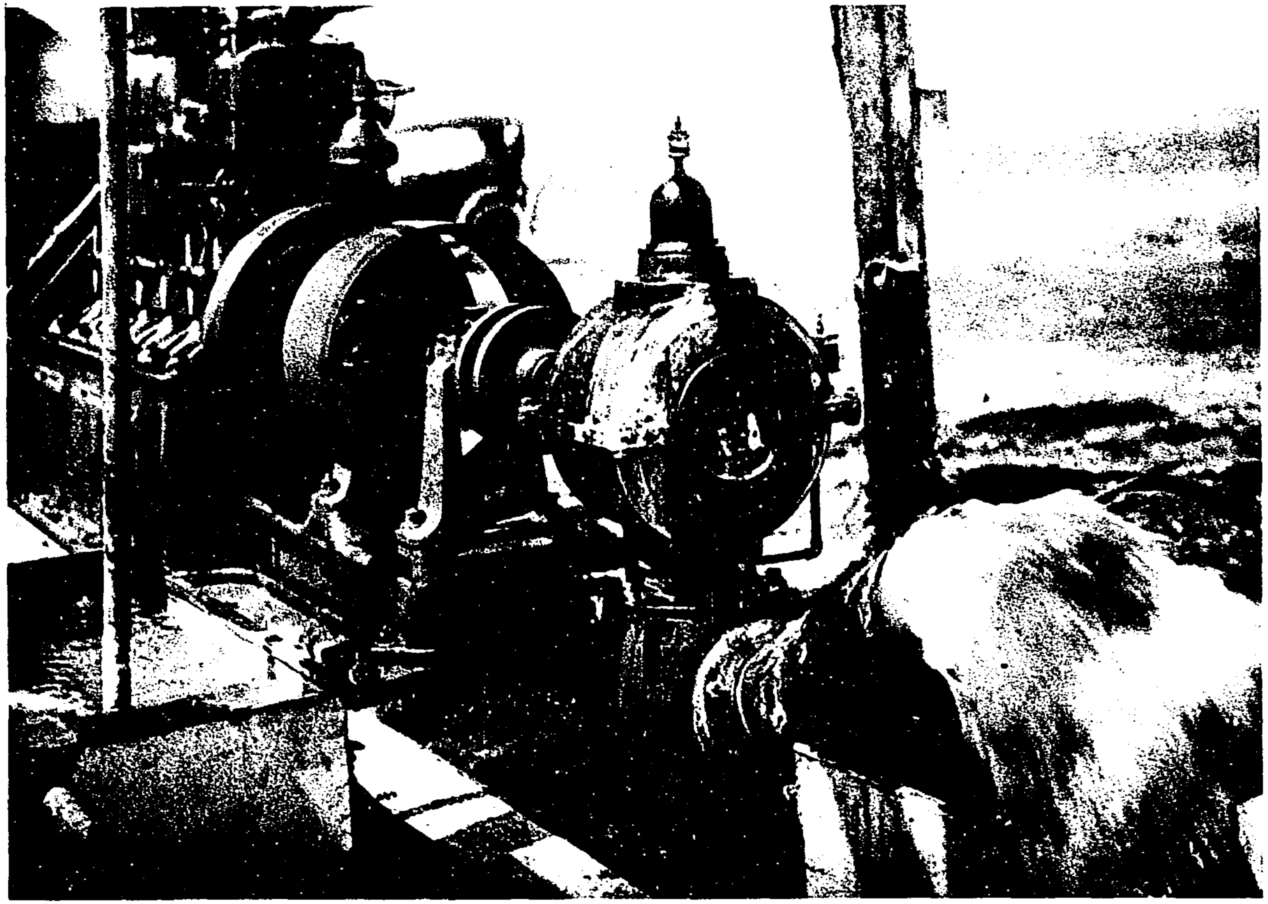
date was put on the photograph several years after it was taken. Files of Green Machinery Company, Plainview, Texas. Joseph F. Gordon, "George E. Green," Builders of the Southwest, ed. by Seymour V. Connor (Lubbock: Texas Technological College, 1959), pp. 96-97, states: "In 1917 he [Green] was the first to design and construct a geared head for a deep-well turbine pump." But the blueprints for the "No. 1 Geared Head" in the files of Green Machinery Company, carry the date of November 15, 1916.

Information about the rpm rating of the early Twin City engine was obtained by the author in a conversation with Otto Crawford, a Twin City implement dealer, of Spearman, Texas, December 29, 1968, at Tulia, Texas.

[30]The unit was installed on the farm of a French-Canadian from Minnesota named Octave Poissant. Agreement signed by George E. Green and C. E. Craig, general manager of the Texas Land and Development Company, April 20, 1917, Plainview, Texas; C. E. Craig to Wallin and Johnson Land Company, March 26, 1917, Plainview, Texas; C. E. Craig to Wallin and Johnson Land Company, April 3, 1917, Plainview; C. E. Craig to Wallin and Johnson Land Company, January 30, 1917, Plainview; Elmer G. Johnson to C. E. Craig, March 29, 1917, Minneapolis, Minnesota, in file no. 102, TL&D Papers.

[31]The first gear-head to appear in the chattel mortgage records of Floyd County is December 15, 1934. The first in Swisher County records is June 6, 1934. Prior entries for chattel mortgages on pumps specified belt pulleys. Chattel Mortgage Record of Machinery on Realty, Swisher County, I, no. 29, p. 5. Register of Chattel Mortgage, Machinery on Realty, Floyd County, I, no. 77, p. 20.

George E. Green did not secure a patent on his early gear-head although the phrase "Pat. applied for by G. E. Green, Plainview, TEX." appears on the blueprints for the device. Files of Green Machinery Company.



EARLY PUMP GEAR-HEAD DESIGNED BY GEORGE E. GREEN AND CONNECTED TO A TWIN CITY ENGINE, *ca*. 1917

From: Courtesy of Green Machinery Company, Plainview, Texas.

motors connected directly to the pump shafts, the necessity arose for the gear-head in areas inaccessible to electricity. Gear companies appear to have been the first to mass-produce the device. The Johnson Gear and Manufacturing Company of Berkeley, California, established in 1905, began manufacturing a right-angle gear-drive for irrigation pumps in 1933, primarily for the California market. The firm also supplied many of the gear-heads used on the Texas High Plains during the middle 1930's.[32] In addition, the Amarillo Machine Shop of Amarillo, which had been established in 1924, began manufacturing gear-heads in 1934.[33] By 1935 or 1936, the Green Machinery Company of Plainview was mass-producing its own gear-head. In a sales brochure probably printed about 1936, Green advertised that his "direct gear heads" were, "as compact, and easily operated as electric. Engine and pump direct connected with Geared Pump Head, equipped with spiral Steel Gears in oil tight case, makes most modern and efficient plant known. . . . You save all present and future belt costs and about 10% slippage. . . ."[34]

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[32]G. M. Pamphilon, Engineer for the Johnson Gear & Manufacturing Company to author, January 30, 1969, Berkeley, California.

[33]Telephone interview of author with Miss Margaret Johnson, formerly associated with the Amarillo Machinery Company, December 31, 1968, Amarillo, Texas.

[34]Sales brochure entitled "Modern Irrigation by Direct Gear Heads" in files of Green Machinery Company, Plainview, Texas.

The increased efficiency of the new pumping plants was illustrated by the increased acreage per pump under irrigation. In 1919, seventy-two acres was the average unit of land watered by each pump. By 1937 the average had climbed to 139 acres per pump, almost double.[35] Although the increase in acreage may be partly explained by the new practice of operating pumps twenty-four hours per day, rather than the daylight to dusk routine of the early irrigators, and by the increased efficiency of farm machinery which allowed a single farmer to cultivate more land, much of the increase must also be attributed to more efficient pumping units.

Another important technological factor, also closely related to the economics of irrigation was the decrease in cost for installation of a pumping plant. The most efficient and trouble-free unit which could be installed in the earlier period, such as those put down by D. L. McDonald, cost from $4,000 to $6,000. Many of the newer units were now installed for a total price of $2,000 including the cost for drilling and casing the well. A typical well 180 feet deep could be drilled and the unit installed for the following amounts: pump--$835; drilling and casing at $3.25 per foot--$585; gear-head--

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[35] Fourteenth Census of the United States, State Compendium, Texas, pp. 201-02. W. N. White, *et al.*, "Ground Water in the High Plains of Texas," (mimeographed; Texas State Board of Water Engineers, December, 1940), p. 15.

$270; V-8 engine--$310; house over engine and pump--$75. Total cost for this type of unit was $2,073.[36] It could be lowered even more by the farmer taking some short-cuts such as building his own pump house out of scrap lumber, using a cheaper Chevrolet engine or one from a junked automobile.

New irrigation technology not only lowered the initial installation cost for the pumping plant but even more important, the improvements were largely responsible for a significant decrease in operating expenses. The average operating expense for the earlier irrigation units ranged from $5.00 to $6.25 per acre-foot of water. According to a study made in 1937 by a team of economists in the Land Use Planning Division of the Resettlement Administration, the cost per acre-foot of water in the area, including the initial cost for the plant, interest, depreciation,

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[36]These figures are taken from Ratliff, "A Survey, Analytical and Historical, of Irrigation in Hale County, Texas," p. 37, and from Ed Bishop, "Rain When You Want It," The Progressive Farmer and Southern Ruralist, LI (August, 1936), 6. The figures used by Bishop are lower than those quoted by Ratliff, but prices used by the former were supplied by a Plainview Chamber of Commerce Committee, and probably represented the cheapest possible installation costs rather than average costs. For example, Bishop puts the cost for drilling and casing a well at $2.50 per foot.

Neither gives the cost for the gear-head. Ratliff lumps the gear-head and pump together in reaching the cost of $1,105 for the pump unit. Bishop gives the cost for the pump as $835. The author has subtracted Bishop's figure from Ratliff's figure to find the cost for the gear-head.

repairs, and fuel consumption, was about $4.50 with a Ford "V-8" engine or abour $3.20 with a Chevrolet engine.[37]

A change in the kinds of crops raised under irrigation was another important factor which aided the development of irrigation. In the earlier period, the crop which seemed especially attractive to irrigators was alfalfa, which required a great deal of water and which was a risky crop to raise in the region.[38] Some farmers still produced alfalfa which brought good prices on local markets during drouth years. The Texas Land and Development Company continued to raise irrigated alfalfa which brought $20 per ton at Plainview in 1934.[39] But the most prominent cash crops were now winter wheat and cotton. The change of emphasis from alfalfa is illustrated by the example of Charles Pickrell, a farmer who lived near Littlefield. In 1936 he irrigated twenty-two acres of alfalfa, but his most important crop was ninety acres of cotton from which he harvested 107 bales.[40]

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[37]Ratliff, "A Survey, Analytical and Historical, of Irrigation in Hale County, Texas," pp. 35-39.

[38]See pp. 182-84.

[39]<u>The Earth</u>, XXVII (November, 1930), 10; XXXI (December, 1934), 3. Billy Ray Brunson, "The Texas Land and Development Company," (unpublished Ph.D. dissertation, Texas Technological College, 1960), p. 213. By contrast, during the "wet" year of 1937, alfalfa hay sold for only $10 per ton in the area. <u>The Earth</u>, XXXIV (October, 1937), 4.

[40]<u>Ibid</u>., XXXIV (August, 1937), 5.

Cotton had first been planted on the "South Plains" as early as 1889 when Rollie Burns introduced the crop to the region. He planted some three acres using seed originally purchased for milch cow feed. As he later recalled: "I was interested in knowing whether or not cotton would grow on the Plains." The crop matured but was not harvested.[41]

In 1895 Crosby County produced five bales of cotton from a twelve-acre tract. In 1908 Dawson County reported a cotton crop of 749 bales. Lynn County farmers harvested 252 bales in 1909.[42] By 1910 cotton was established as a major crop of the South Plains.

Beginning on the southeastern edge of the plains, cotton gradually worked its way as far north as Floyd and Hale Counties by the 1930's. During the wet years of the 1920's, when low cattle prices caused many large ranches to sell much of their lands to farmers, cotton became the most important cash crop of the South Plains.[43] While not yet a major irrigated crop, there were indications

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[41]W. C. Holden, Rollie Burns or An Account of the Ranching Industry on the South Plains (Dallas: The Southwest Press, 1932), p. 188. Joseph F. Gordon, "The History and Development of Irrigated Cotton on the High Plains of Texas" (unpublished Ph.D. dissertation, Texas Technological College, 1961), pp. 97-98.

[42]Jean Alexander Paul, "The Farmer's Frontier on the South Plains" (unpublished M.A. thesis, Texas Technological College, 1959), pp. 128, 131.

[43]Wellington Brink, "Big Crops from Shallow Wells," Farm and Ranch (Dallas), XLV (March 6, 1926), 1.

during the 1920's of its future importance to irrigation. Tenants living on Texas Land and Development Company farms were watering the crop during the decade. For example, in 1925, R. E. Keniston made thirty-one bales of cotton from thirty irrigated acres. Winfield Holbrook, the general manager of the Company, announced that, "Cotton, milo maize, truck, alfalfa, and other crops paid fine dividends on every drop of water pumped from the wells."[44]

By the middle 1930's cotton had become the most important irrigated crop in the southern part of the region. In Lubbock County, Travis Tubbs planted 81 acres of cotton on his 148 irrigated acres in 1935, and harvested 112 bales. He planted the remainder in oats and corn,[45] and in Terry County, C. P. Obar made more than a bale to the acre on a 32-acre tract of cotton in 1937.[46]

In the central part of the region, primarily Hale and Floyd Counties, irrigators planted both cotton and winter wheat, for maximum utilization of their pumping plants. Cotton was watered primarily during the summer; farmers irrigated wheat, for the most part, in the spring. For example, in Floyd County, George T. Meriwether, a

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[44]Ibid.

[45]"Water from Wells," The Farmer-Stockman, XLIX (January 15, 1936), 42.

[46]Reprint of article from the Terry County (Texas) Herald of 1937 in the Terry County Herald, special edition, July 23, 1954, section II, p. 4.

landlord, reported that rent from his 292-acre farm in 1936 was $1,200 for 126 acres of wheat, and $1,600 for 86 acres of cotton. And Ralph Brown irrigated 100 acres of cotton and 260 acres of winter wheat that same year.[47] A. R. Meriwether's first irrigated crop in 1934 consisted of wheat and millet, planted on the same land. But by 1937 Meriwether was planting 130 acres of cotton, 23 acres of grain sorghums, and no wheat on his Floyd County farm. J. R. Bowman of the same county divided 120 acres equally between wheat and cotton the same year.[48]

The growing popularity of irrigated cotton was directly related to good profits realized from the crop in spite of low prices. According to an analysis made in 1938, cotton yielded a higher profit per acre than any other major irrigated crop. The study indicated that on a field of one hundred acres, assuming that the total operating cost per acre foot was $4.37, the cost for putting on twenty-four inches of water would be $874. Barring natural disasters, the field could be expected to yield one and one-half bales per acre or a total of about 75,000 pounds of lint. At eight cents per pound, the approximate price of the 1937 season, the gross profit would

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[47]Article in Fort Worth Star-Telegram, April 2, 1937, reprinted in the Lockney (Texas) Beacon, irrigation issue, April 30, 1937, section II, p. 4; section IV, p. 1.

[48]The Lockney Beacon, irrigation issue, April 30, 1937, section I, pp. 4, 9.

amount to $6,000. After deducting irrigating costs, $5,126 would remain. Of course, labor costs for hoeing weeds and hand-pulling must be deducted. But assuming such cost to be as much as $2,000, the farmer would still make a net profit of approximately $3,000. On the other hand, the study showed that the same amount of land planted in wheat, and yielding 32 bushels to the acre, would only net $1,174, after irrigation costs were deducted, assuming the price of wheat to be sixty-four cents per bushel.[49]

The growing importance of cotton as an irrigated crop may also be seen in the ratio of irrigated to non-irrigated crops. Hale County in 1937 had about 46,500 acres under irrigation, or approximately 32 per cent of the total irrigated acreage of the region. With 21,000 acres, wheat constituted more than 40 per cent of the total acreage. Cotton consisted of 10,500 acres or a little less than one-fourth of the total. But 12 per cent of the total cotton acreage in the county was under irrigation while irrigated wheat made up only 8.4 per cent of the total wheat crop.[50]

Grain sorghums probably ranked third in importance as an irrigated crop. Most farmers had livestock; and

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[49]Ratliff, "A Survey, Analytical and Historical, of Irrigation in Hale County, Texas," p. 41.

[50]*Ibid.*, pp. 30-31.

irrigators planted some acreage in forage crops. In Hale County, 9,400 acres or a little more than one-fifth of the total irrigated acreage, was planted in grain sorghums in 1937.[51] In addition, other small grain, such as oats and barley, as well as alfalfa and truck, were raised under irrigation.[52]

Irrigation farmers, especially those in Deaf Smith County which lay outside the cotton belt, also experimented with other crops. D. L. McDonald, of Deaf Smith County, raised sugar beets as early as 1911 and again in 1921, but like the early irrigation movement the attempt was premature.[53] In about 1935, new experiments were inaugurated in Bailey, Hale, Swisher, Floyd, Hockley, Lubbock, Deaf Smith, and other counties, sponsored by the American Crystal Sugar Company of Rocky Ford, Colorado, under the leadership of H. E. Knapp, an agricultural expert of the company, and Harry M. Bainer, agricultural agent for the Santa Fe Railroad. At first, the beets tended to wilt under a disease called "curly top." But by 1938 a wilt-resistant strain had been developed, and some farmers harvested 14 to 16 tons per acre with a sugar content of 17 to 19 per cent. The crop, however, required a great deal of water

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[51] *Ibid*., p. 31.

[52] W. A. Browne, "Agriculture in the Llano Estacado," *Economic Geography*, XIII (April, 1937), 170.

[53] The Amarillo *Daily News*, January 2, 1912, p. 3. *The Earth*, XVIII (February, 1922), 12.

and hand labor, which added to the cost. In addition, rail freight costs to Rocky Ford, Colorado, for refining further narrowed the margin of profit. Consequently, for the time being, sugar beets failed to become an important crop.[54]

Potatoes appeared to be a more promising crop for some farmers. M. B. Jewell, in 1932, harvested an average of 300 bushels of potatoes from 20 irrigated acres in Hale County.[55] In Lubbock County, J. B. McCauley, who had installed an irrigation plant in 1934, planted six acres of potatoes in 1936. By 1940 McCauley had 30 acres in potatoes. That year he harvested 150 sacks to the acre at $1.50 to $2.00 per sack. And in 1941 McCauley expanded his crop to 50 acres. Potatoes were even more important for Deaf Smith County because the higher elevation of that county caused cool summer nights which made it difficult for cotton to mature within the usual growing season. During the late 1930's, twenty-five farmers migrated to the county from Idaho for the specific purpose of raising potatoes. Two of the immigrants, "Tater Joe" Ballinger and Glenn Boardman, grossed $3,528 from their fifteen-acre crop. And the largest potato farm in the county consisted of 250 acres. In 1939, farmers of Deaf Smith organized a

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[54]Thelma W. Stevens, "History of Bailey County" (unpublished M.A. thesis, Texas Technological College, 1939), pp. 79-81. The Farmer-Stockman, LV (July, 1942), 323. The Amarillo Times, December 16, 1939, section E, p. 4.

[55]The Earth, XXIX (October, 1932), 10.

marketing cooperative, Hereford Potato Growers, Inc., and began marketing their crop in major southwestern cities such as Houston, Dallas, and Oklahoma City. By 1940 the total crop for Deaf Smith County was estimated to be about 400,000 bushels. And the total acreage planted in potatoes on the Texas High Plains totaled some 12,000 acres in 1941.[56]

One factor which had retarded the expansion of irrigation during the earlier period was lack of credit. Irrigation plants were installed either by speculators or farmers and ranchers who could afford to pay cash for pumping plants and wells. Roy E. Huffman has pointed out that: "The problem of financing the irrigation farmer is the dual one of providing enough credit and of making available the right kind of credit . . . adapted to the peculiar characteristics of new irrigated farms."[57] In other words, large operators of established irrigated farms have no problem in getting credit from banks because they are able to borrow money based upon their present productivity and farm valuation. In contrast, small farmers needing money initially to develop their non-irrigated farms into irrigated farms "need loans based on the expected productivity of the farm in the future and not based on current equity

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[56]The Farmer-Stockman, LIV (July 15, 1941), 363. Victor Schoffelmayer, "Plains Potato Growers Use State Fair to Tell World of their Achievements," the Dallas Morning News, October 14, 1940, section I, p. 8.

[57]Huffman, Irrigation Development and Public Water Policy, p. 114.

of the operator."[58] Although Huffman was referring specifically to farmers on Federal reclamation projects, the same was true for farmers on the Texas High Plains who needed capital to install pumping plants.

During the Depression decade, a strange combination of High Plains entrepreneurship, Franklin D. Roosevelt's New Deal and Herbert Hoover's leftover Reconstruction Finance Corporation, combined to produce the first really effective program for extending credit to average High Plains farmers for the installation of pumping plants.

In spite of Roosevelt's concern for conservation as symbolized by the creation of the Civilian Conservation Corps, the Soil Conservation Service and the Great Plains Committee, the New Deal did little at first to provide direct aid for the development of pump irrigation on the Great Plains. In one case, however, the government did create a windmill-irrigation project reminiscent of efforts on the Great Plains during the drouth of the late nineteenth century. In the resettlement project at Ropesville, sponsored by the Resettlement Administration, settlers were moved onto 60-acre tracts on the South Plains in 1936, encouraged to plant twenty acres of dry-land cotton, and to irrigate three acres of truck from a windmill. The government agency calculated that the total income of each settler

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[58] *Ibid.*, p. 115.

would be $1,747. Instead, the first year average income for the thirty-three settlers on the project was $900.[59]

By 1937, the Water Facilities Act provided some assistance. That act authorized the Secretary of Agriculture to provide for the installation of pumping plants, as well as for the construction of other water utilization and conservation facilities. The act failed to mention specifically irrigation pumping plants, but by 1939 some farmers were putting down wells through loans provided under this law.[60]

The act, however, was evidently insufficient for the needs of most farmers who wished to put down wells. It was used primarily to construct ponds, check-dams, and small wells because the national emphasis upon the heels of the "dust bowl" era was upon soil conservation rather than upon the exploitation of sub-surface water for irrigation purposes. This attitude was reflected in the Great Plains Committee's acceptance of the findings of the Water Resources Committee of the National Resources Committee in 1936. The Great Plains Committee reported: Irrigation at best can cause only minor changes in the economic life of the Great Plains [italics mine]." Moreover, "the

[59]Vernon O. Stafford, "The Ropesville Resettlement Project," West Texas Historical Association Year Book, XXV (October, 1949), 94-98.

[60]U.S. Statutes at Large, Vol. L, pp. 869-70. The Farmer-Stockman, LIV (March 15, 1941), 179.

shallow underground waters of the Great Plains generally are adequate to supply only domestic and farmstead demands. They are not plentiful, and over large sections are almost wholly lacking. . . . Increased drafts upon ground water for irrigation therefore are practicable only in a few favorable areas."[61] The report did not recommend government aid for pump irrigation even in the "few favorable areas."

Part of the reason for the Federal government's lack of a policy toward the development of pump irrigation may possibly have been merely a continuation of John Wesley Powell's attitude toward irrigation in the region expressed in the early 1890's, namely, that water resources were inadequate for irrigation on any great scale. Even more important, the government may simply have felt it unwise to encourage projects which would lead to still more overproduction of staple crops. Whatever the causes, this lack of Federal interest prompted state senator Harry E. Gantz of Nebraska, in a speech on the need to develop pump irrigation in western Nebraska, to remark: "At the present time there is no adequate or workable public agency through which pump irrigation projects can be properly or adequately financed. Due to general

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[61]The Great Plains Committee, The Future of the Great Plains (Washington: Government Printing Office, 1936), pp. 76-77.

conditions, the average farmer is unable to finance his own individual pump irrigation project. . . ."[62]

Although no Federal aid designed specifically for pump irrigation projects was available, an aggressive, tobacco-chewing High Plains banker conceived a plan using certain Federal programs to finance the installation of pumping plants in 1934. Artie Baker, a member of a pioneer Floyd County family which owned most of the businesses in Lockney, had become president of the First National Bank in 1928. During the depression he kept his bank doors open through massive loans from the Intermediate Credit Bank of Houston,[63] and because the Federal Reserve Bank of Dallas continued to honor checks drawn on Baker's bank in spite of the fact that his institution ran a continual overdraft for two years.[64] Sometime in the summer of 1934, Baker received a form letter from the newly-created Federal Housing Administration stating that the FHA would

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[62] Harry E. Gantz, "Pump Irrigation in Nebraska," Nebraska History Magazine, XX (October-December, 1939), 246.

[63] Intermediate credit banks had been in existence since 1923. They were designed to give more flexibility to rural credit. Benedict, Farm Policies of the United States, 1790-1950: A Study of their Origins and Development, pp. 184-85.

[64] Interview of author with Artie Baker, June 3, 1968, at Pecos, Texas. Reprinted English translation of article about Baker in El Fronterizo (Ciudad Juárez, Mexico), December 30, 1966, in files of Baker Pump Company, Pecos, Texas.

guarantee 20 per cent of any home improvement loan made by his bank for amounts up to $2,000 each. The act stated that such loans were to be "for the purpose of financing alterations, repairs, and *improvements upon real property* [italics mine]." Baker felt that an irrigation plant would certainly be an "improvement" for any "real property" in his region. Thus, he received permission from the local FHA administrator at Plainview to make such loans.[65]

Baker then formed the First National Company, a separate corporation from his bank, to loan money to farmers for pump equipment. Offices of the new company were located at the rear of the bank building. While loaning money to a few farmers to purchase pumps in the spring of 1934, he realized that farmers needed more than credit for pumps. They needed comprehensive loans to finance the drilling and casing of wells and the purchase of engines as well. For this purpose, Baker needed much more capital than his small company had at its disposal.[66]

The Lockney banker then faced two immediate obstacles. Baker needed money to loan, and he had to interest farmers in applying for the loans. The High Plains businessman tackled the former problem first. He went to

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[65] Interview of author with Artie Baker. The National Housing Act," Forty-eight *United States Statutes* (1934), pp. 1246-1247. *The Earth*, XXXII (February, 1935, 10.

[66] Interview of author with Artie Baker.

Washington that hot summer of 1934 to meet an old acquaintance in the offices of the Reconstruction Finance Corporation. Baker had known Lynn P. Talley, special assistant to the directors of the RFC and president of the Commodity Credit Corporation,[67] since the latter had been governor of the Federal Reserve Bank in Dallas. Baker told Talley that he wanted RFC aid in order to install and finance complete irrigation plants for farmers, which, in turn, would greatly aid the economic recovery of the High Plains. The banker then presented the following plan to Talley. If the RFC would furnish the necessary capital for the project, he would install complete irrigation plants at the turnkey rate of about $2,000 for each well. This amount was the maximum loan which the FHA could insure. The FHA, in turn, would guarantee 20 per cent of the loan. Moreover, Baker would use 20 per cent of his profits to buy government bonds as collateral for the RFC loan. And to further secure the loans to farmers, the banker would take a mortgage on the farmers' lands, crops, and irrigation equipment. A further security for the loan would consist of the increased value of the land under irrigation. Baker concluded: "There's not a damn way in the world I can lose any money."[68]

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[67] Ibid. Jesse H. Jones, Fifty Billion Dollars: My Thirteen Years with the RFC (New York: Macmillan, 1951), p. 91, describes Talley's relationship with the RFC. Who Was Who in America (Chicago: A. N. Marquis Co., 1950), II, 523.

[68] Interview of author with Artie Baker.

The next day after the meeting, Talley informed Baker that the Board of Directors of the RFC had approved the loan request for several hundred thousand dollars. With a letter from Talley to that effect, Baker returned home making two important stops on the way. First, he stopped at the Central Iron and Steel Company at Harrisburg, Pennsylvania, to place an order for thirty carloads of steel well casing. Then he stopped at the Ford Motor Company assembly plant at Dallas. That company agreed to ship him V-8 engines in "car lots" of fifty at a wholesale price, including freight, of $125 each. Baker ordered one "car lot."[69]

The tobacco-chewing banker also needed quantities of gear-heads and pumps. To meet the former need, he went to the Amarillo Machine Shop at Amarillo. He wanted a gear-head designed specifically for a small horsepower, high rpm engine such as the fifty horsepower Ford V-8. Older gear-heads such as those manufactured by Green Machinery Company at Plainview were designed so that a slower rpm engine could drive a higher rpm pump. For example, in a 2:3 ratio gear-head, for every two revolutions of the engine, the pump shaft would develop three revolutions. Baker, however, wanted a 4:3 ratio gear-head. That is, his desired unit would develop four revolutions for the engine for every three revolutions of the pump. Such an

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[69] Ibid.

arrangement would not only allow a cheaper, smaller, high rpm engine to be used, but would also prevent overloading the smaller engine in the same way that first gear on an automobile is better suited for steep grades than third gear. The company agreed to manufacture the gear-head of Baker's design for a wholesale price of $150 each. The banker then placed an initial order of three hundred gear-heads, and the Amarillo Machine Shop began manufacturing the Amarillo Gear Head.[70]

Next, Artie Baker took a bus to the West Coast. At San Francisco, he talked with the president of the Kimball-Krough Pump Company. The official agreed to ship several hundred pumps immediately. In less than a two-week period in which he had traveled from Washington to San Francisco, Baker accumulated a debt of $300,000 and "didn't use a damn penny of money to buy that stuff."[71]

Finally, the High Plains banker needed drillers. He advertised through radio stations in Amarillo, Lubbock, and Wichita Falls for well-drillers who wanted "plenty of work." Within fifteen days, fifty rigs were in Floyd County. Baker then sub-contracted the well-work for 10 per cent of the drillers' fees.[72]

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[70] Ibid. Telephone conversation with Miss Margaret Johnson, December 31, 1968, Amarillo, Texas. Miss Johnson, formerly associated with the Amarillo Machine Shop, confirmed the importance of Baker's initial order to the company.

[71] Interview of author with Artie Baker.

[72] Ibid.

Baker's final problem involved attracting farmers to his credit plan which involved 9.3 per cent interest and payments over a five year period. He found that those farmers who had the money to install plants were generally not interested in drilling wells. On the other hand, those who had mortgages on their land and whose debts continued to accumulate from year to year through the drouth were the most receptive. Baker found that, "A man who had money wouldn't buy an irrigation well; you had to find a 'poor devil' to buy one."[73]

The great majority of those remaining on the drouth-stricken High Plains were poor and burdened with cumulative debts. Farmers existed primarily by selling eggs and cream during their weekly trips to town. For example, Royal Crawford, a Swisher County farmer, bought alfalfa hay produced by the Texas Land and Development Company's irrigated farms in Hale County, in order to feed his milch cows which, in turn, produced cream to market. Tom McGehee of Floyd County made more money from his cream and eggs than from his field crops. In 1936 he made three "light bales of cotton" from 27 acres, and his wheat crop was a complete failure.[74]

Just as the desperation of farmers during the depression influenced their support of the New Deal's radically

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[73] Ibid.

[74] Interview of author with Royal Crawford, December 29, 1965, Tulia, Texas. The Lockney Beacon, irrigation issue, April 30, 1937, section II, p. 8.

different farm program, so desperate farmers of the Texas High Plains, besieged by both depression and drouth, turned to the new experience of irrigation. As Mrs. J. B. Stevenson of Floyd County put it: "In 1934 when drouth and the depression had swept everything from us, we decided to give up dry farming and irrigate." The Stevensons subsequently obtained a loan that year to put down an irrigation plant.[75] M. C. Scheele, also of Floyd County, summed up his desperation in this way: "hadn't gathered a grain of wheat in two years, made very little feed and cotton, and in general I was 'flat broke' and ready to move when I installed a well on my place in May 1936."[76] Clarence Todd of Swisher County, who installed a plant on his farm in 1937, later recalled that with a well, "you were sure of a crop; without a well you were sure of a failure."[77] Carl Ferguson who lived near Lockney concluded: "It's the only possible way for farmers in this area to make a crop any more."[78]

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[75]The Lockney Beacon, irrigation issue, April 30, 1937, section II, p. 1. Reprint of letter from Mrs. J. B. Stevenson to the editor in The Farmer-Stockman, XLVIII (December 1, 1935), 592.

[76]The Lockney Beacon, irrigation issue, April 30, 1937, section II, p. 1.

[77]Interview of author with Clarence Todd, May 25, 1968, Swisher County, Texas.

[78]The Lockney Beacon, irrigation issue, April 30, 1937, section III, p. 6.

Within a year after Baker's First National Company began extending credit to farmers for the pumping plants installed by the concern, other firms offering similar services appeared on the scene. The Peerless Pump Company, a subsidiary of the nationally important Food Machinery Corporation, established offices at Plainview in 1935 and began to market turnkey jobs using Peerless Pumps, its own gear-head, automobile engines, and sub-contracting the drilling of wells to local drillers, as well as extending credit to farmers through the Food Machinery Corporation. The Peerless Company charged 8 per cent interest over a three year period, but unlike Baker who required no down payment, the company required a flat $500 down payment. The average price for its installations ranged from $1,600 to $2,000.[79]

In addition, some local concerns, such as the Bradford Supply Company, and Green Machinery Company of Plainview, began to finance their pump installations in 1935. Green installed Byron Jackson pumps and his own gear-head designed for high-speed engines.[80] At the same time, pump

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[79]Interview of author with J. K. Childress, manager of the Peerless Pump Division of FMC Corporation, May 24, 1968, Plainview, Texas. Mr. Childress has been associated with the Plainview branch since 1937.

[80]Chattel Mortgage Record of Machinery on Realty, Hale County, I, for the years 1934-1940 reveals the activities of these companies in Hale County, in which most of the irrigation wells of the region were drilled.

companies which did not have turnkey organizations such as Layne & Bowler, Johnston, and others, began selling their pumps on credit in the region.[81]

Encouraged by the new credit facilities for installing pumping plants, farmers developed more favorable attitudes toward irrigation, all of which stressed greater efficiency. First, low crop prices in tandem with the drouth seems to have influenced many farmers to become irrigators. Many farmers told J. K. "Bill" Childress, manager of the Peerless Pump Division of the Food Machinery Corporation at Plainview, during 1937-39, that low farm prices were a primary consideration in their decisions to put down irrigation wells. In other words, at the current low prices, farmers could not raise enough to pay their debts and meet expenses by dry-land farming.[82]

Second, farmers began to think of irrigation no longer as simply "crop insurance" to be used during abnormally dry years. The earlier attitude was expressed by an irrigation farmer on a Texas Land and Development Company farm in 1917. When asked why he had not begun to

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[81] Chattel Mortgage Record of Machinery on Realty, I, for Hale, Deaf Smith, Floyd, Swisher, Bailey, and Lamb Counties contain various entries for these companies in the period 1934-1940. By the end of World War II, the Green Machinery Company was manufacturing its own pumps, as well as its gear-head, and had become one of the most important irrigation equipment supply companies on the High Plains. Moreover, the company has continued to finance turnkey installation jobs.

[82] Interview of author with J. K. Childress.

irrigate his parched crop, he replied: "It may rain."[83] D. L. McDonald, the early irrigation promoter who had continued to operate his irrigated farm throughout the 1920's and 1930's wrote in 1935: "This is the worst drawback to local irrigation. The farmer has watched the clouds and prayed for rain when he should have been pumping water and the idea that the pumping plant is just for emergencies during dry years is all wet all over."[84] Fred Hage, who installed a pumping plant in 1937 in Floyd County, expressed the new attitude when he stated that formerly, irrigation in the region "was used merely as a last resort when the weather man failed. The average irrigation farmer watered with an eye on the sky for possible rainfall and usually waited until the last possible moment before he used his well. Consequently, his crops did not show sufficient margin of profit over that of the dry farmer." But Hage concluded: "In the past two or three years, since serious thought has been given to irrigation with an eye to producing capacity crops, irrigation has been a different story."[85]

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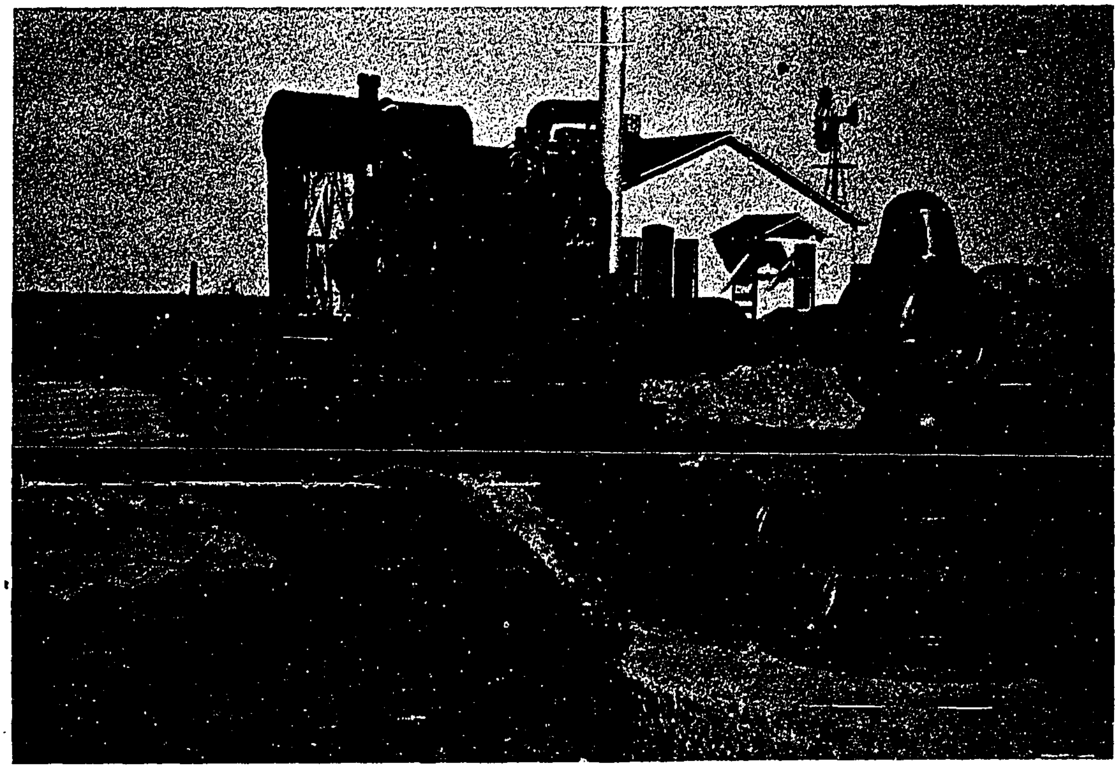
[83] D. L. Alexander to C. E. Craig, May 25, 1917, Plainview, Texas, file no. 3-5, TL&D Papers.

[84] D. L. McDonald to Carl Gilliland, April 7, 1935, Hereford, Texas, in files of McDonald Drilling Company, Amarillo, Texas.

[85] The <u>Lockney Beacon</u>, irrigation issue, April 30, 1937, section III, p. 1.



MODERN PUMPING PLANT, <u>ca</u>. 1940's

From: Courtesy of Green Machinery Company, Plainview, Texas. Notice gear-head on pump and automobile engine.

Third, farmers began to use more efficient irrigation techniques. The pre-World War I irrigation farmers of the High Plains watered their crops only during the day and almost never on Sunday. Local prejudices against profaning Sunday with any type of work were so strong that in 1913 the Texas Land and Development Company felt compelled to place an advertisement in a local Plainview newspaper to apologize for running a pump on Sunday.[86] By 1937, farmers such as Paul Cooper of Floyd County irrigated their crops "both day and night."[87] Another irrigation practice which came into widespread use during the 1930's was that of "pre-planting irrigation"--the practice of watering the soil before planting a crop. In 1937, H. A. Brotherton of Floyd County reported that he irrigated his land "from once to twice" prior to planting his cotton.[88] By that year the practice had become widespread among irrigators in the region according to the editor of the Lockney (Texas) Beacon.[89]

News of the wells and abundant crops tended to influence other farmers to install pumping plants. In Bailey County, for example, the announcement of C. A. Barnett of

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[86] Billy Ray Brunson, "The Texas Land and Development Company" (unpublished Ph.D. dissertation, Texas Technological College, 1960), p. 264.

[87] The Lockney Beacon, irrigation issue, April 30, 1937, section II, p. 1.

[88] Ibid., p. 2. [89] Ibid.

Muleshoe that his well had produced enough profit to pay for itself in one season undoubtedly influenced some of his neighbors to consider seriously the prospect of drilling wells on their farms.[90] During the dry spring of 1934, J B. McCauley installed one of the first new irrigation units in Lubbock County. A few years later McCauley recalled: "I thought of all the pumps I'd seen up around Plainview and decided to put one down on my farm."[91] Travis Tubbs, also of Lubbock County, put in a system in 1935 for $2,258 after looking at pump irrigation plants in Arizona and California. Because of irrigation, Tubbs' profit amounted to almost $4,000 for the first year of operation.[92] During the spring of 1936, John McDonald, a son of D. L. McDonald, recalled that a "parade" of visitors drove up "25-mile avenue" north of Hereford to see the stand of irrigated wheat on the farm which his father had first irrigated in 1910. One visitor asked the younger McDonald if irrigation "really paid." McDonald replied that even though many "domino-parlor" farmers contended that irrigation was unprofitable, the McDonalds' had been irrigating for twenty-six years and had managed to live well.[93] A farm journalist who termed the new irrigators

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[90] The Earth, XXXI (December, 1934), 2.

[91] Francis Flood, "Pump Irrigation is Good Crop Insurance," The Farmer-Stockman, LI (April 15, 1938), 237.

[92] The Farmer-Stockman, XLIX (January 15, 1936), 42.

[93] Interview of author with John McDonald.

"modern rainmakers" observed that "during 1935, crops raised on irrigated farms of the shallow water belt proved some things conclusively. Among them, that to place moisture where and when needed, produces certain and abundant crops in spite of cloudless skies and torturing suns."[94]

The growth of irrigation during the 1930's is vividly illustrated in the increased number of wells and irrigated acreage during the decade. In contrast to the 170 pumping plants reported in the census of 1930, the number of wells by the end of 1940 stood at 2,180. And these irrigation plants located in Hale, Floyd, Deaf Smith, Swisher, Lubbock, Lamb, Bailey, and several other counties were watering some 250,000 acres.[95]

By 1940, irrigation on the High Plains of West Texas had become a reality as a result of a combination of favorable conditions. The drouth, always a strong stimulus for irrigation on the Great Plains, descended with unprecedented severity on the region once again. Because of the increased growth in population on the High Plains, it touched the lives of many more farmers than had the previous drouths. Even more important, the Great Depression

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[94]C. V. Eubanks, "Modern Rainmakers," The Farmer-Stockman, XLIX (May 15, 1936), 277.

[95]White, "Ground Water in the High Plains of Texas," p. 15. Fifteenth Census of the United States, 1930, Irrigation of Agricultural Lands, pp. 219-33. Ground Water and Irrigation in the High Plains of Texas, p. 9.

coupled with the Dust Bowl produced a feeling of desperation throughout the region. Inhabitants began to feel that something had to be done.

New developments in irrigation technology, and changed attitudes toward the utility of irrigation played important roles in converting the region to irrigation. Less expensive, more efficient, and more trouble-free pumping plants were now available. Cash crops more suitable both to the unstable High Plains climate and to irrigation, particularly cotton, became well-established in the region after 1920. Moreover, because of low crop prices, farmers developed attitudes toward the use of irrigation which stressed maximum production rather than a guarantee against crop failure.

Perhaps most important, a means for the installation of pumping plants on long-term credit appeared on the scene. First, a local banker, aided by Federal government loan agencies, organized a company to install and finance irrigation plants. Then, pump companies and other concerns formulated similar plans. As in the abortive irrigation movement in the decade 1910-1920, urban business leadership played an important part. In the earlier period, however, that role had been confined primarily to using irrigation as a tool for speculation. By contrast, urban leadership in the 1930's provided farmers with credit which had been needed but unavailable in the previous irrigation movement.

## CHAPTER IX

# THE EXPANSION OF IRRIGATION, 1940-1960

Although favorable conditions were responsible for the revival of irrigation on the Texas High Plains in the 1930's, there was no assurance that the movement would continue. But in the 1940's and 1950's pump irrigation expanded at a phenomenal pace and exerted a significant influence upon the economy and society of the region. The expansion, like the revival of irrigation, was the result of national as well as regional circumstances.

American agricultural prosperity associated with World War II, the post-war period, and the Korean War, stimulated the expansion of irrigation because the pumping plant constituted a method for increasing both crop production and profits for individual farmers. Considering 1910-1914 as equaling 100, in 1941 the wholesale index price for farm products stood at 116. By 1942, the index price had moved up to 172, and by 1945 it was 180.[1] In addition, the policy of the Federal government toward

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[1] Murray R. Benedict, Farm Policies of the United States: A Study of their Origins and Development (New York: Octagon Books, 1966), pp. 449-50.

agriculture emphasized increased production. Farm income for the period 1939-1945 rose from $5.25 billion to about $14 billion, an increase of 165 per cent. Another indication of agricultural prosperity was the decrease of farm mortgage debts from $6.8 billion in 1939 to $5.25 billion by 1945. In addition, the liquid assets of American farmers ascended from $3.9 billion at the beginning of 1940 to $14 billion as of January, 1946. Farmers also held some $5 billion in United States Savings Bonds at the end of the war.[2] After 1945, American agriculture continued to share in the booming national economy, fed in part by the food and fibre needs of war-torn Europe whose economy was in shambles, and in part by a post-war inflation.[3] Farm prosperity was further assured by the Agricultural Act of 1948 which guaranteed a price of 90 per cent of parity for certain staple crops including cotton and wheat to farmers who cooperated by restricting their acreage.[4] The policy of high price supports was continued as a result of the Democratic-controlled Congress which came back into power in the election of 1948.[5] And good farm prices continued into the early part of the 1950's as a result of the Korean War. Farmers used increased profits to raise their standard

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[2]*Ibid.*, pp. 452-53, 459. [3]*Ibid.*, pp. 463-64.

[4]For an analysis of the act and an explanation of the formula used to determine "parity," see *ibid.*, pp. 474-76.

[5]*Ibid.*, pp. 479-90.

of living, to pay off mortgage debts, to buy more land, and to purchase more farm equipment. In 1948, American farmers spent $5,194 million on equipment and improvements, or about three times more than they had invested for that purpose in 1941.[6]

Many farmers of the Texas High Plains invested much of their increased profits in pumping plants. During World War II, irrigation equipment, like all machinery, was in short supply for home-front demands. The sharp decrease in the number of new wells drilled in 1942 partly reflected this shortage. But the temporary decrease in rate of expansion did not indicate a decline of interest in irrigation. The demand for pumping plants continued to be strong. From 1941 through 1945 the number of irrigation plants in the region increased from 2,560 to 4,300. It was not until about 1948, however, that the supply of irrigation equipment began to catch up with the demand for the machinery.[7]

Expansion continued during the early 1940's in spite of the fact that rainfall during those years was generally sufficient to produce dry-land crops. For example, 1941 was the wettest year in the annals of the United States

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[6] _Ibid._, pp. 463-64.

[7] W. L. Broadhurst, _Ground Water in High Plains of Texas_, Board of Water Engineers Progress Report No. 6 (Austin, 1946), p. 8. William F. Hughes and Joe R. Motheral, _Irrigated Agriculture in Texas_, Texas Agriculture Experiment Station Miscellaneous Bulletin No. 59 (College Station, 1950), p. 16.

Weather Bureau for the Texas High Plains. Lubbock received 40.55 inches of rainfall, and precipitation at Muleshoe totaled 43.52 inches.[8] The increase of irrigation plants despite generally sufficient rainfall strongly indicated the new emphasis upon irrigation as a means for increasing production rather than as a last resort against crop failure.[9]

After World War II, irrigation expansion accelerated as another severe drouth slowly enveloped the Texas High Plains. From 1945 through 1949, the rainfall at Plainview fell below twenty inches every year except 1949. Then, the most extensive drouth the region had yet suffered gripped much of the Southern Great Plains from 1950 through 1956.[10] In spite of soil conservation measures which had originated in programs of the Federal government during the Dust Bowl of the 1930's, some dust storms again descended on the area.[11]

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[8] J. W. Barnes, et al., Geology and Ground Water in the Irrigated Region in the Southern High Plains in Texas, Texas Board of Water Engineers Progress Report No. 7 (Austin, 1949), pp. 16-18.

[9] See pp. 232-33.

[10] C. A. Bonnen, et al., Use of Irrigation Water on the High Plains, Texas Agricultural Experiment Station Bulletin No. 756 (College Station, 1952), p. 8. William F. Hughes and A. C. Magee, Some Economic Effects of Adjusting to a Changing Water Supply, Texas High Plains, Texas Agricultural Experiment Station Bulletin No. 966 (College Station, 1966), p. 3.

[11] The author experienced some of the severe dust storms of the early 1950's while living in the Texas Panhandle.

The effect of the drouth coupled with reasonably good crop prices may be seen in the great increase in the number of irrigation plants installed in the period 1948-1957. There were 8,356 irrigation wells on the Texas High Plains in 1948. But nine years later, some 42,225 large pumps were pouring water on the region's crops. By 1957, Hale County alone had half-a-million acres "under pump" and Lubbock County had 350,000 irrigated acres. The period of most rapid growth was 1950-1954, roughly coinciding with the Korean War, when the number of wells increased from 14,000 to 27,500; and the irrigated acreage rose from 1,860,000 to 3,500,000.[12] An example of the expansion of irrigation may be seen in Lamb County which had a mere 26,000 acres "under pump" by 1944. In 1957, irrigators in that county were watering 350,000 acres.[13]

Although costs climbed sharply in the post-World War II period, this did not seem to deter the expansion of irrigation. In the 1947-1949 period, the least expensive irrigation pumping units were about $3,900, almost twofold more than the cost in 1938. This included $1,272 for drilling and casing the well, $2,155 for the pump and gear-head,

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[12]Lorin Kennamer, "Irrigation Patterns in Texas," Southwestern Social Science Quarterly, XL (December, 1959), 208-09. William F. Hughes and A. C. Magee, Changes in Investment and Irrigation Water Costs, Texas High Plains, 1950-54, Texas Agricultural Experiment Station Bulletin No. 828 (College Station, 1956), p. 3.

[13]Kennamer, "Irrigation Patterns in Texas," 208-09.

and $485 for a small automobile engine. For electric motors, larger engines, and deep wells, the cost was more than $4,000.[14] But increased prices probably reflected a greater demand for such equipment, and improvements in machinery, as well as post-war inflation.

Because of the increased efficiency of irrigation pumping plants, as well as profitable prices for farm products, irrigation moved beyond the old "shallow water" belt into areas of deep ground water. For example, as early as 1937, several farmers drilled wells south of Floydada in eastern Floyd County. Among those who put down wells was Lovell Jones who made an agreement with the Floydada Chamber of Commerce to insure the drilling of a well on Jones' farm. The group of businessmen agreed to pay Jones the cost for drilling the well if he failed to find sufficient irrigation water. The well, drilled to a depth of 330 feet, was successful, and Jones installed a Peerless pump powered by an International Harvester engine.[15]

Irrigation expanded to the south and to the north of the older irrigated area. In the southern part of the Texas High Plains, farmers began installing pumping plants

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[14] A. C. Magee, et al., Cost of Water for Irrigation on the High Plains, Texas Agricultural Experiment Station Bulletin No. 745 (College Station, 1952), pp. 12-13.

[15] The Lockney (Texas) Beacon, irrigation issue, April 30, 1937, section IV, p. 1. Interview of Garry Nall with Lovell Jones, July 5, 1968, Canyon, Texas.

in about 1946. Within eleven years, Dawson County had approximately 600 wells irrigating 70,000 acres on 450 farms.[16] By 1958, Gaines County reported 108,000 acres in irrigation from 900 wells, and Lynn County was watering 65,000 acres from 1,500 pumping plants. North of Amarillo, the same year, Dallam County had 42,255 acres "under pump," Moore County boasted 81,280 irrigated acres, and Hansford County reported 69,150 acres in irrigation.[17]

The extension of irrigation into some counties was made possible not only by the greater efficiency of the deep-well pumping plant, but was facilitated by the growing use of sprinkler irrigation systems using lightweight portable aluminum pipe. The sprinkler-system was especially suited to rolling land in which it was difficult to run water down rows, and sandy soils which could absorb great quantities of water. The growing popularity of this type of irrigation distribution system is indicated by its use in Gaines County which had 101,000 of its 108,000 irrigated acres watered by 830 sprinker systems in 1958.[18]

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[16] M. C. Lindsey, The Trail of Years in Dawson County, Texas (Lamesa, Texas, 1958), p. 103.

[17] Paul T. Gillett and I. G. Janca, Inventory of Texas Irrigation, 1958 and 1964, Texas Water Commission Bulletin No. 6515 (Austin, 1965), pp. 15-17, 21.

[18] Ibid., p. 16.

Several other technological developments aided the expansion of irrigation. The growing use of cheap fuels for the powerful new automobile and industrial engines used for power sources on pumps, and the extension of electrical lines into irrigation areas were important factors. As early as 1936, a few electric motors were running pumps in Deaf Smith, Floyd, and other counties.[19] But electricity came into common use for irrigation purposes only after the Rural Electrification Administration brought cheap electricity into rural areas for the first time on the Texas High Plains. In 1937 an REA program for Deaf Smith County costing some $135,000 was approved by the Federal government. Under the leadership of the Hereford Chamber of Commerce which had petitioned for the loan, some 115 miles of power lines were to be constructed in the county to power 150 irrigation wells and to supply electricity for 220 farm homes.[20]

The cost of operating electric motors was relatively cheap, but irrigators had some reservations about using electricity. The average cost for operating electrically-powered pumping plants in the period 1947-1949 was about forty-nine cents per hour, which was considerably cheaper

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[19] C. V. Eubanks, "Modern Rainmakers," The Farmer-Stockman (Oklahoma City), XLIX (May 15, 1936), 277. The Lockney Beacon, irrigation issue, April 30, 1937, section II, p. 2. The Floyd County (Texas) Hesperian, May 28, 1940, p. 7.

[20] The Earth (Topeka), XXXV (July, 1937), 4.

than gasoline.[21] Some irrigators who were near electric lines, however, seemed to prefer internal combustion engines because the speed of the electric motor could not be reduced for a weak well, and frequent spring and summer electrical storms occasionally "cut-out" electrical transmissions for several hours.[22]

More recently developed liquified petroleum gases, butane and propane, were more widely used than electricity for running irrigation pumps in the 1940's. By making a few minor modifications, gasoline engines could be converted to these high-pressure fuels. In Swisher County, A. C. Julch was using butane gas from a one-thousand gallon tank to power two irrigation engines in 1940.[23] The cost for butane in 1947 was about 8 cents per gallon if the operator furnished his own storage tank, and about 9 cents per gallon if the fuel distributor supplied the tank. This cost compared favorably with gasoline which sold for 11.5 cents per gallon. In a study of average fuel consumption on a group of irrigation engines, it was determined that butane-powered engines consumed 26 to 37 cents of fuel

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[21]Magee, _et al._, _Cost of Water for Irrigation on the High Plains_, pp. 15, 25.

[22]_Ibid._, p. 9.

[23]Ferdie Deering, "Water is Where you Find It," _The Farmer-Stockman_, LIII (August 1, 1940), 374.

per hour while gasoline units used 40 to 52 cents worth of fuel.[24]

The most important progress in cheaper fuels, however, was the greatly increased use of natural gas in the late 1940's and 1950's. Vast deposits of natural gas had been known to exist in the Texas Panhandle as early as 1904 when Charles N. Gould, geologist from the University of Oklahoma, had conducted the first of his investigations of the region for the United States Geological Survey. During his field surveys of 1904 and 1905, Gould noticed geological "domes" along the Canadian River which strongly indicated oil and gas deposits. In 1916, two Amarillo businessmen, M. C. Nobles and T. J. Moore, approached Gould. The geologist was subsequently employed to chart the oil and gas formations of the northern Panhandle. A group of High Plains businessmen formed the Amarillo Oil Company which brought in the first gas well in December, 1918. Consequently, the Panhandle emerged as one of the most important oil and gas fields in Texas.[25]

During the 1920's, gas companies extended their transmission lines to towns and cities over the Panhandle-

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[24]William F. Hughes, "Cost of Pumping Water for Irrigation, Texas High Plains," (mimeographed; Austin: Texas Board of Water Engineers, 1951), p. 9.

[25]Charles N. Gould, "The Beginnings of the Panhandle Oil and Gas Field," Panhandle-Plains Historical Review, VIII (1935), 24-35. Gould's reports were published by the U.S. Geological Survey in 1906 and 1907, respectively.

High Plains region. By 1927, gas lines reached from the petroleum fields on the Canadian to Lubbock, Canyon, Happy, Tulia, Kress, Plainview, Hale Center, and other towns.[26] As early as 1921 some anonymous reporter predicted that irrigation pumping plants near Hereford "soon may be using natural gas as fuel."[27] And in 1927, the West Texas Gas Company, which had constructed many of the lines into the High Plains, announced that it would establish a demonstration farm near Plainview which would be irrigated by gas-powered engines in order "to show the practicability and cheapness of irrigating with gas."[28] By the end of the decade a few farmers in Deaf Smith and Floyd Counties were using natural gas for irrigation purposes.[29]

More irrigators began to use gas during the 1930's, but the fuel did not come into general use until after World War II. Even then its use for irrigation purposes was retarded primarily because of the expense of extending underground pipes from main transmission lines to farmers' wells. At first those irrigators who wanted to use natural gas had to pay for the installation of their own lines.

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[26] The Earth, XXIV (November, 1927), 2. Amarillo Daily News, September 7, 1927, p. 1.

[27] The Earth, XVII (October, 1921), 11.

[28] Amarillo Daily News, September 7, 1927, p. 1.

[29] Amarillo Sunday News-Globe, July 22, 1928, section III, p. 1. The Earth, XXVI (July, 1929), 10.

For example, in 1948 a farmer in Swisher County "laid" a line a distance of three hundred yards from a main line to his well. Some farmers overcame this obstacle in the late 1940's, however, by forming their own cooperatives to construct gas lines.[30] But in the early 1950's, the increased number of irrigation plants made it profitable for gas companies to bear all or most of the expense in laying lines to wells.[31] Consequently, after 1952, farmers rapidly began converting their fuel systems to natural gas. By 1958, 68 per cent of the irrigation pumps on the Texas High Plains were powered by natural gas. Of the total number of wells using gas that year, only 3 per cent had employed the fuel to power irrigation pumps before 1952.[32]

A study conducted by the Texas Agricultural Experiment Station for the period 1947-1949, concluded that natural gas was significantly cheaper than any other fuel. Investigations compared the cost per acre-foot of water, which included such items as depreciation on plant, interest on investment, taxes, fuel cost, fixed costs, and

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[30]Interview by author with Royal Crawford, December 29, 1965, Tulia, Texas.

[31]Thomas F. Cartwright, "History of Pioneer Natural Gas Company," Panhandle-Plains Historical Review, XXXII (1959), 86. As late as 1952, farmers generally had to construct their own lines. Magee, et al., Cost of Water for Irrigation on the Texas High Plains, p. 12.

[32]Hughes and Magee, Some Economic Effects of Adjusting to a Changing Water Supply, Texas High Plains, p. 10.

repairs, for the four major fuels. Gasoline was the most expensive at $8.70 per acre-foot. Liquified petroleum gas cost $7.53. Electricity, reflecting primarily inexpensive upkeep of electrical motors, rather than the kilowatt cost per hour, was $6.58. But the cost per acre-foot for those using natural gas was only $5.15.[33]

Technological improvements which decreased the amount of labor in water distribution and increased efficiency also came into general use. By the end of World War II, plastic or aluminum siphon tubes to carry water from ditches down field rows had replaced the old method of spading out a part of the ditch wall. These simple devices not only cut down on the amount of labor previously required for cutting out wedges of soil in ditches, they also decreased the labor previously required to repair erosion caused by the old method and to close up breaks in ditches after making "a set."[34]

Some form of closed conduit system was needed to replace the open ditch through which as much as 30 per cent of the water was lost through seepage and evaporation.

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[33]These figures were for engines rated at 100 horsepower or less. The cost was proportionately higher for larger engines. Magee, et al., Cost of Water for Irrigation on the Texas High Plains, pp. 9, 25.

[34]Hughes and Magee, Some Economic Effects of Adjusting to a Changine Water Supply, Texas High Plains, pp. 10-11. A "set" is the term used by irrigators in the region to designate the watering of one segment of a crop at a time.

according to some agricultural specialists.[35] That need was met when irrigators began using large-diameter aluminum and concrete pipe instead of ditches to carry water from pump to field. By 1958, some form of "closed distribution system" was being used on 50 per cent of the irrigated farms on the Texas High Plains. About 15 per cent of this number were equipped with surface aluminum pipe. The remainder had underground concrete conduits. A state agricultural report found one "concrete pipe" system which had been installed as early as 1944, but only 17 per cent of those in existence in 1958 had been put in before 1954. Some 80 per cent of the concrete conduits were installed between 1954 and 1958.[36]

Technological innovations were not the only important characteristics of irrigation expansion. Irrigators on the Plains also made some major changes in agricultural methods. One such adjustment concerned the use of fertilizer. Previously, very few High Plains farmers had used fertilizer because of the fertility of the rich top soil. But with the advent of irrigation, the emphasis upon maximum yield rapidly depleted the soil. In 1951, an observer reported that in irrigated areas of the Texas High Plains,

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[35] Bonnen, *et al.*, *Use of Irrigation Water on the High Plains*, p. 18.

[36] Hughes and Magee, *Some Economic Effects of Adjusting to a Changing Water Supply, Texas High Plains*, pp. 10-11.

"constant cultivation is exhausting the organic content of the soil. . . ."[37] At first farmers thought in terms of rotating crops and applying cattle manure. A Swisher County farmer said in 1940 that irrigation would require more "crop rotation" than dry-land farming had required.[38] The maximum production of cash crops which continued to bring good prices left little time, however, for growing soil-building crops of low cash value. Farmers needed some type of high-nitrogen fertilizer to replenish the soil rapidly after the harvesting of each crop. By the early 1950's, various petroleum-products manufacturers were producing such a chemical fertilizer in gas form--anhydrous ammonia--which was especially suited to the clay loam soils of the grain sorghum and wheat farming areas.[39] In a study conducted in 1958, it was found that approximately 67 per cent of the irrigators who relied primarily upon the production of grain sorghum and wheat used fertilizer. In the sandy loam soils of the cotton-producing region in the southern Texas High Plains, however, only about 31 per cent of the irrigation farmers used fertilizer.[40]

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[37]Frank A. Briggs, "Touring the Plains and Panhandle," Farm and Ranch, LXXXI (December, 1951), 24.

[38]Deering, "Water is Where you Find It," 374.

[39]Interview of author with Royal Crawford.

[40]Hughes and Magee, Some Economic Effects of Adjusting to a Changing Water Supply, Texas High Plains, p. 11.

Another significant change in irrigation agriculture was the development of grain sorghum[41] as the major cash crop in terms of total acreage for the Texas High Plains. This crop was especially suited for the clay loam soils north of Lubbock County. In 1948, grain sorghum was planted on 518,600 acres of irrigated land. In comparison, cotton ranked second with 482,700 acres and wheat was third with an acreage of 266,900. Among other crops were alfalfa, 55,900 acres; forage grain sorghums, 23,700 acres; and 8,870 acres in commercial truck crops.[42] By 1957, grain sorghum was still the most extensively grown irrigated crop on the High Plains.[43]

The expansion of grain sorghum indicated an increased demand for grain in the production of feeder livestock during and after World War II. The increase in grain sorghum production was made possible by the development of short-stalk, erect-headed, plants bred for high-yield grain production and suitable for harvesting by combine. This type of plant, sometimes called "combine maize," was developed in the early 1940's by R. E. Karper,

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[41]The singular term "grain sorghum" was being used by agricultural specialists at this time to designate the kind of grain sorghum grown as a cash crop.

[42]Hughes and Motheral, Irrigated Agriculture in Texas, p. 6.

[43]Kennamer, "Irrigation Patterns in Texas," 209.

an agronomist who had long been associated with the Lubbock, Texas, Agricultural Experiment Station.[44]

In the central area of the Texas High Plains, irrigators raised all three major irrigated crops. For example, in 1948 Hale County's irrigated acreage consisted of 100,000 acres in grain sorghum, 80,000 acres of wheat, and 35,000 acres planted in cotton. Swisher County boasted 130,000 acres in irrigated grain sorghum, with the remainder of the acreage "under pump" planted in 100,000 acres of wheat and 35,000 acres of cotton.[45]

Another significant aspect of the new irrigation movement was that irrigated farms tended to be relatively large. By 1948, there were some 1,385,000 irrigated acres on 7,500 farms in the Texas High Plains, an average of approximately 185 acres per farm. The size of farms varied from some 10 to 20 acre truck patches on the outskirts of urban areas to wheat farms of 2,000 acres or more. In the wheat and grain sorghum belt, farms averaged about 250 acres. And in the cotton-producing areas, the units were smaller, averaging about 160 acres. The number of wells per irrigated farm in the region averaged 1.3. And it was reported that farms having 5 or more wells were

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[44]Briggs, "Touring the Plains and Panhandle," 24. Everett A. Gillis, "R. E. Karper," Builders of the Southwest, ed. by Seymour V. Connor (Lubbock: Texas Technological College, 1959), pp. 111-13.

[45]Arthur B. Kennerly, "Irrigation Today in Texas," Farm and Ranch, LXVIII (September, 1949), 9.

not unusual. A study by the Texas Agricultural Experiment Station concluded in 1948 that High Plains irrigators "seldom strive for maximum per-acre yields. They choose instead to spread water over the greatest possible acreage with the accent on increased total production rather than on the highest per-acre yields."[46] But subsequent increased use of fertilizer in the 1950's undoubtedly contributed to high per-acre yields.

Extensively irrigated farms, which characterized irrigation agriculture in the region, were also more mechanized than dry-land farms. By 1952, about 55 per cent of all row-crop tractors used by irrigation farmers on the Texas High Plains were 4-row machines.[47] Moreover, most irrigators who produced grain sorghum and wheat as cash crops owned their own combines. Cotton production was less mechanized. More hand-hoeing was required because irrigation produced more weeds. And almost all cotton was hand-pulled the first time. But tractor-mounted cotton-strippers were used the second time on 40 to 50 per cent of the irrigated acreage.[48] In a comparative study done in 1955 of the total farm machinery

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[46] Hughes and Motheral, Irrigated Agriculture in Texas, p. 17.

[47] A. C. Magee, et al. Production Practices for Irrigated Crops on the High Plains, Texas Agricultural Experiment Station Bulletin No. 763 (College Station, 1953), p. 6.

[48] Ibid., pp. 9, 11, 14, 16.

investments on irrigated and dry-land farms on the Texas High Plains, it was determined that irrigated farms had two to three times larger investments in farm machinery, excluding irrigation equipment, than dry-land farms. For example, on a typical dry-land farm of 320 acres, the investment in equipment was $6,615, whereas on a 320-acre irrigated farm the amount totaled approximately $18,000. The same study showed that even the investment in farm machinery on a 160-acre irrigated farm averaged about $11,000.[49]

The expansion of irrigation had social and economic significance for the Texas High Plains which went beyond the increased profits for individual farmers. As a social consequence, the population of those counties whose economies rested primarily upon irrigation agriculture either remained stable or showed an increase for the period 1950-1960, while dry-land agricultural counties suffered significant losses of population. For example, Swisher County's population expanded from 8,249 to 10,607. The population of Hockley County grew from 20,407 to 22,340, and Deaf Smith County which had counted 5,979 in 1930, expanded from 9,111 in 1950 to 13,187 in 1960. By contrast, some West Texas counties east of the irrigation region showed

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[49]William F. Hughes and A. C. Magee, Water and Associated Costs in the Production of Cotton and Grain Sorghum, Texas High Plains, 1955, Texas Agricultural Experiment Station Bulletin No. 851 (College Station, 1957), p. 5.

marked declines in population. Collingsworth County, which had numbered 14,461 in 1930, declined in population from 9,139 to 6,276 in the period 1950-1960. Childress County, which had declined from more than 16,000 in 1930 to 12,123 by 1950, fell to 8,421 by the end of the following decade. And Donley County's population declined from 6,216 in 1950 to 4,449 a decade later.[50]

Irrigation even modified the vocabulary of the High Plains. New words crept into the West Texas drawl of its farmers. One observer reported in 1949: "Irrigation has brought many new words as well as dollars to Crosby County. Farmers talk of siphons, canvas gates, and ditches."[51] Irrigators also created new phrases such as "make a set," "check the water," "change the water," "tail-water," and "pre-water."[52]

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[50] Sixteenth Census of the United States: 1940, Population, Vol. II, Part 6 (Washington, 1943), pp. 792-806. Eighteenth Census of the United States, Population, Vol. I, Part A (Washington, 1961), pp. 45-25 through 45-27.

[51] John Mitchell, "Irrigation in Crosby County," Southwestern Crop and Stock (Lubbock), (February, 1949), reprinted in Nellie Witt Spikes and Temple Ann Ellis, Through the Years: A History of Crosby County, Texas (San Antonio: Naylor Company, 1952), pp. 60-61.

[52] For a definition of the term "make a set," see footnote 34 in this chapter. The following are definitions of the other terms. To "check the water" means to walk across a field to check the progress of water as it flows down the rows. If the water has reached the end of the rows and is flowing down a drainage ditch or across the lower end of the field, it becomes "tail-water." Then one must "change the water," that is, stop the water from flowing down already soaked rows by setting another canvas

Even more important, the expansion of irrigation changed the working habits of farmers because of the increased labor involved. Because irrigators usually raised more than one cash crop, work became more extensive as well as more intensive, stretching through the entire year. Labor began with preparing the soil in the winter as soon as the last bale of cotton reached the gin. Preparation included discing, chiseling, and applying fertilizer. Preplanting irrigation was required in the early spring if little moisture had accumulated during the winter. In the spring farmers also watered wheat and planted cotton. In June, irrigators applied water to cotton, harvested wheat, and planted grain sorghum. During July and August both cotton and grain sorghum required cultivation and irrigation. And through the summer, farmers "side-dressed" their crops with fertilizer, and periodically sprayed insecticides on growing plants. Then in the fall, winter wheat had to be planted, cotton required harvesting, and combines gathered the grain sorghum crop.[53]

Applying irrigation water to crops also required much labor. Farmers often had to "make a set" during the

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dam farther down the main ditch, and taking up the siphon tubes and re-setting them, or by opening a riser valve from an underground concrete conduit and by closing the valve of the previous "set." Pre-water" is a shortened term for pre-planting irrigation of the soil. Phrases gathered from author's personal experiences.

[53]Magee, et al., Production Practices for Irrigated Crops on the High Plains, p. 32.

late night or early morning. The spectacle of pick-up trucks driving down country roads at 2 A.M., or the bobbing of flashlights across distant fields, and the incessant distant roar of hundreds of irrigation engines became commonplace during what had once been the still of a Plains' summer night.[54] As one reporter described the scene:

> People from the eastern part of the State who might drive through Crosby County at night are often amazed by the flashlights and electric lanterns darting over the fields near the highway. They usually stop at the nearest service station and ask, "What's going on?" Often they get fantastic answers such as, "The farmer planted his crop this afternoon and wants to see if it's coming up. . . ." Anyway, if they realize it or not, big business is going on, and big engines are pumping a drink for the crops from several feet under the ground.[55]

A spade and a pair of rubber boots in the back of a mud-splattered pick-up truck marked the High Plains irrigator. His twenty-four hour per day schedule during the summer gave him little leisure time.

The most significant consequence of irrigation was its impact upon the total economy of the Texas High Plains. In 1959, the increased annual farm income which resulted from irrigation in the region was estimated at some $74 million. Moreover, the enlarged annual profit for businesses involved in marketing the increase in agricultural products was calculated to be $68 million. And the additional income for agricultural supply businesses

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[54]Personal experiences of the author.

[55]Mitchell, "Irrigation in Crosby County," p. 61.

such as implement, fertilizer, and insecticide dealers was believed to be another $63 million. Most important for the region as a whole, the increased profits to businesses not directly associated with marketing agricultural products nor in supplying goods for agricultural production to farmers was estimated to be an additional $125 million annually. The total economic benefit of irrigation to the Texas High Plains in 1959 was estimated at $330 million.[56]

Notwithstanding the economic and social gains made possible by the phenomenal increase in the number of pumping plants, the growth of irrigation in the 1950's was not without its problems. By the end of the Korean War, American farmers were losing many of their Asian and European markets for agricultural products. In spite of the Soil Bank land retirement program of the Eisenhower Administration, farmers continued through greater mechanization and increased use of fertilizers and hybrid seed to produce more than ever before. Consequently, as prices for other goods and services continued to rise, Plains farmers, like other American farmers, found themselves caught in the kind of cost-price squeeze which they had experienced in the 1920's. On the High Plains, cotton acreage was reduced and

[56]Herbert W. Grubb, Importance of Irrigation Water to the Economy of the Texas High Plains, Texas Water Development Board Report No. 11 (Austin, 1966), 20-21.

the prices for cotton, wheat, and grain sorghum edged downward.[57]

Many factors contributed to the expansion of irrigation in the two decades from 1940 to 1960. Despite increased costs for irrigation plants after World War II, farmers found irrigation profitable. Reasonably good prices for farm products caused by the demands of World War II, the post-war economic boom, the Federal government's agricultural policies, and the Korean War encouraged maximum agricultural production by means of irrigation on the Texas High Plains. Technological improvements such as the increased use of natural gas as a fuel for pumping plant engines, the use of siphon tubes, closed conduits, and chemical fertilizers decreased some expenses and labor while increasing efficiency. In addition, grain sorghum became the most important cash crop in terms of irrigated acreage in the region, solving the problem of a needed cash crop for the area north of the cotton belt. Although lower prices for farm products and high costs for goods and services plagued Plains irrigators by the middle 1950's, irrigation continued to expand.

In 1950, the average irrigated farm on the Texas High Plains was a relatively large, highly mechanized

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[57]Hughes and Magee, Water and Associated Costs in the Production of Cotton and Grain Sorghum, Texas High Plains, 1955, p. 3.

economic unit. By the close of that decade it was apparent that irrigation had exerted important social and economic influences upon the region. Although most West Texas agricultural counties lost population, the counties of the High Plains with extensive irrigation either stabilized or increased their population. And significantly, irrigation contributed to the economic growth of the entire High Plains region.

## CHAPTER X

## THE PROBLEM OF GROUND WATER CONSERVATION

Falling farm prices posed a serious problem to farmers in the late 1950's, but the most important dilemma facing High Plains irrigators resulted, ironically, from the very success of irrigation itself. The growing number of wells and acres under irrigation caused a significant decline in the water table of the massive Ogallala ground water formation. This threatened the irrigation economy of the region.

Early settlers of the Texas High Plains believed that their ground water came from an "inexhaustible" source. The editor of The Earth voiced local opinion when he remarked of the Panhandle in 1904: "It has a water sheet under it that is inexhaustible. . . . An inexhaustible water supply from such wells is a thing expected and counted upon in all cases."[1] This belief was widely held because of a local myth that the water came from a kind of gigantic underground river. People believed that the river originated at some distant source

[1] The Earth (Chicago), I (April, 1904), 3.

to the northwest and flowed under the High Plains on its course to the Gulf of Mexico.[2]

This myth may have had its origin in scientific thinking of the late 1880's when interest in the sources for artesian water had been aroused. Richard R. Hinton, who conducted an investigation and wrote the findings for the Federal government's first report on irrigation, believed that the water underlying the western Great Plains originated as snow on the eastern slope of the Rocky Mountains.[3] One scientist who worked on the Federal government's investigation of artesian and "underflow" water in 1891, which Hinton also headed, noted that there were two theories about the origin of the water. First, the plains were underlaid with a deposit of gravel through which most of the run-off from the Rockies flowed in an easterly direction. Secondly, the gravel deposits held water which had percolated down into the earth from rain and snow on the surface of the plains. But this scientist did "not know which theory is correct."[4]

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[2]In 1907, Charles N. Gould reported: "There is a prevalent but erroneous idea in most parts of the High Plains that the water which supplies the wells on the plains comes from the Rocky Mountains." Gould, <u>The Geology and Water Resources of the Western Portion of the Panhandle of Texas</u>, United States Geological Survey Water-Supply and Irrigation Paper No. 191 (Washington, 1907), p. 40.

[3]Richard R. Hinton, <u>Irrigation in the United States</u>, Senate Misc. Document No. 15, 49th Cong., 2d sess., Serial No. 2450 (Washington, 1887), p. 42.

[4]Howard Miller, "Preliminary Report on the Possibilities of the Reclamation of the Arid Regions of Kansas and

A variation of the idea was that the water flowed from some distant arctic glacier rather than from the melting snows of the Rockies. This misconception supposedly originated with a certain "Captain Livermore" who supposedly conducted a topographical survey of West Texas in the 1880's. H. C. "Hank" Smith, who had settled in Crosby County in 1877, recalled in his later life that Livermore had related the theory to him. According to Smith, the Captain had concluded that "the only power that could ever exhaust the Plains water supply would be an earthquake that would crack the flint bottom [of the underground river] and give the water another channel."[5] At least one other later settler continued to embrace this idea after hearing it from Smith. Don H. Biggers, who had installed one of the earliest irrigation plants in Lubbock County in 1911, recalled in 1941 that upon completing the well he noticed the movement of water across the bottom of the pit "at the rate of about a mile an hour." He concluded: "Livermore was right. It was not melted snow from distant mountains but glacier water from the Arctic, thousands of miles away. How it gets to

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Colorado by Utilizing the Underlying Waters," in Irrigation: The Final Report of the Artesian and Underflow Investigation and of the Irrigation Inquiry, Senate Executive Document No. 41, 52d Cong., 1st sess., Serial No. 2899 (Washington, 1892), p. 303.

[5]"Uncle Hank" Smith, "Down the Reminiscent Line," The Crosbyton (Texas) Review, Old Timers' and Present Day edition, February 29, 1912, section II, p. 6.

the Plains and then spreads out is a matter to be worked out."[6]

A number of plainsmen, however, believed that their "inexhaustible" supply of water originated in the melting snows of the Rocky Mountains. Zenas E. Black, executive secretary of the Plainview Commercial Club in 1914, stated that the water came from "the 'Underground River.' . . . It starts in the melting snows of the Rockies, sinks below the surface and at the urge of gravity starts southeast."[7] Harry M. Bainer, agricultural agent for the Santa Fe Railroad, reported in 1912 when the early irrigation wells were being drilled: "Geologists, and others who have studied the underground waters of the Panhandle and South Plains, say that much of the area here is underlaid with a great body of water. They claim that this water has its origin in the mountains to the north and west, and that it is an underground stream, flowing southeasterly.

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[6]Don H. Biggers, "Exploration and Tests of Underground Water on the Plains," West Texas Historical Association Year Book, XVII (October, 1941), 78-81. The editor of the above journal reported that he failed to find any mention of Livermore or the Livermore report in the Checklist of United States Government Documents. Ibid., footnote, 77. This researcher also failed to find any evidence of the elusive "Captain Livermore" in either government documents or in William H. Goetzmann's exhaustive treatment of scientific reconnaissances in the West in his Exploration and Empire: The Explorer and the Scientist in the Winning of the American West (New York: Alfred A. Knopf, 1966).

[7]Z. E. Black, "The Land of the Underground Rain," The Earth, XI (April, 1914), 13.

The claims of the geologists, apparently, are true."[8] The theory of an "inexhaustible" source of water from distant mountains continued to be prevalent on the Texas High Plains well into the 1950's.[9]

Soon after the turn of the century, however, leading geologists concluded that the ground water of the region was simply the accumulation of local precipitation over thousands of years. Charles N. Gould, the University of Oklahoma geologist, noted that the only geological formation of the High Plains which touched the Rocky Mountains was the Permian which lay below the water table of the region. Moreover, Gould pointed out that the Pecos Valley on the west cut off the High Plains ground water formation from the mountains. Thus, it was physically impossible for water from the mountains to reach the Ogallala formation of the Texas High Plains.[10] In 1914, O. E. Meinzer,

[8]The Earth, IX (July, 1912), 10.

[9]A group of Lamb County citizens included the following in its resolutions of 1946: " . . . it has not been condlusively [sic] established whether the source of such underground water is from surface rainfall or from undercurrents of water flowing through such territory." Copy of resolutions of Lamb County Water Conservation Association in Water Associations File, Arthur P. Duggan, Jr., Papers, Southwest Collection, Texas Technological College. Also see Joseph F. Gordon, "George E. Green," in Builders of the Southwest, ed. by Seymour V. Connor (Lubbock: Texas Technological College, 1959), 97.

[10]Gould, Geology and Water Resources of the Western Panhandle, 40-41. See geological illustration in Gould, The Geology and Water Resources of the Eastern Portion of the Panhandle of Texas, United States Geological Survey Water-Supply and Irrigation Paper No. 154 (Washington, 1906), p. 36.

also of the United States Geological Survey, stated that, "the fact is well established that the supply [of ground water] does not come chiefly from the mountains, as is still popularly believed, but from the rain and snow that fall on the Great Plains."[11]

Ground water resources of the High Plains were so vast, however, that most irrigators of the 1930's and 1940's continued to believe in the myth of an "inexhaustible" supply. Indeed, the very massiveness of the Ogallala formation was partly to blame for the misconception. Early irrigators could pump a thousand gallons per minute from beneath the ground day after day without exhausting the supply. In an address given in 1938 before the Statewide Ground-water Conservation meeting at Austin, Walter N. White, Senior Hydraulic Engineer for the United States Geological Survey, warned ground water users: "Practically everywhere that large supplies of water can be obtained from wells the popular belief has developed that the water is inexhaustible. This belief in many parts of the United States has led to disastrous over-development."[12]

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[11]O. E. Meinzer, "Note on Ground Water for Irrigation on the Great Plains," in Ground Water for Irrigation in the Vicinity of Enid, Oklahoma, by A. T. Schwennesen, United States Geological Survey Water-Supply and Irrigation Paper No. 345-B (1914), p. 22.

[12]Walter N. White, "A Few Facts Regarding Ground Water in Texas and the Principles Governing the Occurrence of Ground Water" (mimeographed; Austin: Board of Water Engineers, 1938), p. 5.

Moreover, White observed at the same time that, "in parts of the High Plains the wells are spaced too closely and the present pumpage probably exceeds the limits of safety."[13]

Even before great numbers of irrigation wells had been drilled, other geologists and agricultural specialists suggested the need to conserve ground water resources of the Texas High Plains. In 1915, Charles L. Baker of the University of Texas wrote: "It is fortunate for the shallow water districts that the ground water level of so much the greater portion of the Llano Estacado lies too deep to be used for profitable irrigation. . . . The error should not be made of thinking that all the annual increase to the ground water supply can be withdrawn for irrigation without lowering the ground water level."[14] But within two decades, the development of more powerful, more efficient deep-well pumping plants had removed this natural safeguard. In 1936, Bradford Knapp, then President of Texas Technological College, after reading a report concerning the slight decline in ground water level in some areas of the High Plains, cautioned: "It is our hope that this bulletin . . . will serve to call the attention of farmers throughout the entire South Plains area to the fact

[13]Ibid., p. 6.

[14]Charles L. Baker, Geology and Underground Waters of the Llano Estacado, University of Texas Bulletin No. 57 (Austin, 1915), p. 87.

that the water supply in our soil, while apparently abundant at the present time, can be depleted by injudicious use."[15] And the Texas Board of Water Engineers noted in 1939 that, "there has been a general decline in the water table in the principal pumping districts of the High Plains during the last few years."[16]

Studies conducted in the late 1930's indicated that the decline in ground water level varied in different areas and from year to year. In Deaf Smith County the average fall in one group of wells for the 1939-1940 season was 1.4 feet while in another area of the county, the drop amounted to only 1.3 feet for the two-year period 1938-1940.[17] Variations were caused by a number of factors including distance or spacing between wells, thickness of the Ogallala formation and the volume of water pumped by farmers.

After World War II, three important factors contributed to an even more drastic drop in the water table. First, the number of new wells greatly accelerated. Second, many farmers began to irrigate more than one crop

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[15]Bradford Knapp, "Irrigation in the South High Plains," The Progressive Farmer and Southern Ruralist, LI (May, 1936), 8.

[16]Fourteenth Report of the Texas Board of Water Engineers (Austin, 1940), p. 53.

[17]Walter N. White, W. L. Broadhurst, and J. W. Lang, "Ground Water in the High Plains of Texas" (Mimeographed; Austin: Texas State Board of Water Engineers, December, 1940), pp. 24, 27.

which required irrigation pumps to be operated for longer seasons. Third, the severe drouth of 1950-1956 created a much greater demand for new pumping plants and for more water from each well. Consequently, between 1937 and 1959, the average decline in the water level throughout the irrigated Texas High Plains was some 43 feet. But again, the amount and rate of decline varied in different areas. In more recently developed sectors of deep water on the perimeter of the old shallow water belt, the drop was less than 20 feet. In some areas of heavy concentration of irrigation wells, such as Hale, Lubbock, and Floyd Counties, the decline in some sectors reached an astounding 100 feet.[18] A report issued by the Texas Board of Water Engineers in 1949 warned that "if present trends of pumping and water-level decline continue, those areas [under pump irrigation] and other parts of the irrigated region will be seriously affected within 5 to 10 years."[19]

The decline of water levels was exacerbated by the fact that Texas had no law dealing with ground water conservation until 1949. Every western state has some type of legislation to regulate the appropriation of water from

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[18]William F. Hughes and A. C. Magee, Some Economic Effects of Adjusting to a Changing Water Supply, Texas High Plains, Texas Agricultural Experiment Station Bulletin No. 966 (College Station, 1960), p. 5.

[19]J. R. Brown, et al., Geology and Ground Water in the Irrigated Region of the Southern High Plains in Texas, Texas Board of Water Engineers Progress Report No. 7 (Austin, 1949), p. 46.

streams,[20] but as of 1948 only eight states in the nation had laws to conserve ground water.[21] One problem which has hindered legislation to regulate the appropriation of sub-surface water has been the lack of understanding about the origin of such water. Courts have generally classified ground water as originating either from sub-surface streams or from rainfall which has percolated down through the soil. Judicial bodies have ruled that underground streams, such as some sources of artesian water and ground water along the banks of rivers, are subject to the same regulations as surface streams. But, on the other hand, percolated water has been declared by various state courts and legislatures to fall within the scope of three different legal doctrines. First, the doctrine of "absolute ownership" gave a property owner the right to unrestricted use of all water below the surface of his land regardless of consequences to neighboring

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[20]Most surface water laws of western states are modeled after either those of Colorado or of California. For treatments of those laws and their origins, see Walter Prescott Webb, The Great Plains (New York: Grossett and Dunlap, 1931), pp. 431-52; Robert G. Dunbar, "Water Conflicts and Controls in Colorado," Agricultural History, XXII (July, 1948), 180-86; Robert G. Dunbar, "The Significance of the Colorado Agricultural Frontier," Agricultural History, XXXIV (July, 1960), 119-25; and Benjamin F. Rhodes, Jr., "Thirsty Land: The Modesto Irrigation District, A Case Study of Irrigation Under the Wright Law" (unpublished Ph.D. dissertation, University of California, Berkeley, 1943).

[21]Roy E. Huffman, Irrigation Development and Public Water Policy (New York: Ronald Press, 1953), p. 50.

wells. Second, "correlative rights" granted landowners the ownership of sub-surface water, but required that they use the water for beneficial purposes without injuring the rights of other well-owners. Third, the doctrine of "prior appropriation" declared that all ground water belonged to the state, and a state agency supervised the distribution of water rights on the basis of prior claims according to the estimated amount of water in the underground formation. In order words, the state issued only a certain number of permits for wells in each area.[22]

Texas has long held to the "absolute ownership" theory. In 1904, the State Supreme Court in the case of Houston & T. C. Ry. v. East elected to follow the doctrine of absolute ownership laid down in Acton v. Blundell, an 1843 English case. The Texas Court stated: "So the owner of the land is the absolute owner of the soil and of percolating water, which is a part of, and not different from, the soil."[23] In 1913, the Texas Legislature enacted a law for the regulation and control of artesian water, but the bill did not apply to pumped wells. At the same time, a State Board of Water Engineers was created to

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[22]Ibid., pp. 50-51. Carl Frederick Kraenzel, The Great Plains in Transition (Norman: University of Oklahoma, 1955), pp. 293-94.

[23]98 Texas 146 (1904). Quoted in Joe R. Greenhill and Thomas Gibbs Gee, "Ownership of Ground Water in Texas; the East Case Reconsidered," Texas Law Review, XXXIII (May, 1955), 620.

regulate the use of surface stream water and artesian wells.[24]

The Board of Water Engineers, aided by reports of some Federal agencies in the 1930's, began to urge the State Legislature to enact comprehensive ground water legislation. In 1929, the Texas Board, in cooperation with the United States Geological Survey, undertook an extensive annual survey of ground water resources throughout the State. During the early New Deal, the work was augmented by the Works Progress Administration. Subsequently, the Board's biennial report published in 1934 called for a law, "first, to declare the underground water of the State the property of the State; second, to guarantee vested rights to those who already have made beneficial use of underground water; and third, to exercise proper control over future underground-water development." The Board concluded: "There is no reason why underground water should not be subject to the same control as surface water."[25] The position of the State agency was strengthened by the report of the Great Plains Committee, formed by President Roosevelt as a response to the disastrous Dust Bowl experience. That national

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[24] John T. Thompson, "Governmental Responses to the Challenges of Water Resources," Southwestern Historical Quarterly, LXX (July, 1966), 54.

[25] Report of the Board of Water Engineers of Texas (Austin, 1934), pp. 36-37, 40-43.

committee noted that with the exception of New Mexico, the Great Plains States "either have inadequate or no statutes relating to ground-water utilization control."[26] Subsequently, the committee endorsed the report of the National Advisory and Legislative Committee on Land Use submitted in March, 1933, which strongly urged that states "declare all unappropriated underground waters to be public waters of the state, subject to appropriation for beneficial use."[27] In its report of 1938 the Texas Board of Water Engineers reiterated the need for such laws.[28] But bills dealing with ground water control introduced into the Texas Legislature in 1937, 1941, and 1947, were defeated.[29]

In the latter part of the 1940's because of declining water levels in some parts of Texas, particularly in the Rio Grande Valley, and possibly because of widespread national publicity given to a growing shortage of water resources throughout the United States,[30] a movement for ground water conservation emerged in Texas. By the

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[26]Report of the Great Plains Committee, The Future of the Great Plains (Washington: Government Printing Office, December, 1936), p. 116.

[27]Ibid., p. 117.

[28]Report of the Board of Water Engineers of Texas (Austin, 1938), p. 43.

[29]Thompson, "Governmental Responses to the Challenges of Water Resources," 58.

[30]Lester Velie, "Are We Short of Water?" Collier's (May 15, 1948), pp. 14, 74.

fall of 1946 it was obvious in some quarters of the Texas High Plains that the State Legislature at its next biennial session in 1947 would consider a bill to control or regulate ground water withdrawal. Support for such a bill appeared to be gaining strength in some parts of Texas. Urban interests on the High Plains, alarmed at the declining water level, began to advocate similar legislation. The Lubbock Chamber of Commerce wanted legislation "to protect, control, and allocate the withdrawal of underground water."[31] On October 29, a resolution presented by E. L. Killingsworth, city engineer of Big Spring, to a joint meeting of the Permian Basin Water Works and Sewage Association, the Caprock Water Works Operators Association, and the Panhandle Water Works Operators at Lubbock, called for laws to regulate withdrawal of sub-surface water and to establish ground water districts based upon geological unity rather than upon river drainage basin areas.[32]

Rural irrigation interests on the Texas High Plains generally opposed such legislation. Several county groups were organized in the fall of 1946 to oppose ground water control legislation. For example, some "dry-land farmers, irrigation farmers, and business men of Lamb County" met at Amherst on November 21, 1946, and organized the Lamb

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[31] The Hub (official publication of the Lubbock Chamber of Commerce), VII (November, 1946), 4, Water Printed Material File, Arthur P. Duggan, Jr., Papers.

[32] Ibid.

County Water Conservation Association.[33] The Association passed resolutions on December 27, which left little doubt as to its objectives. Among its resolutions was the following: "Whereas the rising water level in our country demonstrates conclusively that there is no immediate danger to our water supply . . . NOW, THEREFORE, BE IT RESOLVED that LAMB COUNTY WATER CONSERVATION ASSOCIATION go on record opposing any bill by the coming Legislature of the State of Texas applying to or concerning the control of the underground water of the High Plains area of Texas." Moreover, the organization called for further investigations "as to the possible existence of stronger and deeper water strata," and possibilities for "increasing the re-charge of the underground water supply from streams, rivers, and lakes by any reasonable method thoroughly investigated and determined."[34]

A regional meeting composed of delegates from about fourteen county organizations met at Plainview on December 28, 1946, and organized the High Plains Water Conservation and Users Association. W. O. Fortenberry of Lubbock County was elected president. The organization's primary

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[33]The name of the organization was originally the Lamb County Water Conservation District. It was changed to Lamb County Water Conservation Association on December 16, 1946.

[34]Copy of resolutions of Lamb County Water Conservation Association in Water Associations File, Arthur P. Duggan, Jr., Papers.

objective was to launch a united opposition of High Plainsmen against any type of legislation to control ground water in the next session of the Texas Legislature. The Association indicated, however, that it was not opposed to water withdrawal regulations if such controls were absolutely necessary. But for the present time, the group insisted there was no need because the Texas Board of Water Engineers had found that water levels had risen in the region in the last couple of years.[35] When regulation proved to be necessary, however, authority should be vested in the local area rather than in a state agency.[36]

Opposition to the ground water bill was strong enough to defeat the proposal in the State Legislature in 1947, but the issue did not die. Urban interests on the High Plains continued to be alarmed at the prospects of declining water supplies for municipal and industrial uses, and at the possible future collapse of an irrigation

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[35]The report referred to was probably W. L. Broadhurst, Ground Water in High Plains in Texas, Texas Board of Water Engineers Progress Report No. 6 (Austin, 1946). The report showed that most counties of concentrated irrigation, such as Floyd and Hale, were experiencing some decline. The Association's assertion that ground water levels were rising was probably based upon the report's findings that because of the unusually wet year of 1941, ground water re-charge from precipitation had caused marked rises varying from 0.9 to 2.1 feet in ground water levels for Hockley, Lamb, and Lubbock Counties for the overall period 1938-1946. But the report also showed that from 1943 to 1946, all counties suffered some decline. *Ibid.*, pp. 8-21.

[36]A. B. Slagle, "Proposed Controls by State Opposed," Lubbock *Avalanche-Journal*, December 29, 1946, pp. 1, 4.

economy. For example, J. E. Cunningham, President of the Southwestern Public Service Company, a large electric utility corporation of the Texas Panhandle which also supplied electricity to fifteen Rural Electrification Administration cooperatives, met with Claude R. Wickard, Administrator of the REA, and other members of Wickard's staff in Washington, D. C., on August 17, 1948. Cunningham and Wickard discussed the future extension of electrical lines into the Texas High Plains.[37] Cunningham told one member of the REA staff:

> The present agricultural income level on the High Plains is largely dependent on irrigation, and we are worried about the sudden collapse of our agricultural economy when the water becomes too low for economical pumping. We are afraid that this will happen within the next 8 or 10 years. Parties interested in the entire area, such as the REA and our Company, must take the factor of underground water supply into consideration in making long term plans and commitments.[38]

Eschewing the myth of the "inexhaustible" supply, the business leader suggested to Wickard that "an educational program be inaugurated to acquaint the water users of the region with the facts. It is doubtful that our irrigation farmers will wish to continue to pump water fifteen times faster than it is recharged when they realize that the

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[37]Mimeographed copy of memorandum, J. E. Cunningham to Claude R. Wickard, August 23, 1948, Amarillo, Texas, in Water Texas File, Arthur P. Duggan, Jr., Papers.

[38]Mimeographed copy of letter, J. E. Cunningham to R. F. Richter, Manager of Applications and Loans Division, Region 10 of the REA, August 31, 1948, Amarillo, Texas, in Water Texas File, in <u>ibid</u>.

underground reservoir may be exhausted in many locations within the next decade." Cunningham concluded: "The REA set-up appears to be a splendid medium for the dissemination of information on this important question."[39]

By early 1949 the High Plains Water Conservation and Users Association, perhaps aware that some type of ground water law would eventually be enacted, took the leadership in lobbying for a bill with few regulatory provisions and one which would leave administration to local authorities. Arthur P. Duggan, Jr., prominent Littlefield attorney and son of one of the early promoters of irrigation in Lamb County, drew up a list of proposals representing the concensus of the Association. Duggan believed: "An ideal law would work out in such a manner that no limitations on withdrawals of ground water would ever be necessary." Subsequently, he proposed the study of methods for re-charging ground water formations; creation of ground water districts with responsibility, among other things, for re-charge operations from playa lake basins; programs for conservation of rain water and information to farmers about the minimum amount of water needed for various crops; measures to prevent the waste of ground water reserves; permits to drill new wells in order to regulate spacing of wells and the size of pumps, and "limitation of withdrawals"

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[39]Mimeographed copy of memorandum, J. E. Cunningham to Claude R. Wickard, August 23, 1948, Amarillo, Texas, Water Texas File, in <u>ibid</u>.

of ground water reserves if "ground water supply situations become really critical." But Duggan qualified the final point by insisting that restrictions upon withdrawals should be established only if water users within a district voted to impose such regulations upon themselves.[40]

The Texas Legislature in 1949 enacted the Ground Water District Act which was very similar to the proposals advocated by Duggan and the High Plains Water Conservation and Users Association. The law provided for the creation of "underground water conservation districts." Such districts were to be established upon the presentation of petitions to the State Board of Water Engineers which would determine the geological boundaries of ground water districts. A referendum would then be held on a local option system in which the majority of property owners within each precinct of the proposed district would have the power to include the precinct in the district. Among other things, the district would have the power to make and enforce rules for conservation and re-charge of ground water; to make rules to prevent waste of ground water; to issue drilling permits; to require the spacing of wells and "regulate the production therefrom"; to establish "research projects," to publish information on conservation practices

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[40]Arthur P. Duggan, Jr., attorney for the High Plains Water Conservation and Users Association, "Some Texas Ground Water Problems, A Regenerative Approach" (manuscript copy, <u>ca</u>. 1948 or 1949), Literary Productions File, in <u>ibid</u>.

for the benefit of water users; and to enforce regulations through court injunction. But the law did not do away with the private ownership theory of the "East Case." Provisions were incorporated in the statute to the effect that no district could deny a permit to drill a well to any landowner and that the "ownership and rights of the owner of the land . . . in underground water are hereby recognized."[41]

After passage of the act, the High Plains Water Conservation and Users Association sent the required petitions to the State Board of Water Engineers, and undertook an active program in 1950 and 1951 to get regional support for the creation of a ground water district. In February, 1950, Arthur P. Duggan, Jr., returned to Littlefield from hearings before the State Water Code Committee and warned High Plainsmen that the new law was under strong criticism by urban industrial interests which wanted control of ground water vested in the State Board of Water Engineers.[42] Within a few weeks, the regional organization established an "information and publicity office" at Littlefield for the purpose of promoting "the educational

[41]Vernon's Annotated Revised Civil Statutes of the State of Texas, XI, Article 7880-3c, 418-25. Thompson, "Governmental Responses to the Challenges of Water Resources," 58.

[42]County-Wide News (Littlefield), February 16, 1950, section III, p. 1, Clippings File, Arthur P. Duggan, Jr., Papers.

campaign of the High Plains Water Conservation and Users Association in publicizing the Underground Water Conservation Law and facilitating organization of a conservation district."[43] Members of the group were urged to enlist the support of local newspaper editors to speak before local civic organizations, to talk to influencial community leaders, to write letters to newspapers, and to use other means for focusing public opinion upon the need for the establishment of a ground water district.[44] On April 14, 1950, the executive committee of the Lamb County Water Conservation Association, noted that some wells were now suffering "mutual interference caused by close spacing of wells." Moreover, the committee warned that if the rapid expansion of new wells continued, "some attention should be given to proper spacing to prevent the mutual interference problem and to help keep the underground water level high."[45] At the same meeting, Gus Parrish, the president of the county group, stated that a number of farmers in Lamb County now believed that water conservation districts should be organized in

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[43]Form letter from Charles Schuler, Jr., Secretary, to officers and members of the High Plains Water Conservation and Users Association, ca. 1950, High Plains Water Conservation and Users Association File, in ibid.

[44]Ibid.

[45]The Earth (Texas) Sun, April 21, 1950, Clippings File, Arthur P. Duggan, Jr., Papers.

order to space new wells, re-charge ground water, and prevent water waste.[46]

A recurrent argument voiced by local leaders of the movement was that formation of a ground water district was the best means for assuring the region of local control over its sub-surface water resources. In other words, if High Plainsmen did not take advantage of the law of 1949, the Texas Legislature might vest control of ground water in the Texas Board of Water Engineers. W. O. Fortenberry, President of the High Plains Water Conservation and Users Association, stated that Plainsmen needed to form such districts in order to prevent future efforts by other interests to modify the law in such a way to vest control in the State Board.[47] Duggan warned in February, 1950: "If underground water is put under state control, supporters will probably ask that the State Board of Engineers, which controls surface waters, administer the law."[48] Most irrigators on the High Plains probably disliked the idea of state control as much as one Hockley County farmer who said at a local meeting: "I favor no control, but if we must have it, let it be

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[46] County-Wide News, April 20, 1950, p. 1, Clippings File, in ibid.

[47] Plainview Evening Herald, May 16, 1950, pp. 1, 8.

[48] County-Wide News, February 16, 1950, section III, p. 1, Clippings File, Arthur P. Duggan, Jr., Papers.

local."[49] By the end of April, 1950, the High Plains Water Conservation and Users Association reported that interest in the formation of a district was growing.[50]

Many of the small-town newspapers in the region came out strongly for creation of the district, primarily because of the fear of state control. The Floyd County Hesperian, for example, urged that "water districts be formed and that the situation be kept in hand rather than to let their districts and possible self-rule go by default."[51] The County-Wide News of Lamb County warned that High Plains irrigators "by their inaction . . . are running the risk of losing control of their water. If they fear regulation, they should pause to consider the fact that self regulation would be far better than state regulation."[52] At least one newspaper favored the formation of the district simply because of the need for water conservation. The Tulia Herald of Swisher County sounded the ominous warning: "If there is not some regulation of water pumpage there is a real danger--note the fall of the water

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[49]The Hockley County Herald, April 27, 1950, p. 1, Clippings File, in ibid.

[50]The Amarillo Sunday News-Globe, April 23, 1950, p. 23, Clippings File, in ibid.

[51]The Floyd County Hesperian, May 18, 1950, section II, p. 2, Clippings File, in ibid.

[52]County-Wide News, April 13, 1950, p. 1, Clippings File, in ibid.

table this year--of this country having to exist on a dry farming and range economy."[53]

Farmers on the High Plains were discussing the issue by the spring of 1950. A farm journalist reported that the majority of High Plainsmen were apparently united in opposing water controls vested in a State Board of Austin, but were about evenly divided over the issue of whether or not to form a ground water district.[54] The same reporter discovered a wide range of opinions but much indecision in interviewing farmers of Lamb County. For example, one irrigator said: "I don't know which way I would vote. Haven't made up my mind, even though I am aware of the problems confronting irrigation farmers and our water." Another stated: "If there is any controlling of underground water to be done, we, of course, want to do it here. But I haven't made up my mind whether even local control is necessary." A farmer who had apparently decided to vote for the water district responded: "What has caused this underground water crisis which we talk so much about here on the South Plains? Abuse of our natural resources, that's what caused it. . . . It's those who want to squeeze every last drop of wealth from the land every

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[53]The Tulia Herald, June 8, 1950, Clippings File, in ibid.

[54]Garland Smith, "Control of Underground Water is Life-and-Death Issue on Farms," The Amarillo Sunday News-Globe, May 28, 1950, p. 22.

year. They are the people who hurt. Maybe a water district could do something about that." Still another point of view was expressed by a farmer whose wells had probably not suffered from an appreciable decline of water. He was "somewhat puzzled about all this excitement over the wells going dry. Spacing probably is important, but we are getting along all right in this neighborhood. . . . My well has been going good since 1936, and it's still going strong." Finally, a farmer who adamantly opposed any type of regulation emphatically stated: "All the water under my land belongs to me. No government, no association, nobody can tell me how to use it. I've never wasted any water in my life. I couldn't afford it. If my neighbors want to drill wells right next to mine, that's all right with me. I won't fuss. If the wells go dry, we will all run out together. I don't intend to live in a country full of Hitlerism laws."[55]

In response to petitions favoring the formation of a district from several counties, the Texas Board of Water Engineers held an open hearing at Plainview on August 9, 1951. The meeting began with about 200 people present; it ended three and one-half hours later with 400 in attendance. Among those who appeared in order to voice their opinions in favor of creation of a ground water district

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[55]Garland Smith, "Farm Quiz," The Amarillo Sunday News-Globe, May 28, 1950, p. 23.

were Duggan, and W. O. Fortenberry, of the High Plains Water Conservation and Users Association. In addition, delegates from several county water users associations appeared, including Thomas J. McFarland of Deaf Smith County and Clyde Bradford of Swisher County. Some business and professional leaders such as George E. Green of Plainview, an irrigation equipment manufacturer who had installed the first irrigation pumping plant in Hale County in 1911, came out in favor of formation of the district. Wendell Bedichek, publicity director of the West Texas Chamber of Commerce, bestowed the blessings of his organization upon the district plan. The only opposition at the hearing was that of T. L. Wright of Plainview who stated: "You can say you prefer local control to state control or federal control. I don't want any control by anybody but the land owner. That's like asking who you'd rather be hanged by. I don't want to be hanged."[56]

After the hearing at Plainview, the Board of Water Engineers set September 29, 1951, as the date for an election to determine whether High Plains Underground Water District No. 1 would become a reality. At the same election, voters were to decide on propositions for giving the district the authority to raise funds for its operation

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[56]Plainview Evening Herald, August 9, 1951, pp. 1, 4, Clippings File, Arthur P. Duggan, Jr., Papers.

through a property taxation levy, and to elect one director from each of five sub-districts.[57]

Urban interests, particularly in Lubbock, strongly supported creation of the water district. The Lubbock City Commission approved a resolution to "actively engage in, and use every possible influence toward the formation of the High Plains Underground Water Conservation District No. 1 and tender all assistance in carrying out the intention of this law."[58] The Lubbock _Avalanche-Journal_ came out in support of the proposed district. The editor warned that "unless residents of this territory, comprising more than 6,000,000 fertile acres, adopt conservation regulations themselves, the job will be taken over by the State or Federal governments." He concluded: "The water district organization . . . therefore, has been called in self-defense."[59]

Strong opposition to the district also flared up in the High Plains. Some landowners simply disliked the idea of "growing bureaucracy." Perhaps typical of this viewpoint was the feeling expressed in a letter to an official of the High Plains Water Conservation and Users

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[57] Lubbock _Morning Avalanche_, August 25, 1951, section I, p. 4, Clippings File, in _ibid_.

[58] Copy of resolutions in City of Lubbock File, in _ibid_.

[59] Lubbock _Avalanche-Journal_, August 16, 1951, Clippings File, in _ibid_.

Association. The writer stated:

> Give these bureaucrats [of the water conservation district] ten or not more than twelve years of unrestricted rule and most of the farmers will be reduced to spiritless peasants just one degree above the insensible clod, and, regardless of what they tell you, that is the way they [bureaucrats] want it. This proposition should be met with 30-30's [rifles] and its sponsors not only driven back to the City of Austin, but on south across the San Jacinto battlefield and into the Gulf of Mexico where they can get their fill of water.[60]

Others who had invested much in irrigation equipment and farm mechanization probably believed creation of the district to be a threat to their economic existence. Opposition to the formation of the water district was particularly strong in Hale County, which had more acres in irrigation than any other part of the region. One week before the election, a spirited meeting was held at Edmonson in Hale County at which local farmers debated the issue with officials of the High Plains Water Conservation and Users Association. Although one farmer from Abernathy spoke out in favor of the plan, the majority opposed it. One irrigator declared frankly, "Nobody's going to cut my well off. I think it's time we stood up for our rights." Another farmer stated: "I think this talk about government control is just a threat they [supporters of the plan] are holding over the irrigation farmers. I don't think it can be done." Among influential

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[60] C. V. Woolley to Paul Mathews, August 21, 1951, Amarillo, Texas, 1951 Correspondence File, in <u>ibid</u>.

county leaders who opposed the plan was H. S. Hilburn, a landowner and publisher of the Plainview Evening Herald who also spoke out against the district. The effect of the debate upon farmers in the audience was evidently to push many of the previously undecided ones into the camp of the opposition. For example, a farmer who had taken no part in the discussion told a newspaper reporter at the meeting: "I did not know when I came to this meeting how I was going to vote, but I know--well now--I'm going to vote against it."[61]

In the election on September 29, 1951, portions of ten counties and two entire counties--Lubbock and Parmer--voted to join the district. The others were Lynn, Lamb, Hockley, Deaf Smith, Floyd, Castro, Bailey, Armstrong, Randall, and Cochran. Among those areas which voted against joining the underground water district were two of the most important irrigation counties--Hale and Swisher. But because voting was on a precinct basis, two towns of Hale County--Abernathy and Petersburg--were included in the district.[62] Voter turnout was light, but incomplete returns by the next day showed not only that

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[61] Luron Brown, "Farmers Debate on Water District Plan," The Amarillo Sunday News-Globe, September 23, 1951, Clippings File, in ibid.

[62] C. W. Ratliff, "Water District Okayed," the Lubbock Avalanche-Journal, September 30, 1951, Clippings File; A. P. Duggan, Jr., to John Hammermann, Jr., August 20, 1952, Littlefield, Texas, in re Water 1952 File, in ibid.

the vote was close, but even more important, the election demonstrated that if a majority vote in the whole of the proposed district had been required for its creation, the issue would not have passed. Incomplete returns were 1,814 for the district and 1,941 against the proposal.[63] But because only a majority vote in each precinct was required, the district was formed of consenting precincts.

Thus, the new High Plains Water Conservation District No. 1 did not enjoy an overwhelming mandate as it began operations. The organization did not fully begin to function until late 1952 when collections of special property taxes began to flow in. In the meantime, the elected Board of Directors hired a general manager and opened an office at Lubbock in April, 1952.[64] The first rules set forth by the District went into effect February 1, 1953. These regulations required drilling permits for wells which would produce in excess of 100,000 gallons per day, which included all irrigation wells, and complete, accurate logs of wells to be maintained by drillers. The next rules were made public in January, 1954. These consisted of general statements forbidding water waste, and specific rules governing the spacing of wells and the replacement of old wells.[65]

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[63] Amarillo Daily News, October 1, 1951, Clippings File, in ibid.

[64] Memorandum, n.d., Tom McFarland File, in ibid.

[65] The spacing provisions provided the following minimum distances from existing wells according to the

Within the next few years, two other districts were organized in the less concentrated irrigation area north of the Canadian River. Local voters approved formation of the North Plains Ground Water Conservation District No. 2 in March, 1955, and the Dallam County Underground Water Conservation District No. 1 in April, 1959.[66]

In spite of initial optimism of the supporters of High Plains Underground Water District No. 1, ground water depletion continued at a rapid rate. Between 1951 and 1958 the average decline in ground water level was 27.92 feet.[67] There were many weaknesses in this program of water conservation. First, and perhaps most obvious, the method of establishing a ground water district in a kind of checkerboard pattern based upon local option left some very important areas of ground water withdrawal out of the District. Even if the majority of farmers in the region had wanted some type of water conservation program, they would have been frustrated by the local option method. It was simply not logical for one part of a county to limit

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size of pump: 4-inch or smaller--200 yards, 5-inch--250 yards, 6-inch--300 yards, 8-inch--400 yards. In addition no old wells could be replaced with larger wells without a permit. Rules of High Plains Underground Water Conservation District No. 1 (ca. 1954), in ibid.

[66]W. H. Alexander, Jr., Geology and Ground-Water Resources of the Northern High Plains of Texas, Texas Board of Water Engineers Bulletin No. 6109 (Austin, 1961), pp. 9-10.

[67]Hughes and Magee, Some Economic Effects of Adjusting to a Changing Water Supply, Texas High Plains, p. 6.

its well-spacing while another part of the same county continued punching wells at random.

Second, the program relied too much upon the value of voluntary cooperation of irrigators through the District's information dissemination services. The Underground Water District sent out articles to newspapers with such titles as "Wise Water Use Now Means Plentiful Supply for Future."[68] Thomas J. McFarland, the General Manager, and other officials of the District delivered lectures, showed movies on water conservation practices, and answered questions in dozens of small communities through the Plains in order to impress upon farmers the need for reducing "tail-water" and other wasteful practices.[69] But by the end of the 1950's there was some evidence that a policy of voluntary compliance was not working. In 1960, McFarland stated: "The time has come when the District must take a more positive control over the waste of water or remove the rule from the rulebook. If we remove the rule, we are neglecting part of the duties the law sets out as a conservation practice." Moreover, he noted that "we are being subjected to some very severe criticism for the hands-off attitude we have tried to use in the past." Consequently, the District Board,

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[68]News copy of article by Thomas J. McFarland, in Tom McFarland File, Arthur P. Duggan, Jr., Papers.

[69]Garland Smith, "Conservation is Sold on Man-to-Man Basis," Amarillo Daily News, January 22, 1954, Clippings File, in ibid.

according to McFarland, intended to enforce by judicial injunction provisions in the law of 1949 against wasting ground water.[70] Another problem the District faced was compliance with well-spacing regulations. Although farmers seemed to have generally complied with these rules, some county committeemen, who had the responsibility of initially approving all well-drilling permits, at times disregarded well-spacing provisions. In 1954, McFarland wrote: "We have been a little disturbed about some applications that have been coming through approved by committeemen in three or four counties in violation of the spacing regulations."[71] Thus, at least part of the problem was that the District failed to use its few powers to enforce water conservation much of the time, choosing instead to rely on persuasion and "education."

Third, the District Ground Water Law was weak in that it allowed Districts to make rules dealing with conservation, but did not require them to make or enforce such regulations. Although the law declared that ownership of ground water was still vested in the ownership of the land, the act appeared to espouse the doctrine of "correlative rights," allowing the regulation of water

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[70] Form letter from T. J. McFarland to county committeemen of the District, May 11, 1960, Lubbock, Texas, General Correspondence File, in ibid.

[71] T. J. McFarland to committeemen, September 2, 1954, Lubbock, Texas, Rules and Regulations of High Plains Water District File, in ibid.

withdrawal for beneficial purposes on the basis of equity.[72] But one observer noted that as late as 1959, no ground water district created under the law had attempted to exercise its authority over ground water withdrawal.[73]

Fourth, no effective re-charge program was started in the 1950's. Much experimentation was still required, and as late as the 1960's, the program was still in the experimental stages.[74]

Finally, conservation of ground water began too late and never had the support of most High Plains irrigators during the 1950's. In 1954, the General Manager of the High Plains Underground Water Conservation District No. 1 stated that he knew "of at least six farmers who started 1953 as irrigation men but ended up as dryland operators. Their wells played out." At the same time he admitted: "Our conservation program is about 25 years or more too late. That's why something must be done now about the

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[72]Jack R. Barnes, "Hydrological Aspects of Ground-Water Control," Proceedings, Water Law Conference, University of Texas School of Law May 25-26, 1956 (Austin, 1956), pp. 142-43.

[73]W. L. Matthews, "Ground Water Rights and Regulation," Proceedings, Water Law Conference, University of Texas School of Law May 22-23, 1959 (Austin, 1959), pp. 13-14.

[74]Victor L. Hauser and Donald C. Signor, Water Conservation and Ground-water Recharge Research, Texas Agricultural Experiment Station Bulletin MP-850 (College Station, 1967)

habitual water waster."[75] If an effective law had been enacted in the 1930's when people of the Great Plains were feeling strongly about all types of conservation practices, farmers would have drilled their wells in the 1940's and 1950's within good conservation practices. Even as late as 1946 when the region had 650,000 irrigated acres, an effective conservation program might not have been too late. But by 1954 when the High Plains District was beginning its operations, there were 2,692,000 acres "under pump."[76] It was understandable by that time, as one opponent of the formation of the district put it, that "where the farmers themselves have provided the irrigation system at a cost of many millions of dollars" those same farmers would resist efforts to regulate their investments or cut down on their irrigated acreage.[77] They had developed their irrigation plants without the assistance of governmental aid, and they intended to continue using them without governmental regulation.

Few irrigators saw the issue as did one small-town newspaper editor who warned that, "lack of water control

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[75]Garland Smith, "Conservation is Sold on Man-to-Man Basis," Amarillo Daily News, January 22, 1954, Clippings File, Arthur P. Duggan, Jr., Papers.

[76]Hughes and Magee, Some Economic Effects of Adjusting to a Changing Water Supply, Texas High Plains, p. 4.

[77]Luron Brown, "Farmers Debate on Water District Plan," The Amarillo Sunday News-Globe, September 23, 1951, Clippings File, Arthur P. Duggan, Jr., Papers.

would destroy the enormous investments of most of our irrigation farmers. Some form of water control seems necessary to protect what we have." The same editor put the dilemma of irrigation on the High Plains concisely when he asked: "Which is better, a super abundance for a few years and then nothing or reasonable abundance for many years."[78]

High Plains farmers chose "a super abundance for a few years." By 1960, it was apparent that numbers of irrigators were making significant adjustments to a rapidly declining water level. It was reported that many farmers had already lowered their pumps deeper into the ground as many as six different times. Others were drilling additional wells. In attempting to use declining water resources more efficiently, a number of irrigators were installing closed conduit systems. Other changes in practices included watering every other row of some crops, putting smaller pumps into older wells, planting more crops to be irrigated in the fall and winter season and fewer acres of summer-irrigated crops, making two or more plantings of grain sorghum at intervals of ten to fourteen days in order to stagger irrigation, reducing the number of irrigated acres, and similar practices.[79] One

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[78]The Tulia Herald, June 8, 1950, Clippings File, in ibid.

[79]Hughes and Magee, Some Economic Effects of Adjusting to a Changing Water Supply, Texas High Plains, pp. 13-18.

study of the economic effects of diminishing water resources concluded: "The most widespread and pronounced effect of adjusting to a changing water-supply situation is reflected by an increase in the investment required to maintain and supply the irrigated acreage."[80] Economically, the irrigation farmer, faced with declining crop prices and rising costs, was put in an even more disadvantageous position because of his declining level of ground water.

By the end of the 1950's, a comprehensive program of water conservation had failed to emerge on the Texas High Plains. Although declining ground water levels in the 1940's demonstrated the need for such a program, only regional urban interests, by and large, came out strongly in favor of some type of effective conservation legislation. The District Ground Water Law enacted by the Texas Legislature in 1949 suited the wishes of most rural High Plainsmen because it lacked any strong regulatory provisions for ground water conservation, and it was a means of preventing a State Board from controlling ground water resources. In other words, rural interests on the High Plains supported the act because it promised to be an effective means for preventing rather than establishing a system of ground water conservation.

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[80] Ibid., p. 18.

When the movement for a ground water district, subsequent to the provisions of the law of 1949, emerged, rural forces divided. Much strong opposition against the creation of the district existed primarily because of the broad regulatory powers which the district could exercise under the law if it so desired. Those rural interests which supported the district, however, did so primarily because they believed that the district plan would be an effective means for maintaining local control over any program of water conservation. High Plains Underground Water District No. 1 became a reality but because of weaknesses both in the structure of the district plan and in the means for enforcing conservation measures, ground water levels continued to decline rapidly through the 1950's. By 1960, diminishing ground water resources had begun to have economic consequences upon High Plains irrigators.

Texas High Plainsmen had opposed water conservation measures in the 1940's because most of them still believed that their ground water was "inexhaustible." But by 1960, those inhabitants of the region who still embraced the myth of the "inexhaustible supply" accepted it on the basis of irrational hope rather than upon firm evidence. Farmers no longer needed to be acquainted with scientific geological findings which showed that their ground water did not originate in the Rocky Mountains or some distant glacier. They only had to observe the empirical evidence of deeper pump settings, of fewer acres being watered from their wells year by year, and by the discouraging sight of an 8-inch discharge pipe spewing out only half its capacity of water.

# CONCLUSION

The lack of streams on the Texas High Plains probably presented the most important barrier to its settlement. In the late nineteenth century, early settlers found it necessary to tap its vast ground water resources in order to provide water for livestock, human consumption, and irrigation purposes. But the utilization of subsurface water for irrigation was at first restricted by serious technological problems.

In the late 1880's and early 1890's, a severe drouth struck the Great Plains. Many leaders of the region became involved in the western irrigation movement which ultimately culminated in the passage of the National Reclamation or Newlands Act of 1902. But Great Plains inhabitants lost interest in the movement by 1896 for several reasons. First, the end of the drouth by the middle 1890's left little need for irrigation for the time being. Second, most irrigation promoters were thinking in terms of developing projects in the mountainous west rather than on the Great Plains. Third, even if a farmer had wanted to irrigate with underground water, there was no relatively inexpensive pumping plant yet designed for this purpose.

Attempts to use ground water for irrigation, in the absence of adequate pump technology, led to efforts at finding artesian well-water which would flow to the surface under its own pressure, as well as in a few unrealistic schemes. But subsequent investigations by the Federal government failed to discover significant resources of artesian water in the semiarid zone between the 98th meridian and the western edge of the High Plains.

Another drouth emerged on the Texas High Plains in 1908. By this time irrigation pumping plants, which had been developed primarily in the humid Gulf Coast rice belt, were available to bring large quantities of water to the surface from relatively shallow ground water resources. Urban land speculators, who had done much to colonize the region in the early twentieth century, assumed the leadership in a pump irrigation movement on the Texas High Plains which extended from 1910 to about 1920. They employed pumping plants to enhance property values and to attract land buyers. But less than three hundred wells were drilled during this period.

The movement failed to expand because of several factors. World War I created demands for wheat and meat products thereby stimulating dry-land farming. The world crisis also caused an increase in costs and shortages of irrigation equipment manufactured from iron and steel products. Although the early irrigation pumping plants proved to be troublesome and most irrigators were inexperienced with techniques of artificial watering and with pump technology, irrigation might still have expanded if it had not been for certain obstacles. The drouth which had at first stimulated the movement for irrigation, ended, cash crops suitable to the unstable Plains climate had not been adapted to irrigation, pumping plants were too expensive, and finally, long-term credit facilities for the installation of irrigation units were not available to average farmers.

The irrigation frontier emerged again on the Texas High Plains in the early 1930's during the era of the Dust Bowl and the Great Depression. As in the earlier movement, urban interests furnished the initial leadership. Stimulus for the revival was supplied by long-term credit supplied at first by a Plains banker-entrepreneur through some Federal assistance programs, then by irrigation equipment manufacturers and pump dealers. Several circumstances were responsible for the renewed interest in irrigation. Cotton appeared on the scene as an irrigated cash crop. Recent technological developments contributed cheaper, more efficient pumping plants. An extended drouth created a sense of desperation in High Plains farmers who were willing to take economic chances with irrigation because, already deeply in debt, they believed that they had little to lose. Moreover, farmers exhibited new attitudes toward the uses of irrigation, stressing its utility in achieving maximum production rather than as a form of crop insurance.

In the 1940's and 1950's the irrigation frontier expanded on the Texas High Plains to include several million acres. Its expansion was assured because of favorable crop prices caused by World War II, the post-war economic boom and the Korean War. Good crop prices, in turn, stimulated maximum production on irrigated farms. Expansion was also facilitated by the use of cheaper fuels for irrigation power plants, the emergence of grain sorghum as the most extensively irrigated crop in the region, greater farm mechanization, and the increased use of chemical fertilizers.

In the later 1950's, however, serious problems began to threaten the permanency of irrigation in the region. Lower farm prices and higher costs adversely affected High Plains irrigators who already had heavy investments in farm machinery and irrigation equipment. But even more important was a problem which sprang from the very success of the movement--diminishing ground water reserves.

In the late nineteenth century, the primary obstacle to irrigation of the High Plains was that no cheap pumping plant capable of producing a large volume of water yet existed. But by the late 1950's, the very efficiency of over 40,000 irrigation plants on the Texas High Plains, each of which could suck 500 to 1,000 gallons or more per minute from the earth day after day threatened what settlers had once called an "inexhaustible supply" of ground water. Although declining sub-surface water reserves indicated the need for water conservation measures, no effective program emerged. Texas lacked any conservation legislation dealing with non-artesian ground water reserves until 1949. The District Ground Water Law enacted that year, however, was largely ineffective because of its generalities and its emphasis upon local initiation and administration of ground water conservation and control. But the law was favored by rural interests of the High Plains which wanted little or no regulation of ground water withdrawal. Fed by a myth of the "inexhaustible supply" of ground water flowing under the High Plains from some distant source, most plainsmen in the late 1940's refused to believe that effective conservation was necessary. An "underground water conservation district" was set up in the region in 1951 after a struggle between two different rural viewpoints, one of which wanted the district in order to stave off ground water controls through state administration, and the other element which wanted no controls either state or local. The drawing of the "district" boundary lines through local option elections within county precincts excluded some important areas of concentrated irrigation acreage which voted against inclusion. Moreover, the effectiveness of the ground water conservation district was further hindered by emphasis upon voluntary compliance with its regulations rather than upon enforcement.

By 1960, irrigation was no longer a frontier on the Texas High Plains. By that date the economy of much of the region rested significantly upon the recovery of massive volumes of pumped water. An irrigation-based society emerged in which working habits of farmers changed, rural population was stabilized and other changes were effected. But diminishing ground water resources which required more expensive means for utilization, at a time when high costs and low farm prices were affecting all of American agriculture, did not promise a bright future for the Plains irrigator.

The irrigation frontier on the Texas High Plains was significant from several viewpoints. First, the urban element of the region assumed the leadership in promoting irrigation in both the earlier and later periods, but was not strong enough to enact effective conservation measures. Second, the thesis of Walter Prescott Webb's, The Great Plains,[1] is that settlement of the Great Plains was facilitated by technological innovations, such as barbed wire and the windmill, which were invented in other regions,

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[1]Walter P. Webb, The Great Plains (Grosset and Dunlap, 1931).

but adapted to the needs of a semiarid region. Like the windmill, the irrigation pumping plant was originally designed for utilization of ground water resources in other areas, but was adapted to the needs of the High Plains. Thus, the pumping plant was one more adaptation which inhabitants of the High Plains used in order to tap its resources. Third, the irrigation frontier demonstrated that several circumstances were required to make irrigation a reality. The inter-relationships of technological innovations, crops, credit, climate, urban and rural interests, and even attitudes produced irrigation on a vast scale in the region.

Frederick Jackson Turner once stated that if a person could have viewed the pageant of the American frontier from the vantage point of Cumberland Gap and later at South Pass, one would have seen the representatives of each type of frontier pass in review.[2] The Indian would have been followed by the fur trapper, the cattleman would have succeeded the trapper, and the farmer would have marched triumphantly through the pass after the herdsman. If Turner could have stood on the eastern edge of the Cap Rock escarpment of the Texas High Plains, he would have seen another type of pioneer--the pump irrigator,

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[2]Frederick Jackson Turner, "The Significance of the Frontier in American History," The Early Writings of Frederick Jackson Turner, comp. by Everett E. Edwards (Madison: University of Wisconsin, 1938), p. 199.

dependent upon technology, shod in rubber boots rather than buckskin, and carrying a shovel rather than a rifle.

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The most important archival repository for materials on the history of irrigation on the Texas High Plains is the Southwest Collection, Texas Technological College. Among the more significant materials pertaining to irrigation in the earlier period are the Billy Ray Brunson Papers, Double U Company Papers, Arthur P. Duggan Papers, Arthur B. Duncan Papers, R. C. Hopping Papers, Ralph E. Huston Papers, Lone Star Land Company Papers, Matador Land and Cattle Company Papers, William P. Soash Papers, Spade Ranch Papers, Texas Land and Development Company Papers, and Yellow House Land Company Papers. For the problem of ground water conservation in the later period, the Arthur P. Duggan, Jr., Papers are invaluable.

The Division of Manuscripts at the University of Oklahoma has materials on the geological surveys of the Texas Panhandle in the Charles N. Gould Papers.

Some information on the problem of the utilization of ground water resources on the High Plains are found in the White Deer Lands Company Papers and the XIT Ranch Papers located at the Panhandle-Plains Historical Museum, Canyon, Texas.

The Chattel mortgage records of machinery on realty for Bailey, Floyd, Hale, Lamb, Lubbock, and Swisher Counties were helpful for the later irrigation period.

Many sources in private collections proved to be invaluable. Among them are: the Littlefield Lands Company Papers in the possession of David B. Gracy, II, Lubbock, Texas; records, papers, and photographs in the files of Green Machinery Company, Plainview, Texas; photographs and papers in the files of McDonald Drilling Company, Amarillo, Texas; papers, records, and publications of the Layne & Bowler Pump Company, Memphis, Tennessee; diaries of Roland Loyd in possession of Mrs. Roland Loyd, Vega, Texas.

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## APPENDIX

## AN ESTIMATE OF THE NUMBER OF WELLS DRILLED, 1910-1920

No reliable statistics on the number of irrigation wells drilled during this period are available. Local boosters almost always exaggerated the number of wells. For example, Zenas E. Black, executive secretary of the Plainview Commercial Club, reported that there were already more than 300 wells by June, 1913. But Charles L. Baker, who made an agricultural and geological survey of the region in 1914, reported only 139 wells by that date. There were, however, more wells drilled after the Baker report. This researcher has concluded from the available evidence that there were at least 232 wells drilled and in use sometime between 1910 and 1920, and possibly more. The wells were distributed in the following areas:

| Area | Number of Wells |
|---|---|
| The Texas Land and Development Company wells in Hale, Floyd and Swisher Counties | 127 |
| Other wells in Hale and Floyd Counties | 33 |
| Other wells in Swisher County | 4 |
| Bailey County | 22 |
| Deaf Smith County (vicinity of Hereford) | 30 |
| Oldham County (the Matador Ranch) | 3 |
| Lamb County (Littlefield Lands) | 5 |
| Lubbock County | 7 |
| Randall County | 1 |
| Total | 232 |

Sources for estimate: Walter N. White, W. L. Broadhurst and J. W. Lang, "Ground Water in the High Plains of Texas" (mimeographed; Austin: Texas Board of Water Engineers, 1940), p. 12; Averlyne M. Hatcher, "The Water Problem of the Matador Ranch," West Texas Historical Association Year Book, XX (October, 1944), 69-70; Ranch Manager's Diary, Alamocitas Division of the Matador Land and Cattle Company, Matador Ranch Papers, various entries from July, 1913, through September, 1914, in Southwest Collection, Texas Technological College; Charles L. Baker, Geology and Underground Waters of the Northern Llano Estacado, University of Texas Bulletin No. 57 (October, 1915), p. 6; David B. Gracy, II, Littlefield Lands: Colonization on the Texas Plains, 1912-1920 (Austin: University of Texas, 1968), p. 40; Amarillo Daily News, April 18, 1913, p. 2; Amarillo Daily News, February 25, 1912, section II, p. 8; Amarillo Daily News, February 5, 1913, p. 6; Amarillo Daily News, February 18, 1912, section II, p. 1; Amarillo Daily News, May 31, 1912, p. 2; telephone interview of Ozella M. Green with Marshall Vaughn, November 25, 1968, Tulia, Texas.

An exaggerated estimate may be seen in Zenas E. Black, "Market Gardens of the Texas Plains," The Earth (Chicago), X (June, 1913), 6.